REVA UNIVERSITY
Bengaluru, India

School of Computing and Information Technology

B.Tech. CSSE

2021-25 Batch

HANDBOOK

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
www.reva.edu.in

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Bengaluru, India

SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

HANDBOOK

B. Tech in Computer Science and Systems Engineering

2021-25

Rukmini Knowledge Park,
Kattigenahalli, Yelahanka, Bangalore - 560 064
Phone No: +91-080-46966966

Registrar
REVA University
Bengaluru - 560 064

Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge. As educators, it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is Power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju
The Founder and Honorable Chancellor, REVA University

Vice-Chancellor Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum “Knowledge is Power”, REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this ‘temple of learning’ has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavour to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr.M.Dhanamjaya

Vice-Chancellor, REVA University

Director Message

I congratulate and welcome all the students to the esteemed school of Computing and Information Technology (CS & IT)). You are in the right campus to become a computer technocrat. The rising needs of automation in Industry 4.0 and improvising living standards have enabled rapid development of computer software and hardware technologies. Thus providing scope and opportunity to generate more human resources in the areas of computers and IT. The B.Tech, M.Tech and Ph.D. programs offered in the school are designed to cater the requirements of industry and society. The curriculum is designed meticulously in association with persons from industries (TCS, CISCO, AMD, MPHASIS, etc.), academia and research organizations (IISc, IIIT, Florida University, Missouri S & T University, etc.).

This handbook presents the B.Tech in Computer Science and Systems Engineering program curriculum. The program is of 4 years duration and split into 8 semesters. The courses are classified into foundation core, hard core, and soft core courses. Hard core courses represent fundamentals study requirements of B.Tech CS&SE program. Soft courses provide flexibility to students to choose the options among several courses as per the specialization, such as, Artificial Intelligence, Fuzzy Logic and Systems, Cognitive science and predictive analytics etc. Theoretical foundations of engineering, science, and Information Science are taught in first two and half years. Later, advanced courses and recent technologies are introduced in subsequent semesters for pursuing specialization. The Curriculum caters to local, national, regional and global developmental needs. Maximum number of courses are integrated with cross cutting issues relevant to professional ethics, global needs, human values, environment and sustainability. The curriculum also focusses on skill development, innovation and entrepreneurship.

The important features of the B.Tech CS&SE are as follows:

1) Choice based course selection and teacher selection, 2) Studies in emerging areas like Machine Learning, Artificial Intelligence, Data Analytics, Cloud Computing, Python/R Programming, NLP, IoT and Cloud security, 3) Short and long duration Internships 4) Opportunity to pursue MOOC course as per the interest in foundation and soft core courses, 5) Attain global and skill certification as per the area of specialization, 6) Self-learning components, 7) Experiential, practice, practical, hackathons, and project based learning, 8) Mini projects and major projects with research orientation and publication, 9) Soft skills training and 10) Platform for exhibiting skills in cultural, sports and technical activities through clubs and societies.

The school has well qualified faculty members in the various areas of computing and IT including cloud computing, security, IOT, AI, ML and DL, software engineering, computer networks, information technology, cognitive computing, block chain technology etc. State of art laboratories are available for the purpose of academics and research.

Dr. Mallikarjun Kodabagi

Director, School of Computing, and Information Technology

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of **Rukmini Educational Charitable Trust (RECT),** in the year 2002. Rukmini Educational Charitable Trust(RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfil its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 15,000+ students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette dated 7thFebruary, 2013. The University is recognised by UGC under Sec 2 (f) and empowered under Sec.22 of the UGC Act, 1956 to award degrees in any branch of knowledge. The Programs of the University are approved by All India Council for Technical Education (AICTE), University Grants Commission (UGC), Bar Council of India (BCI), and Council of Architecture (COA) .The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, auditoriums, seminar halls, custom-built teaching facilities, fully air-conditioned library and central computer centre, well-planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 26 Post Graduate Degree programs, 35 Undergraduate programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 494 Scholars pursuing research leading to PhD in 19 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis on knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given importance while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from

industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science &technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, Big data analytics, Information Retrieval,VLSIand Embedded Systems, Wireless Sensor Networks, Artificial Intelligence, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, , LED Lighting, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor and Dean, and supported by well experienced Trainers, Counsellors and Placement Officers. The University also has University-Industry Interaction (UIIC) and Skill Development Centre headed by a Senior Professor and Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by

NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs, Entrepreneurship activities, and IPR workshops. UIIC has established REVA NEST, an incubation centre for promoting start up industries.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, University of California Berkeley, Arkansas State University, Columbia University, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc., to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director I.I.Sc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such

others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is **'Life Time Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "**REVA Life Time Achievement Award**" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "**REVA Award of Excellence"** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVOTHASAVA conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is ShubhaVidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Within short span of time, REVA University has been recognised as a fast growing university imparting quality higher education to the youth of the country and received many awards, ranks, and accolades from various agencies, institutions at national and international level. These include: Asia's Greatest Brand and Leaders, by Asia One, National Award of Leadership Excellence, by ASSOCHAM India, Most promising University, by EPSI, Promising Upcoming Private University in the Country, by The Economic Times, Best University of India (South), by Dialogue India, Gold Brand by QS University Ranking, placed under 151-200 band by NIRF, 6TH Rank in the Super Excellence category by GHRDC, 6TH Rank in All India Law School Survey, ranked among Top 30 Best B Schools by Business World, India's Best Law Institution by Careers 360, to mention a few.

REVA UNIVERSITY

Vision

''REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards".

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner.

ABOUT THE SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

The School has a rich blend of experienced and committed faculty who are well-qualified in various aspects of computing and information technology apart from the numerous state-of-the-art digital classrooms and laboratories having modern computing equipment. The School offers four full-time undergraduate programs, B.Tech in Computer Science and Engineering (Artificial Intelligence and Machine Learning), B.Tech in Computer Science and Information Technology, B.Tech in Computer Science and Systems Engineering, B.Tech in Information Science and Engineering and the following two postgraduate programs: M.Tech in Artificial Intelligence and M.Tech in Cyber security. In addition, the school has a research centre in which students can conduct cutting edge research leading to a Ph.D degree.

Curriculum of both undergraduate and postgraduate programs have been designed through a collaboration of academic and industry experts in order to bridge the growing gap between industry and academia. This makes the program highly practical-oriented, and thus industry-resilient. The B.Tech programs aims to create quality human resources to play leading roles in the contemporary, competitive industrial and corporate world. The masters' degrees focus on quality research and design in the core and application areas of Artificial Intelligence and Information Technology to foster a sustainable world and to enhance the global quality of life by adopting enhanced design techniques and applications. This thought is reflected in the various courses offered in the masters' programs.

School Vision

To produce excellent quality technologists and researchers of global standards in computing and Information technology who have potential to contribute to the development of the nation and the society with their expertise, skills, innovative problem-solving abilities, strong moral and ethical values.

School Mission

- To create state of the art computing labs infrastructure and research facilities in information technology.
- To provide student-centric learning environment in Computing and Information technology through innovative pedagogy and education reforms.
- To encourage research, innovation and entrepreneurship in computing and information technology through industry/academia collaborations and extension activities
- Organize programs through club activities for knowledge enhancement in thrust areas of information technology.
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism, moral and ethical values.

Quality Policy

The School of computing and Information Technology is committed to excellence through following policies.

1. Impart quality education by providing state of art curriculum, experimental learning, and state of the art labs.
2. Enhance skill set of faculty members through faculty development programs and interaction with academia and industries.
3. Inculcate the competency in software/hardware design and programming through co-curricular activities like Hackathon, Project exhibition, Internship and Entrepreneurship Program.
4. Provide soft skill and skill development training for personality development and better placement.
5. Promote innovation and research culture among students and support faculty members for better research and development activity.

MEMBERS OF BOARD OF STUDIES

Sl. No.	Name		Correspondence Address
1	**Dr. Mallikarjun M Kodabagi** Professor and Director School of Computing and Information Technology REVA University	Chairperson	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
2.	**Dr. Vishwanath R Hulipalled** Professor School of C&IT	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
3.	**Dr. Udaya Rani V** Professor School of C&IT	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
4.	**Dr. Parthasarathy G** Associate Professor, School of C&IT	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
5.	**Dr. M.Thurai Pandian** Associate Professor, School of Computing and Information Technology	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
6.	**SreenivasaRamanujamKanduri** Academic Relationship Manager, TCS	Member (Industry Expert)	Academic Relationship Manager, Tata Consultancy Services, Bangalore.
7.	**Dr. Sundar K S** Associate Vice-President & Head, IMS Academy at Infosys	Member (Industry Expert)	Associate Vice-President & Head, IMS Academy at Infosys, Mysore
8.	**Dr. RamabrahmamGunturi** Consultant, TCS	Industry Expert	Tata Consultancy Services, Hyderabad.
9.	**Dr. S. A. Angadi** Professor, School of CSE,VTU	Academic Expert	Professor, School of CSE Visvesvaraya, Belagavi
10.	**Dr. Bharati Arakeri** Professor**,** School of CSE BMSIT, Bangalore.	Academic Expert	Professor**,** School of CSE BMSIT, Bangalore
11.	**Abhishek Revanna Swamy** Associate Project Manager, Robert Bosch	Alumni-Member	Associate Project Manager, Robert Bosch, Bangalore
12.	**Prasad Chitta** Solution Architect, TCS Bangalore	Member (Industry Expert)	Solution Architect, TCS Bangalore

B. Tech Computer Science and Systems Engineering

Program Overview

Computer Science and Systems Engineering (CS&SE) encompasses a variety of topics that relates to computation and applications of computing like, development of algorithms, analysis of algorithms, programming languages, software design, computer hardware, e-commerce, business information technology, Data Analytics, Machine Learning, Block Chain Technology, Augmented Virtual Reality, Mobile Application Development, IoT, Wireless Sensor network, Web Technology.

Computer Science and Systems Engineering (CS&SE) has roots in Electrical Engineering, Mathematics, and Linguistics. In the past Computer Science and information science were taught as part of mathematics or engineering departments and in the last 3 decades they are emerged as separate engineering fields. In the present information era (Knowledge era), the Computer Science and Systems Engineering program will see an exponential growth as the future machines work on artificial intelligence.

The oldest known complex computing device, called the Antikythera mechanism, dates back to 87 B.C., to calculate astronomical positions and help Greeks navigate through the seas. Computing took another leap in 1843, when English mathematician Ada Lovelace wrote the first computer algorithm, in collaboration with Charles Babbage, who devised a theory of the first programmable computer. But the modern computing-machine era began with Alan Turing's conception of the Turing Machine and three Bell Labs scientists invention of the transistor, which made modern-style computing possible, and landed them the 1956 Nobel Prize in Physics. For decades, Computing Technology was exclusive to the government and the military; later, academic institutions came online, and Steve Wozniak built the circuit board for Apple-1, making home computing practicable. On the connectivity side, Tim Berners-Lee created the World Wide Web, and Marc Andreessen built a browser, and that's how we came to live in a world where our glasses can tell us what we're looking at. With wearable computers, embeddable chips, smart appliances, and other advances in progress and on the horizon, the journey towards building smarter, faster and more capable computers is clearly just beginning.
Computers have become ubiquitous part of modern life, and new applications are introduced every day. The use of computer technologies is also commonplace in all types of organizations, in academia, research, industry, government, private and business organizations. As computers become even more pervasive, the potential for computer-related careers will continue to grow and the career paths in computer-related fields will become more diverse. Since 2001, global information and communication technologies (ICTs) have become more powerful, more accessible, and more widespread. They are now pivotal in enhancing competitiveness, enabling development, and bringing progress to all levels of society.

The career opportunities for computer science and Systems Engineering graduates are plenty and growing. Programming and software development, Data Scientists, Data Analysts, information systems operation and management, telecommunications and networking, computer science research, web and Internet, graphics and multimedia, training and support, and computer industry specialists are some of the opportunities the graduates find.

The School of Computing and Information Technology at REVA UNIVERSITY offers B. Tech., Computer Science and Systems Engineering (CS&SE), an undergraduate program to create motivated, innovative, creative and thinking graduates to fill ICT positions across sectors who can conceptualize, design, analyze, and develop ICT applications to meet the modern day requirements.

The B. Tech. in Computer Science and Systems Engineering(CS&SE) curriculum developed by the faculty at the

School of Computing and Information Technology is outcome based and it comprises required theoretical concepts and practical skills in the domain. By undergoing this program, students develop critical, innovative, creative thinking and problem solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in interdisciplinary topics and attitudinal skills to enhance their scope. The above mentioned features of the program, advanced teaching and learning resources and experience of the faculty members with their strong connections with ICT sector makes this program unique.

Program Educational Objectives (PEO's)

After few years of graduation, the graduates of B. Tech CS & SE will:

- **PEO-1:** Pursue higher education in the core or allied areas of Computer Science and Systems Engineering.
- **PEO-2:** Have technical career in the core or allied areas of Computer Science Systems Engineering or start entrepreneurial activity for the growth of the economy.
- **PEO-3:** Continue to learn and to adapt to ever changing technologies in the core or allied areas of Computer Science and Systems Engineering.

Program Outcomes (PO's)

On successful completion of the program, the graduates of B. Tech CS & SE program will be able to:

- **PO-1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals for the solution of complex problems in Computer Science and Engineering.
- **PO-2: Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
- **PO-3: Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO-4: Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO-5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO-6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO-7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO-8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

- **PO-9: Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
- **PO-10: Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
- **PO-11: Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
- **PO-12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

On successful completion of the program, the graduates of B. Tech CS & SE program will be able to:

- **PSO-1:** Apply the knowledge of mathematics, Computer Science and Systems Engineering to solve complex problems in CS and SE.
- **PSO-2:** Analyze, design, develop solutions and conduct investigations in the domains of database, networks and security, system software and system administration.
- **PSO-3:** Apply appropriate techniques, use modern programming languages, tools, and packages for quality software development.

REVA University Academic Regulations

B. Tech Degree Programs

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

Title and Commencement:

These Regulations shall be called "REVA University Academic Regulations – B. Tech, Degree Program 2020-21 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management

These Regulations shall come into force from the date of assent of the Chancellor.

The Programs:

These regulations cover the following B. Tech, Degree programs of REVA University offered during 2020-21

B. Tech in:

Bioelectronics Engineering
Civil Engineering
Computer Science and Engineering
Computer Science and Information Technology
Computer Science and Systems Engineering
Computer Science and Engineering (AI and ML)
Electrical and Electronics Engineering
Electrical and Computer Engineering
Electronics and Communication Engineering
Electronics and Computer Engineering
Information Science and Engineering
Mechanical Engineering
Mechatronics Engineering

Duration and Medium of Instructions:

Duration: The duration of the B. Tech degree program shall be FOUR years comprising of EIGHT Semesters. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B. Tech degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

The medium of instruction shall be English.

Definitions:

Course: “Course” means a subject, either theory or practical or both, listed under a program; Example: “Fluid Mechanics” in B.Tech Civil Engineering program, Engineering Thermodynamics in B.Tech, Mechanical program are examples of courses to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely:

L	Lecture
T	Tutorial
P	Practice

Where:

L stands for Lecture session consisting of classroom instruction.

T stands for Tutorial session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for Practice session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

4.2 Classification of Courses

Courses offered are classified as: Core Courses, Open Elective Courses, Project work/Dissertation

Core Course: A course which should compulsorily be studied by a candidate choosing a particular program of study.

Foundation Course (FC): The foundation Course is a mandatory course which should be completed successfully as a part of graduate degree program irrespective of the program of study.

Hard Core Course (HC) simply core course: The Hard Core Course is a Core Course in the main branch of study and related branch (es) of study, if any, that the candidates have to complete compulsorily.

Soft Core Course (SC) (also known as Professional Elective Course)

A Core course may be a Soft Core if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

Open Elective Course (OE):

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an Open Elective Course.

Project Work / Dissertation:

Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems. The project will be conducted in two phases, Phase-I (7th Semester), consists of literature survey, problem identification, formulation and methodology. In Phase-II (8th Semester) student should complete the project work by designing or creating an innovative process or development of product as an outcome. A project work carrying TWO, FOUR or SIX credits is called Minor Project work / Dissertation. A project work of SIX, EIGHT, or TEN, credits is called Major Project work / Dissertation. A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned. But the Major Project shall be Hard Core.

"Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma Degree or such other degrees instituted and introduced in REVA University.

Eligibility for Admission:

5.1. The eligibility criteria for admission to B. Tech Program of 4 years (8 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B. Tech)	4 Years (8 Semesters)	Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry, Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together.
2	Bachelor of Technology (B. Tech)	Lateral entry to second year	(A) Passed Diploma examination from an AICTE approved Institution with at least 45% marks (40% in case of candidates belonging to SC/ST category) in appropriate branch of Engineering / Technology. (B) Passed B. Sc Degree from a recognized University as defined by UGC, with at least 45% marks (40% in case of candidates belonging to SC/ST category) and passed XII standard with mathematics as a subject. (C) Provided that in case of students belonging to B. Sc. Stream, shall clear the subjects of Engineering Graphics / Engineering Drawing and Engineering Mechanics of the first year Engineering program along with the second year subjects.

			(D) Provided further that, the students belonging to B. Sc. Stream shall be considered only after filling the seats in this category with students belonging to the Diploma stream. (E) Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized University as defined by UGC, shall also be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first year class in case the vacancies at lateral entry are exhausted. However the admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above.
3	Bachelor of Technology (B. Tech)	Lateral entry to fourth year (final year)	(F) Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester in the concerned branch of study, provided he/she fulfils the University requirements.
5	B. Tech. in Bioelectronics		Pass in PUC /10+2 examination with Physics, Biology/Biotechnology as compulsory along with at least one of the Chemistry/Mathematics / Computer Science / Electronics obtained minimum 45% marks (40% in case of candidates belonging to SC / ST category) in the above subjects taken together of any board recognized by the respective State Government / Central Government / Union Territories or any other qualification recognized as equivalent there to.

Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, such as AICTE, UGC from time to time.

Courses of Study and Credits

Each course of study is assigned with certain credit value

Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for final examination, evaluation and announcement of results

The credit hours defined as below

In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching-learning process.

Credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

The following table describes credit pattern

Table -2: Credit Pattern					
Lectures (L)	Tutorials (T)	Practice (P)	Credits (L:T:P)	Total Credits	Total Contact Hours
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4

The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course

Different Courses of Study:
Different Courses of Study are labeled as follows:
Core Course (CC)
Foundation Course (FC)
Hard Core Course (HC)
Soft Core Course (SC)
Open Elective Course (OE)
Project Work / Dissertation:

A project work carrying TWO, FOUR or SIX credits is called Minor Project work / Dissertation. A project work of EIGHT, TEN, TWELVE or SIXTEEN credits is called Major Project work / Dissertation. A Project work may be a hard core or a Soft Core as decided by the BoS / concerned.

These are defined under Section 4 of these regulations.

Credits and Credit Distribution

A candidate has to earn 160 credits for successful completion of B. Tech degree with the distribution of credits for different courses as given in table below:

Course Type	Credits (Range)
	For B. Tech Degree (8 Semesters)
Foundation Core Course	A minimum of 06 but not exceeding 12
Hard Core Course	A minimum of 118 but not exceeding 121
Soft Core Course	A minimum of 15 but not exceeding 21
Open Elective	A minimum of 04 but not exceeding 12

8.2. The concerned BOS based on the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective, as Foundation Course (FC), Hard Core (HC) or Soft Core (SC), Open Elective (OE).

8.3. Every course including project work, practical work, field work, self-study elective should be entitled as Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE) or Core Course (CC) by the BoS concerned. However, following shall be the Foundation Courses with credits mentioned against them, common to all branches of study.

Sl. No.	Course Title	Number of Credits
Foundation Courses		
1	English for Technical Communication / Communication Skills	2
2	Environmental Studies / Environmental Science	2
3	Indian Constitution and Professional Ethics	2
4	MOOC / Internship /Soft Skill Training	6-15

8.4. The concerned BOS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

8.5. A candidate can enrol for a maximum of 28 credits and a minimum of 19 credits per Semester. However he / she may not successfully earn a maximum of 28 credits per semester. This maximum of 28 credits does not include the credits of courses carried forward by a candidate.

Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 160 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B. Tech Degree program.

Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B. Tech Degree program.

The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the candidate contains the courses studied and grades earned.

Assessment and Evaluation

The Scheme of Assessment will have two parts, namely;

Internal Assessment (IA); and

Semester End Examination (SEE)

Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of UG Engineering programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

The 50 marks of internal assessment shall comprise of:

Internal Test	30 marks
Assignments / Seminars / Model Making / Integrated Lab / Project Based Learning / Quizzes etc.	20 marks

There shall be two Internal Tests conducted as per the schedule announced below. The students shall attend both the Tests compulsorily.

1st test is conducted for 15 marks during 6th week of the semester;

2nd test is conducted for 15 marks during 12th week of the of the semester;

The coverage of syllabus for the said tests shall be as under:

Question paper of the 1st test should be based on first 40 %of the total syllabus;

Question paper of the 2nd test should be based on second 40 %of the total syllabus;

An assignment must be designed to cover the last 20% of the syllabus.

There shall be one Assignment / Project Based Learning / Field Visit / Quiz test carrying 20 marks covering the last 20% of the syllabus.

The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

A test paper is set for a maximum of 30 marks to be answered in 1 hour duration. A test paper can have 4 main questions. Each main question is set for 10 marks. The main question can have 2-3 sub questions all totalling 10 marks. Students are required to answer any three main questions. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document.

The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by the Question Paper Scrutiny Committee to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

Assignment/seminar/Project based learning/simulation based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarise the answer from web or any other resources. An assignment / Quiz can be set for a maximum of 20. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self-study.

Internal assessment marks must be decided well before the commencement of Semester End examinations.

Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18th and 19th week of the semester and the entire course syllabus must be covered while setting the question paper.

Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have a 3-4 sub questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

There shall be three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of Examiners particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

There shall also be an Program Assessment Committee (PAC) comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. The Examination Review Committee shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

The report provided by the Examination Review Committee shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper

Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor

Online courses may be offered as per UGC norms.

For online course assessment guidelines would be as follows:

If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA University norms.

If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain the discretion of the School.

The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

Utilization of one or two credit online courses would be:

4 week online course – 1 credit

8 week online course / MOOC – 2 credits

12 week online course / MOOC – 3 credits

Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	when	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 6th week	First 40%	30	15	7th week
2	Test -2	During 12th Week	Second 40%	30	15	13th Week
3	Assignment / Quiz	15th Week	Last 20%	20	20	16th Week
4	SEE	18/19th Week	100%	100	50	20th Week

Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

The 50 marks meant for Internal Assessment (IA) of the performance in carrying out practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	**50 marks**

10.2 The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

i	Conducting of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

10.3 The duration for semester-end practical examination shall be decided by the concerned School Board.

For MOOC and Online Courses assessment shall be decided by the BOS of the School.

For > 3 credit courses

i	IA-I	25 marks
ii	IA-2	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	50 marks
	Total	**100 marks**

For 1 & 2 credit courses

i	IA-I	15 marks
ii	IA-2	15 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	20 marks
	Total	**50 marks**

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

Requirements to Pass a Course:

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 , SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) which is compulsory.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below:

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course which is rounded to nearest integer. V is the credit value of course. G is the grade and GP is the grade point.

Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA).

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : SGPA (Si) = $\sum(Ci \times Gi) / \sum Ci$ where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
Course 7	3	O	10	3X10=30
	19			**159**

Thus, SGPA = 159 ÷ 19 = 8.37

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
Course 7	2	B+	7	2X7=21
Course 8	2	O	10	2X10=20
	24			**175**

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			**199**

Thus, SGPA = 199 ÷ 24 = 8.29

Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (160) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : CGPA = ∑(Ci x Si) / ∑Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	19	6.83	19 x 6.83 = 129.77
2	21	7.29	21 x 7.29 = 153.09
3	22	8.11	22 x 8.11 = 178.42
4	22	7.40	22 x 7.40 = 162.80
5	22	8.29	22 x 8.29 = 182.38
6	22	8.58	22 x 8.58 = 188.76
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**160**		**1288.36**

Thus, CGPA = 19x6.83+21x7.29+22x8.11+22x7.40+22x8.29+22x8.58+22x9.12+10x9.25 = 8.05

Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:
Percentage of marks scored = CGPA Earned x 10
Illustration: CGPA Earned 8.05 x 10=80.5

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index) G	Letter Grade	Performance	FGP Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
>5 CGPA< 5.5	5.5	C+	Average	
>4 CGPA<5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

Provisional Grade Card: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides Semester Grade Point Average (SGPA).

Final Grade Card: Upon successful completion of B. Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

14.1 All students must attend every lecture, tutorial and practical classes.

14.2 In case a student is on approved leave of absence (e g:- representing the University in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

14.3 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

15.1 In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

15.2 In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

Absence during Internal Test:

In case a student has been absent from an internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

17.1. If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), he/she can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. He/she can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the Grievance committee is final.

18. **Grievance Committee:**

For every program there will be one grievance committee. The composition of the grievance committee is as follows:-

The Controller of Examinations - Ex-officio Chairman / Convener

One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.

One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

Provision to Carry Forward the Failed Subjects / Courses:

The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of succeeding year(s) of study till 8th semester. And he / she shall appear for Semester End examination of failed courses of previous semesters concurrently with odd semester end examinations and / or even semester end examinations of current year of study.

Examples:-

Student "A" has failed in 1 Course in First Semester and 3 Courses in Second Semester. He / she is eligible to seek admission for Third Semester and appear for Semester End Examination of 1 failed Course of First Semester concurrently with Third Semester end examination. Likewise, he / she is eligible to appear for Semester End Examination of 3 failed Courses of Second Semester concurrently with Fourth Semester end examination.

Student "B" has failed in 2 Courses of First Semester and 2 Courses in Fourth Semester and has passed in all Courses of First and Second Semesters. He / she is eligible to seek admission to Fifth Semester and appear for Semester End Examination of 2 failed Courses of First Semester concurrently with Fifth Semester end examination. Likewise he / she is eligible to appear for Semester End Examination of 2 failed Courses of Fourth Semester concurrently with Sixth Semester end examination.

Student "C" has failed in one course in Second Semester one course in third semester and two courses in fifth semester and has cleared all other courses from first semester to Sixth Semester. He / She has also passed all the courses of First to Sixth Semesters. Student "C" is eligible to seek admission for Seventh Semester and appear for Semester End Examination of one failed Course of Second Semester, one course of third semester and two courses in fifth semester concurrently with Seventh Semester end examination. However, he / she has to pass all the failed courses of Second Semester, Third Semester and Fifth Semester along with Seventh and Eighth Semesters courses to earn B. Tech Degree.

Student "D" failed in three courses in first semester and one course in second semester, but has passed in all the courses of second to sixth semester. Student "D" is also eligible to seek admission for 7th Semester and appear for Semester End Examination of 3 failed courses of 1st Semester and one course of second semester concurrently with 7th Semester and 8th semester end examinations. However, he / she has to pass three failed courses of first semester and one failed course of second semester along with Seventh and Eighth Semester courses to earn B. Tech Degree.

The Student failed in any course(s) in any of the first to eight semester has to pass all the failed courses of all Semesters within the double duration to earn B. Tech Degree failing which he / she has to seek re-admission to the program afresh.

Challenge Valuation:

a) A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.
b) The answer scripts (in whatever form) for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

REVA UNIVERSITY
Bengaluru, India

School of Computing and Information Technology
Scheme of Instructions (2021 – 2025 Batch)
B. Tech CS & SE

I SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20AS0105	Multivariable Calculus and Linear Algebra	HC	3	0	0	3	3
2	B20EE0101	Basics of Electrical and Electronics Engineering	HC	3	0	1	4	5
3	B20CI0101	Introduction to Python Programming	FC	2	0	1	3	4
4	B20AS0104	Engineering Chemistry	HC	3	0	0	3	3
TOTAL				**11**	**0**	**2**	**13**	**15**
	Practical /Term Work / Practice Sessions /MOOCs							
5	B20ME0102	Design Thinking	FC	1	0	1	2	3
6	B20AS0109	Biology for Engineers	FC	1	0	0	1	1
7	B20ME0101	Computer Aided Engineering Drawing	HC	2	0	1	3	4
TOTAL				**4**	**0**	**2**	**6**	**8**
TOTAL SEMESTER CREDITS							**19**	
TOTAL CUMULATIVE CREDITS							**19**	
TOTAL CONTACT HOURS							**23**	

II SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20AS0204	Probability and Statistics	HC	4	0	0	4	4
2	B20AS0106	Physics for Computer Science	HC	3	0	0	3	3
3	B20CS0101	Introduction to Data Science	FC	2	0	1	3	4
4	B20CE0201	Basics of Civil and mechanical Engineering	HC	3	0	1	4	5
5	B20CS0102	Programming for Problem Solving	HC	3	0	1	4	5
TOTAL				**15**	**0**	**3**	**18**	**21**
	Practical /Term Work / Practice Sessions /MOOCs							
6	B20EC0101	IoT and Applications	FC	1	0	1	2	3
7	B20ME0104	Entrepreneurship	FC	1	0	0	1	1
TOTAL				**2**	**0**	**1**	**3**	**4**
TOTAL SEMESTER CREDITS							**21**	
TOTAL CUMULATIVE CREDITS							**40**	
TOTAL CONTACT HOURS							**25**	

III SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20CI0301	Analog and Digital Electronics	HC	3	0	0	3	3
2	B20CI0302	Programming with JAVA	HC	3	0	0	3	3
3	B20CI0303	Data Structures	HC	3	0	0	3	3
4	B20AS0302	Discrete Mathematics and Graph Theory	HC	3	0	0	3	3
5	B20EK0301	Computer Organization and Architecture	HC	3	0	0	3	3
6	B20CI0305	Analog and Digital Electronics Lab	HC	0	0	1	1	2
7	B20CI0306	Programming with JAVA Lab	HC	0	0	1	1	2
8	B20CI0307	Data Structures Lab	HC	0	0	1	1	2
TOTAL				**15**	**0**	**3**	**18**	**21**
Practical /Term Work / Practice Sessions /MOOCs								
9	B20MGM301	Management Science	FC	2	0	0	2	2
10	B20AS0301	Environmental Science	FC	2	0	0	2	2
11	B20AHM301 OR B20AHM302	Advanced Kannada OR Basics of Kannada	MC	0	0	0	0	0
TOTAL				**4**	**0**	**0**	**4**	**4**
TOTAL SEMESTER CREDITS							**22**	
TOTAL CUMULATIVE CREDITS							**62**	
TOTAL CONTACT HOURS							**25**	

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20CI0401	Design and Analysis of Algorithms	HC	3	0	0	3	3
2	B20EK0401	Device Driver Programming	HC	3	0	0	3	3
3	B20CI0402	Operating System	HC	3	0	0	3	3
4	B20CI0403	Database Management System	HC	3	0	0	3	3
5	B20EK0402	Microprocessors and Interfacing	HC	3	0	0	3	3
6	B20AS0401	Numerical Methods and Optimization Techniques	HC	3	0	0	3	3
7	B20CI0404	Design and Analysis of Algorithms Lab	HC	0	0	1	1	2
8	B20CI0405	Operating System Lab	HC	0	0	1	1	2
9	B20CI0406	Database Management System Lab	HC	0	0	1	1	2
TOTAL				**18**	**0**	**3**	**21**	**24**
Practical /Term Work / Practice Sessions /MOOCs								
10	B20AH0301	Communication Skills	FC	2	0	0	2	2
11	B20LS0301	Indian Constitution and Professional Ethics	FC	2	0	0	2	2
12	B20AHM401	Universal human values	MC	0	0	0	0	0
TOTAL				**4**	**0**	**0**	**4**	**4**
TOTAL SEMESTER CREDITS							**25**	
TOTAL CUMULATIVE CREDITS							**87**	
TOTAL CONTACT HOURS							**28**	

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20EJ0501	Web Technologies and Applications	HC	3	0	0	3	3
2	B20CI0501	Computer Networks	HC	3	0	0	3	3
3	B20EK0501	Smart Sensors and Transducers	HC	3	0	0	3	3
4	B20CI0502	Machine Learning	HC	3	0	0	3	3
5	B20EXS5(01-06)	Professional Elective-I	SC	3	0	0	3	3
6	B20XXO5XX	Open Elective-I	HC	3	0	0	3	3
7	B20EJ0504	Web Technologies and Applications Lab	HC	0	0	1	1	2
8	B20CI0505	Machine Learning Lab	HC	0	0	1	1	2
9	B20CI0506	Computer Networks Lab	HC	0	0	1	1	2
		TOTAL		**18**	**0**	**3**	**21**	**24**
	Practical /Term Work / Sessions							
10	B20CI0503	Technical Documentation	FC	1	0	0	1	1
11	B20EJ0503	Software Testing	HC	1	0	1	2	3
		TOTAL		**2**	**0**	**1**	**3**	**4**
TOTAL SEMESTER CREDITS							**24**	
TOTAL CUMULATIVE CREDITS							**111**	
TOTAL CONTACT HOURS							**28**	

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20EK0601	IOT and Cloud Programming	HC	3	0	0	3	3
2	B20EA0601	Big Data Analytics	HC	3	0	0	3	3
3	B20EXS6(01-06)	Professional Elective-II	SC	3	0	0	3	3
4	B20EXS6(07-09)	Professional Elective-III	SC	3	0	0	3	3
5	B20EXS6(10-012)	Professional Elective-IV	SC	3	0	0	3	3
6	B20XXO6XX	Open Elective-II	HC	3	0	0	3	3
7	B20EK0602	IOT and Cloud Programming Lab	HC	0	0	1	1	2
8	B20EA0604	Big Data Analytics Lab	HC	0	0	1	1	2
		TOTAL		**18**	**0**	**2**	**20**	**22**
	Practical /Term Work / Sessions							
10	B20CI0601	Research Based Mini Project	HC	0	0	2	2	4
11	B20PA0501	Indian Tradition and Culture	FC	1	0	0	1	1
12	B20EQ0603	Modern Database	HC	1	0	1	2	3
		TOTAL		**2**	**0**	**3**	**5**	**8**
TOTAL SEMESTER CREDITS							**25**	
TOTAL CUMULATIVE CREDITS							**136**	
TOTAL CONTACT HOURS							**30**	

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20EXS7 (01-03)	Professional Elective-V	SC	3	0	0	3	3
2	B20XXO7XX	Open Elective-III	OE	3	0	0	3	3
TOTAL				**6**	**0**	**0**	**6**	**6**
	Practical /Term Work / Sessions							
3	B20CI0701	Summer Internship/Global Certification	HC	0	0	3	3	6
4	B20CI0702	Project Phase-I	HC	0	0	4	4	8
TOTAL				**0**	**0**	**7**	**7**	**14**
TOTAL SEMESTER CREDITS							**13**	
TOTAL CUMULATIVE CREDITS							**149**	
TOTAL CONTACT HOURS							**20**	

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20CI0801	Capstone-Project Phase-II	HC	0	0	8	8	16
TOTAL				**0**	**0**	**8**	**8**	**16**
Practical /Term Work / Practice Sessions /MOOCs								
2	B20XXO8XX	Open Elective-IV	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	3
TOTAL SEMESTER CREDITS							**11**	
TOTAL CUMULATIVE CREDITS							**160**	
TOTAL CONTACT HOURS							**19**	

Professional Electives

	Code	Course	Code	Course	Code	Course
PE-I/V sem	B20EKS501	Introduction to Robotics and Drones	B20EKS503	Cryptography and Network Security	B20EKS505	Storage Area Networks
	B20EAS504	Fuzzy Logic and Systems	B20EKS502	Predictive Analytics using PYTHON	B20EKS506	Digital System Design with Verilog
PE-II/ VI sem	B20EJS606	Neural Networks and Deep learning	B20EJS604	Block Chain Technology	B20EKS605	System-on-Chip Design
	B20EKS601	Text and Web Mining	B20EKS602	High Performance Computing	B20EKS603	Distributed Computing and Parallel Systems
PE-III/ VI sem	B20EJS607	Computer Vision and Applications	B20EJS608	Advanced Topics in Wireless Networks	B20EJS609	Compiler Design
PE-IV/ VI sem	B20EKS610	Advanced Topics in Machine Learning	B20EKS611	Advanced Computer Architecture	B20EKS612	Embedded Systems
PE-V/ VII sem	B20EAS701	Swarm and Bio-inspired Intelligence	B20EKS703	System Modelling and Simulation	B20EKS702	Augmented and Virtual Reality

Open Electives Offered to Other schools											
5TH SEM /OE-I			**6th SEM /OE-II**			**7th SEM /OE-III**			**8th SEM /OE-IV**		
Course code	Course Name	Teaching School	Course code	Course Name	Teaching School	Course code	Course Name	Teaching School	Course code	Course Name	Teaching School
B20CIO501	Introduction to AI	CIT	B20CIO601/602	Data Mining/Machine Learning	CIT	B20CIO701	Python for data science	CIT	B20CIO801	IoT Programming	CIT
B20CIO502/503	OOPS with c++/Web technology	CIT	B20CIO603	Neural Networks	CIT	B20CIO702	Deep Learning	CIT	B20CIO802	Reinforcement Learning	CIT

Detailed Syllabus
Semester1

<table>
<tr><td>Course Title</td><td colspan="4">Multivariable Calculus and Linear Algebra</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0105</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course Differential Calculus deals with the basic aspect's differential calculus. The students of Computer Science are equally benefited with this course as stepping stone to the broad areas of calculus. This course familiarizes students with important concepts coming under differential calculus and to develop strong foundations on these concepts. In Computer Science, Calculus is used for machine learning, data mining, scientific computing, image processing, and creating the graphics and 3D visuals for simulations. Calculus is also used in a wide array software program that require it. Linear algebra provides concepts that are crucial to many areas of computer science, including graphics, image processing, cryptography, machine learning, optimization, graph algorithms, information retrieval and web search.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the scalar product and vector product of two or more vectors.
2. Illustrate how to find angle between polar curves with a suitable example.
3. Demonstrate the use of radius of curvature of the curves can be best suited for machine learning techniques with big data analytics.
4. Describe the concepts of Linear algebra and calculus theory.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply Taylor's and Maclaurin's series for finding series expansions of functions and approximating values. expansions of functions and approximating values.	1-6	1,2
CO2	Identify and evaluate the radius of curvature of the given curve. Also evaluate the given indeterminate form using L' Hospital rule.	1-6	1,2
CO3	Make use of Gauss elimination and Gauss Jordon method for solving the system of equations, if the given system of equations is consistent.	1-6	1,2
CO4	Determine the Eigen values, the corresponding Eigen vectors and diagonalizable the given square matrix.	1-6	1,2
CO5	Learn new tools and technologies in the linear algebra and apply for suitable application development.	12	1,2
CO6	Develop solutions in the linear algebra to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	2, 3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyse(L4)	Evaluate(L5)	Create(L6)
CO1			✓			
CO2			✓		✓	
CO3			✓			
C04			✓			
CO5			✓			
CO6			✓	✓		

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1							3	3	
CO2	3	3	3	3	3	1							3	3	
CO3	3	3	2	2	3	1							2	2	
C04	2	3	2	3	3	1							1	1	
CO5												2	2	2	
CO6					2				2	2				2	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT – 1 **Introduction to Vector Differentiation:** Introduction, Scalar and vector point functions, velocity, acceleration, Gradient, Divergence, Curl, Laplacian, Solenoidal and Irrotational vectors, Vector identities**.** **Differential Calculus-1**:Successive differentiation- nth derivatives of standard functions (no proof) simple problems, Leibnitz Theorem (without proof) and problems, Taylor's series and McLaurin's series expansion for function of one variable(only problems), Polar curves- Angle between the radius vector and the tangent, angle between two curves, Pedal equation for polar curves. Applications in computer science.
UNIT-2 **Differential Calculus-2:** Derivative of arc length – concept and formulae (without proof), Radius of curvature-Cartesian, parametric, polar and pedal forms (with proof) problems. Indeterminate forms and solution using L'Hospital's rule. Analysis of Randomized algorithms using Differential Calculus. Applications in computer science.
UNIT-3 **LinearAlgebra-1:** Basic concepts, Echelon form, normal form of a matrix, Rank of Matrix, Gauss-Jordon method to find inverse of a matrix, consistency of linear system of equations, Gauss elimination and Gauss-Jordon method to solve system of equations. Linear Algebra for statistics. Applications in computer science.
UNIT-4 **Linear Algebra-2:** Linear Transformations, orthogonal transformation, Eigen values and Eigen Vectors. Complex matrices, Similarity of Matrices, Diagonalization. Rayleigh power method to determiner largest Eigen value and the corresponding Eigen vector. Analysis of Randomized algorithms using Linear Algebra. Applications in computer science.

TEXTBOOKS:

1. Theodore Shifrin, "Multi-Variable Calculus and Linear Algebra with Applications", Wiley, 1st Edition,Volume 2, 2018.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition,2013.
4. Ron Larson, "Multivariable Calculus, Cengage Learning", 10th Edition, 2013.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition, 2016.
3. Stanley I. Grossman, "Multivariable Calculus, Linear Algebra, and Differential Equations", 2nd Edition, Academic Press 1986.

JOURNALS/MAGAZINES

https://www.sciencedirect.com/journal/linear-algebra-and-its-applications

SWAYAM/NPTEL/MOOCs:

1. https://youtu.be/XzaeYnZdK5o
2. https://youtu.be/KSntcGOFdUc
3. https://youtu.be/LJ-LoJhbBA4

SELF-LEARNINGEXERCISES:

1. Vectors in Space, Generalized Leibniz Rules, Mean Value of Derivatives, Powers of a matrix,
2. Testing of Linear Dependence and Independence and multivariate calculus. Introduction to differential equations.

<table>
<tr><td>Course Title</td><td colspan="4">Basic Electrical and Electronics Engineering</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>qCourse Code</td><td>B20EE0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory Hours</td><td rowspan="2">Practical Hours</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

Basic Electrical & Electronics Engineering covers basic concepts of electrical engineering and electromagnetism. This course introduces the student to the working AC and DC Machines. It also helps the student to understand the basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes in rectifiers, filter circuits. Further, it has a self-learning component on BJT's.

COURSE OBJECTIVE (S):

1. Explain the basics of electrical and electronics engineering terminologies.
2. Distinguish the single and three phase systems.
3. Illustrate the different building blocks in digital electronics using logic gates and explain simple logic functions using basic universal gates.
4. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
5. To build a broad concept for hands on experience in various types of electrical apparatus, tools and instrumentation with electrical safety norms.
6. To analyze the schematics for making electrical connection and to interpret experimental data for various electrical appliances.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the basics of electrical engineering terminology and the usage.	1-6	1
CO2	Analyze the concepts and applications of DC & AC Machines.	1-5	1
CO3	Apply the concept of domestic wiring, importance of safety and sensing devices	1-5,10	1
CO4	Analyze the different building blocks in digital electronics using logic gates and applications of diode in rectifiers, filter circuits and wave shaping.	1-5	1
CO5	Interpret, Identify and use appropriate electrical tools for electrical connections and to repair electrical equipment's.	1-7, 9,10	1,2
CO6	Compare experimental results with theoretical analysis and the ability to critically evaluate the performance of electrical appliances.	1-7, 9,10	1,2

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2				√		
CO3			√			
CO4				√		
CO5			√			
CO6				√		

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	2	1							1		
CO2	1	3	2	2	1								1		
CO3	2	2	2	2	1					2			1		
CO4	3	3	3	1	1								1		
CO5	2	2	1	3	1	3	1		3	1			3	3	
CO6	2	2	1	3	1	3	1		3	1			3	3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT:
THEORY:

CONTENTS
UNIT-1
Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Resistive, Inductive, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations, Network Theorems (Superposition, Thevenin's & Norton's) Generation of an alternating Emf–average and rms values of alternating quantity–representation of alternating quantities by phasors–single phase series and parallel circuits (simple problems), three phase systems and power calculations
UNIT-2
DC-Machines: Construction and Principle of operation of DC Machines–Emf & Speed equations-types–applications. AC-Machines: Principle of operation of single phase transformers–Emf equation–losses– efficiency and regulation-Construction and working principle of induction motors–Slip–torque characteristics–applications-Construction and Principle of operation of alternators applications.
UNIT-3
Instruments: Basic Principle of indicating instruments–PMMC&MI instruments. Tariff, Protective Devices and Sensors: Tariff schemes, basic concepts of domestic wiring and types, Earthing, protective fuses, MCB, sensors: pressure sensors, strain gage, proximity sensors, displacement sensors, Rotatory encoder and ultrasonic sensors and civil engineering applications.
UNIT-4
Diodes: Introduction, Physical operation of p-n junction diodes, Characteristics of p-n junction diodes, Zener diode, Rectifier circuits (half-wave, full-wave, bridge and peak rectifiers),Light emitting diodes. Digital Electronic Principles: Introduction, Binary digits, Logic levels and Digital waveforms, Introduction to basic logic operation, Number system, Decimal numbers, Binary numbers, Decimal-to-Binary conversion, Simple binary arithmetic.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Electrical Safety Training. a) To Study the importance of Earthing during accidental shorting of line wire and the body of equipment. b) To conduct experiment and to know the Importance and mechanism of FUSE c) To study the Importance and mechanism of MCB.	Trainer kitOhms Law Fall of resistance	Importance & applications of Earthing, Fuse & MCB
2.	Home Electrical Wiring Demonstration. a) To study & verify the connection procedure for fluorescent lamp wiring. b) To study the connection of Fan with switch and regulator.	Fluorescent Lamp wiring Panel Fan with switch and regulator Kit	Connection & Trouble shooting of fluorescent lamp wiring & Fan with switch and regulator
3.	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring	Two-way switch or staircase wiring Kit	Connection, Working & application of Two-way switch
4.	Behaviour of current and voltage in series and parallel circuits. a)To study and verify the behaviour of current and voltage in series circuit. b) To study and verify the behaviour of current and voltage in parallel circuit.	Series and parallel circuits Kit	Connection & behaviour of current & voltage in series, parallel circuit
5	Polarity test on single phase transformer. a)To determine the additive polarity of a single-phase transformer. b) To determine the subtractive polarity of a single-phase transformer.	Transformer Kit	Polarities of single phase transformer
6	Determination of VI characteristics of Zener Diode	VI characteristics of Zener Diode kit	VI characteristics of Zener Diode
7	Determination of VI characteristics of Silicon Diode	VI characteristics of Silicon Diode kit	VI characteristics of Silicon Diode
8	Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Rectifier kit	Determine the efficiency, Voltage regulation, ripple
9	Determine the Characteristics of BJT in Common Emitter Configuration	Characteristics of BJT in Common Emitter	Input & Output Characteristics of BJT
10	Determine the Characteristics of JFETin Common Source Configuration	Characteristics of JFET in Common	Input & Output Characteristics of JFET
11	Realization of Universal gates using basic logic gates.	Trainer kit	Universal gates will be realized using basic gates

TEXTBOOKS:

1. Nagrath I.J. and D. P. Kothari, “Basic Electrical Engineering”, Third Edition Tata McGraw Hill, 2009.
2. Hayt and Kimberly, “Engineering Circuit Analysis”, 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.
5. Hughes, E., “Electrical Technology”, Pearson, 2005.
6. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
7. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.

REFERENCEBOOKS:

1. Theodore Wildi, “Electrical Machines, Drives, and Power, 5thSystems”, Pearson Edition, 2007.
2. Hughes, “Electrical Technology”, International Students 9th Edition, Pearson, 2005.

JOURNALS/MAGAZINES

1. International Journal of Electrical Power and Energy Systems (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)
2. Journal of Electrical Engineering (https://link.springer.com/journal/202)

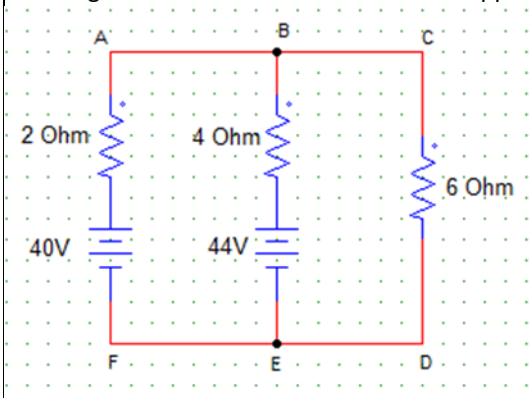
SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/108/108108076/

SELF-LEARNINGEXERCISES:

1. Build an electrical circuit using BJT as a switch
2. Identifying the practical application of Electromagnetic Induction

PROBLEMBASEDLEARNING

No	Problems
1	A current of 20A flows through two ammeter A and B in series. Potential difference across A is 0.2V and across B is 0.8 V. Find how the same current will divide between A and B when they are joined in parallel.
2	For the given circuit calculate the current supplied by each battery and current in 6 ohm resistor. 
3	Two 12V batteries with internal resistances 0.2 ohm and 0.25 ohm respectively are joined in parallel and a resistance of 1 ohm is placed across the terminals. Find the current supplied by each battery.

4	A 6 pole induction motor is connected to a 50 Hz supply. It is running at a speed of 970 R.P.M. Find the synchronous speed and the slip
5	If A= $(1011)_2$ and B = $(1110)_2$, perform the following arithmetic operations. i)Addition ii) subtraction ii) Multiplication
6	Simplify the given Boolean expression and implement using logic gates. i)Y=AB+ABC+AB(D+E) ii) Y=ABCD+ABD iii) Y=AB+A(B+C)+B(B+C)
7	Simplify the given Boolean Expression: i) Y= XY+XYZ+XY$\bar{Z}$+$\overline{XYZ}$ ii) $Y = \bar{A}\bar{B}$C+$\bar{A}$B$\bar{C}$+$\bar{A}$BC iii) Y= AC+C(A+$\bar{A}$B)
8	a) Perform the following operations: (i)Convert $(01110111)_2$ to decimal (ii) Convert $(21)_{10}$ to binary (iii) Add: $(1010)_2$ and $(0011)_2$ (iv) Subtract: $(111.111)_2$ from $(1010.01)_2$ (v) Divide: $(101101)_2$ by $(110)_2$

PROJECTBASEDLEARNING

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

	Suggested Projects
1.	Design & Development of a rectifier circuit
2.	Identify the types of wiring
3.	Electricity bill calculation
4.	Identify the types of motors used in domestic & industrial application with nameplate details.
5.	Identification of different transformer based on their rating used for various applications.

Course Title	**Introduction to Python Programming**				**Course Type**		**Integrated**	
Course Code	B20CI0101	**Credits**	**3**		**Class**		**I Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**4**	**4**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

Python is a Programming Language that can be treated in a procedural way, an object-orientated way or a functional way. It can be used on a server to create web applications, create workflows, connect to database systems, read and modify files, handle big data and perform complex mathematics. It can implement object oriented features and exception handling, It can parse the strings using regular expressions. It can be used for implementing the machine learning algorithms to develop solutions for interdisciplinary problems apart from any general problems leading to automation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of python programming language constructs and their applications.
2. Inculcate knowledge of parsing of regular expressions and their usage in various application domains.
3. Gain expertise in Object oriented programming and NumPy package.
4. Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of language constructs to solve real world problems using python programming.	1- 4, 8, 9, 12	1
CO2	Develop programs for text processing and other application domains by making use of regular expressions.	1-3, 5,9,12	2
CO3	Apply features of object oriented and NumPy package to develop computationally intensive programming to analyze and interpret the data.	1- 5, 9, 12	3
CO4	Create data science solutions with the help of files, Pandas and Data Visualization.	1,4,5,9,12	1-3
CO5	Learn new tools and technologies in the python and apply for suitable application development.	12	1,2
CO6	Develop solutions in the python 1to the complex problems, either individually or as a part of the team and report the results with proper	5, 9, 10	2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√	√		
CO4			√	√	√	√
CO5			√			
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2				1	1			1	3		
CO2	3	2	3		2				1			1		3	
CO3	3	1	2	1	2				1			1			
CO4	3			2	2				1			1	3	3	3
CO5												1	2	2	
CO6					2				1	1				2	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT THEORY

Contents
UNIT-1 **Introduction to Computer Fundamentals:** Computer Components, accessories, specifications of computers and external devices. Flowchart symbols and guidelines, types and advantages, Algorithm design. **Python Fundamentals:** Introduction to Python: History, Applications, Your First Python Program, Constants, Variables, Naming conventions, simple data types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions. Introduction to GitHub and applications.
UNIT-2 Strings: Unicode, Formatting Strings, Format Specifiers, other Common String Methods, Slicing a String. Regular Expressions: Case Study: Street Addresses, Case Study: Roman Numerals, Checking for Thousands, Checking for Hundreds, Using the {n,m} Syntax, Checking for Tens and Ones.
UNIT-3 Object Oriented Programming: Defining Classes, The init() Method, Instantiating Classes, OOP features: Abstraction. Encapsulation, Single Inheritance, Polymorphism. Files: Reading from Text Files, Writing to text files, Reading and Writing the Binary Files.
UNIT-4 NumPy: Introduction to NumPy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output. Pandas and Data Visualization: Introduction, Series and Data Frames in pandas and Data Visualization.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user.	Windows/Linux OS, IDE, Jupiter	Create and perform operations on list.

	b)"TUPLE1" and "TUPLE2" are two tuples that contain "N" values of different data types read using the user defined function "READ" with the help of input() function. Elements of "TUPLE1" and "TUPLE2" are to be read one at a time and the "larger" value among them should be placed into "TUPLE3". Display all tuples.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on Tuples.
2.	a)SET1 and SET2 are two sets that contain unique integers. SET3 is to be created by taking the union or intersection of SET1 and SET2 using the user defined function Operation (). Perform either union or intersection by reading choice from user. Do not use built in functions union () and intersection () and also the operators "|" and "&".	Windows/Linux OS, IDE, Jupyter	Create and perform Union and Intersection, Operations on Sets.
	b)The Dictionary "DICT1" contains N Elements and each element in dictionary has the operator as the KEY and operand's as VALUES. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.
3.	a)A substring "Substr" between index1 and index2 is to be extracted from the given input string "Str1", which is read using input(). Display the substring "Substr" using a user defined function if available in string "Str1", otherwise display NULL.	Windows/Linux OS, IDE, Jupyter	String operations.
	b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. Convert all the strings to uppercase and display Split the words of a string using space as the separation character and display.		
4.	a)Consider the text file, "Std.txt", with the details of students like SRN, NAME, SEMESTER, SECTION AND AVG_MARKS. Read the file, "Std.txt" and display the details of all the students of 4th Semester "A" Section who have scored more than 75%.	Windows/Linux OS, IDE, Jupyter	File Handling.
	b)Consider the text file "Emp.txt", with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: TOTAL_DEDUCTIONS= (LIC+PF) GROSS_SALARY= BASIC_SALARY+ DA NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of "Emp.txt" and display the details of each employee		File Handling.
5.	a). A "CAR" has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for "CAR" to store the above attributes and perform the following operations: Get the details of "CAR" object from user and store into Array of objects Display the details of "CAR" object based on "COMPANY", "MODEL" and "PRICE".	Windows/Linux OS, IDE, Jupyter	Classes and objects usage.

	b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for "Airlilne" with the above attributes and perform the following operations: Get the details of "Airline" object from user and store into Array of objects List details of all the passengers who travelled From "Bengaluru to London". List details of all the passengers who travelled From "Chicago to Beijing" on 10th of Feb, 2020.		
6.	a). "Arr_1" is an integer array of size M x N. Size and content of the array is to be read using input() by using the user defined function READ_DATA(). It is required to display the Diagonal elements of"Arr_1" Elements of m^{th} row (row no should be entered by user) Elements of n^{th}column (column no should be entered by user)	Windows/Linux OS, IDE, Jupyter	NumPy arrays usability.
	b)The dictionary "DICT1" contains the pass percentage of each semester of B. Tech in CSE, where, "Semester" acts as the key and "Pass Percentage" acts as the value. A Python Pandas dataframe is required to be created using the dictionary "DICT1" and display it using a user defined function.		Pandas Series usability.
	Part-B (Mini Project: Library Management System)		
1.	Develop a program to create the class "USER" with the attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add user (), delete user (), edit user (), search user () should be part of the class. Instantiate "User" class with 10 objects. Read the attributes of each "User" object using input () and store them in the file "User_File.txt".	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes of user and store them in a file.
2	Develop a program to get the name of the "User" object whose details are to be deleted. Read the "User_File.txt" and delete the "User" object if found. Display the contents of "User_File.txt" after	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes and
3	Develop a program to get the name of the "User" object whose details are to be edited (modified). Edit the details of the user object in the file "User_File.txt" and display the contents after	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
4	Develop a program to create the class "BOOK" with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add book(), delete book(), edit book() and search book(). Instantiate "Book" class with 10 objects. Read the attributes of each "BOOK" object using input () and store them in the file	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes of user and store them in a file.
5	Develop a program to get the name of the "BOOK" object whose details are to be deleted. Read the "Book_File.txt" and delete the "BOOK" object whose details match with the data entered. Display the contents of "Book_File.txt" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes and delete the object.
6	Develop a program to get the name of the "BOOK" object whose details are to be edited (modified). Edit the details of the "Book" object in the file "Book_File.txt" and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.

7	Develop a program to create the class "TRANSACTION" with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue book(), return book() and search book(). Instantiate "Transaction" class with 10 objects. Read the attributes of each "Transaction" object using input () and store them in the file "TransactionFile.txt". Develop a program to issue the book as requested by the user. Update the attributes in "Transaction _File"	Windows/Linux OS, IDE, Jupyter	Create class and perform string operations.
8	Develop a program to return the book. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in "TransactionFile.txt" and display the contents after modification. Compute the fine amount to be paid if return date is not same as due date. If both return date and due date are same and put zero in fine amount.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operation.
9	Develop a program to search for a book using its "author". Display the message "available" if search is successful otherwise display the message "not available".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
10	Develop a program to get a list of users by referring to "User_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
11	Develop a program to get List of Books in stock by referring to "Book_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
12	Develop a program to get List of Books Issued by referring to "User File", "Book File" and "Transaction File".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and
13	Develop a project by integrating User, Books, Transaction and Reports Modules.	Windows/Linux OS, IDE, Jupyter	Module integration and project

TEXTBOOKS:

1. Mark Pilgrim, "Dive into Python 3", A press special edition, second edition, 20l5.
2. Travis E. Oliphant, "Guide to NumPy", Trelgol publishers, 2006.

REFERENCEBOOKS:

1. A B Choudhary, "Flowchart and Algorithms Basics" Mercury Learning and Information,2020
2. Mark Lutz, "Learning Python", Oreilly. 2003.
3. John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle&Associates , 2004.
4. Michael Dawson, "Python Programming for the Absolute Beginners", 3rd Edition, CENAGE Learning.
5. Wesley J. Chun, "Core Python Programming", 2nd Edition, Prentice Hall.
6. Steve Holden and David Beazley, "Python Web Programming", New Riders, 2002. Springer, Kent D. Lee, "Python Programming Fundamentals", 2nd Edition.
7. John V. Guttag, "Introduction to Computation and Programming using Python", MIT Press, 2016.
8. https://www.tutorialspoint.com/computer_fundamentals/computer_fundamentals_tutorial.pdf

JOURNALS/MAGAZINES

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/1742-6596/423/1/012027
4. https://ieeexplore.ieee.org/document/4160250

SWAYAM/NPTEL/MOOCs:

1. Coursera – Python for everybody, University of Michigan
2. Coursera – Python Basics, University of Michigan
3. https://nptel.ac.in/courses/106/106/106106182/
4. https://www.edx.org/learn/python

SELF-LEARNINGEXERCISES:

1. Explore PYTHON library for IOT programming
2. More exploration on GitHub
3. Data Visualization packages
4. C modules interface

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Chemistry</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0104</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Engineering chemistry covers very relevant topics compatible with ECE, EEE and C&IT students and make them aware of importance of various aspects of basic science in engineering. The subject of Engineering chemistry covers area of light and matter interaction, clean energy storage and conversion devices, corrosion phenomenon and control which is widely an interdisciplinary subject of discussion. Further the course focus on the chemistry of engineering materials, and various applications. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge to enlighten on the energy conversion and storage devices, which have become very attractive field of research in engineering stream. The subject deals with various engineering materials, their properties and applications in the field of engineering.

COURSE OBJECTIVE

The Engineering chemistry course is designed to fulfil the following objective;

1. Engineering chemistry covers the very basic knowledge required for engineering students to understand its importance of science in technology.

2. It provides the basic knowledge on Interaction of light and matter to know the electronic transitions in materials and storage and conversion devices.
3. Corrosion and metal finishing, explains the phenomenon of corrosion and its Prevention. It also covers the importance of metal finishing in various industries and fabrication of PCB
4. Polymers are all about the properties of various polymeric materials and their Commercial significance. The chapter reveals about technical and commercial Importance of composite materials.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the phenomenon of light and matter interaction to study the materials	1,2, 4,7,11	2
CO2	Demonstrate the electrode processes in Batteries and conversion devices.	6,11	2
CO3	Describe Corrosion phenomenon and precautions to be taken in the selection of materials in controlling corrosion, Fabrication of PCB and industrial applications.	2,4,7,11	2
CO4	Illustrate the properties of polymers, nano materials, composite materials and their applications in various fields.	1,2, 11,12	2
CO5	Learn new tools and technologies in the engineering chemistry and apply for suitable application development.	12	1,2
CO6	Develop solutions in the engineering chemistry to the complex problems, either individually or as a part of the team and report the results with proper analysis	5, 9, 10	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyse (L4)	Evaluate (L5)	Create (L6)
CO1	√					
CO2		√		√		
CO3		√	√			
CO4	√	√		√		
CO5			√			
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		1			2				1			2	
CO2						2					2	3		2	
CO3	2	2		2		1	2							2	
CO4		2		2			2				3			2	
CO5												2	2	2	
CO6					2				2	2				2	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

Contents
UNIT-1 **Light and matter interaction**: Electro-magnetic spectrum-Applications in Engineering, Interaction of EM radiation with matter, work function of matter, Electrons in matter. Bonding theories: MOT, Band structure of matters HOMO-LUMO. Photochemical and thermal reactions: Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram - photophysical and photochemical processes, photo-sensitization, photo- polymerization and commercial application of photochemistry.
UNIT-2 **CLEAN ENERGY STORAGE AND CONVERSION DEVICES**: Introduction to electrochemistry, basic concepts of Batteries and characteristics. Classification: Primary (Dry cell, Li-MnO2) and Secondary (Pb-acid, Li-ion) batteries. Super capacitors: classification, construction and applications in hybrid vehicles. Fuel cells: Alkaline fuel cells, Solid oxide fuel cells and phosphoric acid fuel cell. Photo-conversion devices: Photovoltaic cell, antireflective coating, panels and arrays. Production of single crystal semiconductor by Crystal pulling technique (Czochralski pulling technique), zone refining process (of Si). Problems: Calculation of energy and power density, capacity of a Battery and capacitance of super capacitors for electric vehicle applications.
UNIT-3 **Corrosion:** Electrochemical theory of corrosion, types of Corrosion- differential metal corrosion, differential aeration corrosion, boiler corrosion, and grain boundary corrosion, Corrosion studies on Al, Fe with pourbiax diagram, Factors affecting rate of corrosion-Primary, secondary. Corrosion control: Galvanizing & tinning, cathodic protection & Anodic Protection. **Metal Finishing:** Theory of electroplating, Factors required to study electroplating Effect of plating variables in electroplating process, Electroplating of gold (acid, neutral and alkaline cyanide bath). Electro less plating of copper and PCB manufacture by Electro less plating of copper. (Applications/case studies).

UNIT-4

CHEMISTRY OF ENGINEERING MATERIALS: Polymer composites: Carbon fiber, Kevlar synthesis and applications, Conducting polymers: synthesis, electron transport mechanism and applications in polyacetylene and polyaniline. Liquid crystals: Introduction classification and applications in electronic display devices. Nanomaterials: Introduction, classification based on dimensionality, quantum confinement. Size dependent properties- surface area, magnetic properties (GMR phenomenon), and thermal properties. Synthesis, Properties and applications of Fullerenes, CNT and Graphene. Sensors: Physical and chemical sensors, Biosensors for bioelectronic applications.

TEXTBOOKS:

1. R.V.Gadag&Nithyanandashetty,"Engineering Chemistry", Ik International Publishing house.
2. S.S. Dara ,"Text Book of Engineering Chemistry", S. Chand & Co.
3. S.S.Chawla,"Text Book of Engineering Chemistry",DhanpatRaiPub.Co.

REFERENCE BOOKS:

1. P.W. Atkins,"Physical Chemistry", 5thedition Oxford.
2. Callister W.D., "Materials Science and Engineering", John Wiley & Sons.
3. R.Gopalan, D.\/enkappaya, S.Nagarajan,"Engineering Chemistry", Vikas Publication.

JOURNALS/MAGAZINES:

1. https://www.sciencedirect.com/journal/water-science-and-technology
2. https://iwaponline.com/wst
3. https://www.scitechnol.com/nanomaterials-molecular-nanotechnology.php
4. https://www.journals.elsevier.com/journal-of-energy-storage

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/105/105/105105201/
2. https://nptel.ac.in/courses/112/108/112108150/

PROLEM BASED LEARNING

No	Problems
1	Calculation of wavelength and frequencies of the radiations
2	Calculation of band structure by HOMO and LUMO
3	Determination of cell potentials
4	Calculation of energy density and power density of a battery.
5	Determination of capacitance of a super capacitor
6	Crystal field stabilization energy

PROJECT BASED LEARNING

To enhance the skill set in the integrated course, the students are advised to execute course-based

Design projects. Some sample projects are given below

No.	Suggested Projects
1.	Collection of literature for the materials for the semi conducting applications
2.	Synthesis of a semiconductor materials for the electronic applications
3.	Construction of a PCB for the electronic device
4.	Synthesis of conducting polymers
5.	Synthesis of Energy storage materials
6.	Fabrication of efficient aqueous battery or super capacitor

COURSE OVERVIEW:

<table>
<tr><td>Course Title</td><td colspan="2">Design Thinking</td><td colspan="3">Course Type</td><td colspan="3">Integrated</td></tr>
<tr><td>Course Code</td><td>B20ME0102</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>2</td><td>3</td><td>3</td><td>13</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

Today, innovation is everyone's business. At every level, in every kind of organization, design thinking provides the tools that one needs to become an innovative thinker and uncover creative opportunities. For example, companies like Procter, Gamble and GE have incorporated Design Thinking into their strategy and marketing. The course draws on methods from engineering and design, and combines them with ideas from the arts, tools from the social sciences, and insights from the business world. In this course, students start in the field, where they discover the needs of the target audience. They then iterate ideas on teams to develop a range of promising possible solutions, create rough prototypes to take back out into the field, and learn to test with real people in the target audience.

COURSE OBJECTIVE:

1. To impart knowledge on design thinking process for understanding designs.

2. To provide design skills to analyze design thinking issues and apply the tools and techniques of design.

3. To inculcate attitude to solve societal problems using design thinking tools.

COURSE OUTCOMES (CO's):

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the problems that fall under the purview of human centered design process for creative problem solving.	1,2, 9,10,12	1,2
CO2	Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques	1,2,9,10,12	2
CO3	Build simple prototypes for problems using gathered user requirements.	1,3, 9,10,12	1,2
CO4	Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.	1,4,8,9,10,12	1,2
CO5	Learn new tools, technologies and apply for suitable application development.	12	1, 2
CO6	Develop solutions to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	2, 3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					
CO2			✓			
CO3			✓			
CO4				✓		
CO5			✓			
CO6			✓	✓		

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2							2	2		2	3	2	
CO2	1	3							2	3		2		2	
CO3	2		3						3	3		2	2	3	
CO4	2			2				1	3	2		2	2	3	
CO5												2	2	2	
CO6					2				2					2	2

Note:1-Low,2-Medium,3-High

Course Content
Theory

Contents
UNIT-1
Design Thinking Process: Types of the thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking. Problem Exploration, Case Studies from Embrace-Stanford Innovation Challenge, IDEO, GE Healthcare, The Good Kitchen- Denmark Program etc, identifying the target users for the problem selected, Survey on existing solutions for the problem identified. **Empathizing:** Powerful Visualizing tool – a method to connect to the user, Creating Empathy maps – Case studies.
UNIT-2
Defining the problems: POV statements from User perspective. Idea generation: Methods to spark the innovative ideas – Brainstorming, Mind map, Story board, Provocation etc. **What is a prototype?** - Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping- Minimum Viable prototype **Prototyping for digital products:** What's unique for digital, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users.

PRACTICE:

Sl.No	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Identifying the problem that can be solved using Design Thinking approach	Observation and survey	Develop identifying human centered problems
2	Build the empathy maps for simple problems like single user	Visualization	Develop ability to understand other's emotions
3	Build the detailed empathy maps for problem identified in the teams formed	Visualization	Develop ability to understand other's emotions
4	Presentation by student teams	PPT	Develop ability to express their views
5	Obtain the insights into user's problems and make PoV statement	Understanding	Develop making problem statements from user perception
6	Presentation by student teams	PPT	Develop ability to express their views
7	Carry out Brain storming between the groups and generate as many as ideas possible	Ideation tools	Develop innovative mind set
8	Prototype for best 3 ideas selected	Sketching, simple model making etc	Develop prototyping techniques
9	Presentation by student teams	PPT	Develop ability to express their plan
10	Test the developed prototype with set of identified users	Google forms, cold calls, social media etc.	Develop understanding of various testing methods
11	Pitching final solution	PPT	Develop ability to express their views

TEXT BOOKS:

1. Gavin Ambrose, "Paul Harris, Basics Design-Design Thinking", AVA Publishing, 2010
2. Kathryn McElroy, "Prototyping for Designers: Developing the best Digital and Physical Products", O'Reilly,2017.

REFERENCE BOOKS:

1. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking – New Product Essentials from PDMA", Wiley, 2015.
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", 2012.

JOURNALS/MAGAZINES/ADDITIONAL SOURCES

1. Leonard, D., and Ray port, J. F. 1997. Spark Innovation through Empathic Design. In Harvard Business Review, November-December 1997, 102-113.
2. https://www.ideo.com
3. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
4. https://www.ibm.com/design/thinking/page/toolkit
5. https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge- by-creating-your-point-of-view-and-ask-how-might-we
6. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking
7. https://youtu.be/M66ZU2PCIcM
8. https://thisisdesignthinking.net/2017/07/innogy_energy_ecarsharing/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/109/104/109104109/
2. https://nptel.ac.in/courses/110106124/

Course Title	**Biology For Engineers**				**Course Type**		**Theory**	
Course Code	B20AS0109	**Credits**	**1**		**Class**		**I semester**	
Course Structure	**TLP**	**Credits**	**Contact Hours**	**Work Load**	**13Hrs/ Semester**		**Assessment in Weightage**	
	Theory	1	1	1				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Understanding biological systems, principles and concepts in order to create usable, tangible, economically viable product or process has become need of the hour. Hence irrespective of the parent engineering discipline, knowledge and expertise from pure and applied sciences is necessary to create product or process related to healthcare, agriculture, environmental issues and many more. Any engineer will have a high probability of using biology related skills and concepts to create products and processes beneficial to the mankind and as well for the sustainable environmental friendly approach. For example, the knowledge can be used to create medical devices, diagnostic equipment's, bioreactor designing, agriculture related equipment/instruments or anything related to surface science, fluid mechanism and polymer science. This course is designed to lay foundation in the field of Cell biology, Molecular biology and Genetics, so that anyone who is interested can design better product/process to enhance the overall quality of life.

COURSE OBJECTIVES:

1. To inculcate the basic concepts of biology from engineering perspective among students
2. To understand the interplay between biology and engineering disciplines
3. To conceptualize the engineering design/process/product for life science challenges

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand and explain the biology concepts from engineering perspective.	1	1
CO2	Apply the principles of Biology either for the process/product development from the engineering perspective.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√	√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												2	
CO2	2	2											2	1

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
Introduction to Biology, Evolution and Origin of Life, Bio molecules-Lipids, Bio molecules: Carbohydrates, Water, Bio molecules: Amino acids, Proteins, Bio molecules: Enzymes, Bio molecules: Nucleotides, Cell structure and function – Prokaryotes, Cell structure and function – Eukaryotes, Cell cycle-Mitosis and Meiosis, Mendelian genetics: Mendelian inheritance, Genetic diseases and Mendelian inheritance, Central Dogma – Replication, Transcription and Translation.

TEXTBOOKS:

1. G.K. Suraishkumar, "Biology for Engineers", Oxford University Press, 2019.
2. "Biology for Engineers:As per AICTE curriculum", Wiley publication.
3. Dr.Sohini Singh, Dr.Tanu Allen, "Biology for Engineers", Vayu Education of India.

REFERENCE BOOKS:

1. P.S.Verma and V.K. Agarwal, "Cell Biology, Genetics, Molecular Biology", Evolution and Ecology ,2018.
2. Sambamurthy, "Handbook of Genetics", Friends Publisher, 2010 .

JOURNALS/MAGAZINES

1. Current Sciences

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ge31/preview
2. Coursera: Biology everywhere

SELF-LEARNINGEXERCISES:

1. Case study: Computational biology in agriculture and Health Care
2. Artificial Intelligence in health care
3. Image processing for medical applications

PROBLEMBASEDLEARNING

No.	Case Study
1	Case study: Computational biology in agriculture and Health Care
2	Case study: Artificial Intelligence in health care

Course Title	**Computer Aided Engineering Drawing**				**Course Type**		**Integrated**	
Course Code	B20ME0101	**Credits**	**3**		**Class**		**I Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	0	-	-				
	Total	**3**	**4**	**4**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

Engineering Graphics or drawing is known as language of engineers. All phases of engineering process require the conversion of new ideas and design concepts into the basic line language of graphics. There are many areas such as civil, mechanical, electrical, architectural, computer, electronics and industrial applications where knowledge and skills of the drawing play major roles in the design and development of new products or construction. This course emphasizes on projection of point, line, surfaces and solids. It also provides knowledge about representing the object in terms of 3d view and also development of the object.

COURSE OBJECTIVE (S):

1. To introduce the students to various concepts like dimensioning, conventions and standards of engineering drawings in order to become professionally efficient
2. To enable students to learn about the software tool to prepare engineering drawings
3. To teach the students about the concepts and principles of orthographic projections, development of lateral surfaces and isometric projection of simple solids
4. To communicate the concept/idea with others through the language of technical drawing and sketching.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct the simple 2D drawings manually and also by using CAD software	1,5,10,12	1
CO2	Draw orthographic projection of point, line, plane surfaces and simple solids	1,3,5,10, 12	1
CO3	Draw sectional views of a prisms, pyramids, cone and cylinder	1,3,5,10, 12	1
CO4	Develop the lateral surfaces of the solids	1-3,5,10,	1,2,3
CO5	Create isometric view of the solids	1,3,5,10, 12	1
CO6	Develop solutions in the CAD to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	2, 3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				3					3		2	3		
CO2	3		2		3					3		2	3		
CO3	3		2		3					3		2	3		
CO4	3	2	2		3					3		3	3	3	2
CO5	3		2		3					3		3	3	2	1

CO6					2				2	2				2	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY:

CONTENTS
UNIT – 1
Introduction – Geometrical constructions, engineering drawing standards, Introduction to CAD Software. Orthographic projection of points in first and third Quadrant only. Orthographic projection of straight lines inclined to both horizontal and vertical planes. Orthographic projection of regular plane surfaces when the surface is inclined to both HP and VP.
UNIT-2
Orthographic projection of regular solids like prisms, pyramids cone and cylinder when the axis is inclined to both HP and VP.
UNIT-3
Sections of solids – Drawing sectional views and true shape of section, Development of surfaces- Parallel line method for prisms and cylinders, Radial line method for pyramids and cones.
UNIT-4
Isometric projections of simple and combined solids.

PRACTICE:

No	Practice	Tools and Techniques	Expected Skill /Ability
1.	Use of solid edge software and familiarization of tools	Solid Edge Software	Use of commands to draw the drawings
2.	Draw the projection of point locating in first and third quadrant	Solid Edge Software	Analyzing and software skill
3.	Draw the projection of lines locating in first quadrant	Solid Edge Software	Draw the views of the line and software skill
4.	Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	interpretation and software skill
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	interpretation and software skill
9	Draw the projection of section of solids in simple position	Solid Edge Software	analyzing and software skill
10	Develop the lateral surface of prisms and cylinder	Solid Edge Software	Creative and software skill
11	Develop the lateral surface of pyramids and cone	Solid Edge Software	Creative and software skill

No	Practice	Tools and Techniques	Expected Skill /Ability
12	Draw the isometric projection of simple plane surface and simple solids	Solid Edge Software	Analyzing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analyzing and software skill

TEXT BOOKS:

1. K. R. Gopala krishna, "Engineering Graphics", Subhas Publications, 2012.
2 Bhatt N.D., Panchal V.M. & Ingle P.R., "Engineering Drawing", Charotar Publishing House,2014.

REFERENCE BOOKS:

1. Luzadder and Duff, "Fundamental of Engineering Drawing", Prentice hall of India Pvt Ltd. 11thEdition, 2001.
2. Shah, M.B. & Rana B.C., "Engineering Drawing and Computer Graphics", Pearson Education,2008.

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/112/103/112103019/
2. https://www.udemy.com/course/ed/

PROBLEM BASEDLEARNING

Sl. No	Problems
1	A point 30 mm above XY line is the front view of two points A and B. The top view of A is 40 mm behind VP and the top view of B is 45 mm in front of VP. Draw the projections of the points and state the Quadrants in which the points are situated.
2	A point 'A' is 30 mm in front of VP & 40 mm above HP. Another point B is 20 mm behind VP & 35 mm below HP. The horizontal distance between the points measured parallel to XY line is 60 mm. Draw the three projections of the points. Join their front and top views.
3	A point P is on HP and 35 mm in front of VP. Another point Q is on VP and below HP. The line joining their front views makes an angle of 300 to XY line, while the line joining their top views makes an angle of 450 with XY line. Find the distance of the point Q from HP.
4	A point is 35 mm below HP, 20 mm behind VP and 25 mm behind / in front / from RPP. Draw its projections and name the side view.
5	A line AB 80 mm long is inclined to HP at 30 degree and inclined to VP at 45degree. Draw front and top views of line and determine their lengths. Also, measure the perpendicular distance of end B from both HP & VP.
6	A line AB has its end A 20 mm above the HP and 30 mm in front of VP. The other end B is 60 mm above HP and 45 mm in front of VP. The distance between end projectors is 70 mm. draw its true length and apparent inclinations.
7	The top view pq of a straight line is 70 mm and makes an angle of 60 degree with XY line. The end Q is 10 mm in front of VP and 30 mm above HP. The difference between the distances of P and Q above HP is 45 mm. draw the projections. Determine its true length and true inclinations with HP and VP.
8	The top view of a line 75 mm long measures 50 mm. The end P is 30 mm in front of VP and 15 mm above HP. The end Q is 15 mm in front of VP and above HP. Draw the projections of the line and find its true inclinations with HP and VP.

Sl. No	Problems
9	The distance between the end projectors through the end points of a line AB is 60 mm. the end A is 10 mm above HP and 15 mm in front of VP. The end B is 35 mm in front of VP. The line AB appears 70 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.
10	The point B of a line AB is on the horizontal plane, the top view of the line makes an angle of 30 degree with XY line, being 80mm. the point A is on the vertical plane and 50 mm above the horizontal plane. Draw the top and front views of the line and obtain the true length of the line. Also find the inclinations of the line with two planes.
11	The end A of a line AB is in HP and 25 mm in front of VP. The end B is 10 mm in front of VP and 50 mm above HP. The distance between the end projectors when measured parallel to the line of intersection of HP and VP is 80 mm, Draw the projection of the line AB and determine its true length and true inclination with HP and VP.
12	Find the true length and true inclination of a line AB with HP having one of its ends 20 mm in front of VP and 30 mm above the HP. The line is inclined at 40 degree to VP and left side view of the line is 60 mm long and inclined at 60degree to the x1y1 line. Draw all the three views of the line.
13	An equilateral triangular lamina of 25mm side lies with one of its edges on HP such that the surface of the lamina is inclined to HP at 60degree. The edge on which it rests is inclined to VP at 60degree. Draw its projections.
14	A 30 degree-60degree setsquare of 60mm longest side is kept such that the longest side is in HP, making an angle of 30 degree with VP. The set square itself is inclined at 450 to HP. Draw the projections of the setsquare.
15	A square lamina ABCD of 40mm side rests on corner C such that the diagonal AC appears to be at 45 degree to VP. The two sides BC and CD containing the corner C make equal inclinations with HP. The surface of the lamina makes 30 degree with HP. Draw its top and front views.
16	A mirror 30 mm x 40 mm is inclined to the wall such that its front view is a square of 30 mm side. The Longer sides of the mirror appear perpendicular to both HP and VP. Find the inclination of the mirror with the wall.
17	A pentagonal lamina of sides 25 mm is resting on one of its edges on HP with the corner opposite to that edge touching VP. This edge is parallel to VP and the corner, which touches VP, is at a height of 15 mm above HP. Draw the projections of the lamina and determines the inclinations of the lamina with HP and VP and the distance at which the parallel edge lies from VP.
18	A pentagonal lamina of sides 25 mm is having a side both on HP and VP. The corner opposite to the side on which it rests is 15 mm above HP. Draw the top and front views of the lamina.
19	Draw the top and front views of a hexagonal lamina of 30mm sides having two of its edges parallel to both vertical and horizontal planes and one of its edges is 10 mm from each of the planes of projection. The surface of the lamina is inclined at an angle of 60° to the HP.
20	A hexagonal lamina of sides 30 mm has one of its comers in VP and its surface inclined at an angle of 30° with VP. The diagonal passing through that corner which is in VP appears to be inclined at 45° to HP. Draw the projections of the lamina.
21	A hexagonal lamina of sides 25 mm rests on one of its corners on HP. The corner opposite to the corner on which it rests is 35mm above HP and the diagonal passing through the corner on which it rests is inclined at 30° to VP. Draw its projections. Find the inclination of the surface with HP.
22	Draw the projections of a circular plate of negligible thickness of 50 mm diameter resting on HP on a point A on the circumference, with its plane inclined at 45° to HP and the top view of the diameter passing through the resting point makes 60° with VP.
23	A circular lamina inclined VP appears in the front view as an ellipse of major axis 30 mm and minor axis 15 mm. The Major- axis is parallel to both HP and VP. One end of the minor axis is in both the HP and VP. Draw the projections of the lamina and determine the inclination of the lamina with the VP.
24	A square prism 35mm side of base & 60mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the prism when the axis is inclined to HP at 45°

Sl. No	Problems
25	A pentagonal prism 25mm sides of base & 60mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 40° & VP at 30°
26	A Hexagonal prism 25mm sides of base and 50mm axis length rests on HP on one of its edges. Draw the projections of the prism when the axis is inclined to HP at 45° & appears to be inclined to VP 40°.
27	A cone 40 mm diameter and 50 mm axis is resting on one generator on HP which makes 30° inclination with VP. Draw its projections.
28	A pentagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º.Draw the projections of the pyramid when the axis is inclined to HP at 45º
29	A hexagonal pyramid 30mm sides of base and axis 70mm long is resting on its base on HP with one of the edges of the base parallel to VP. It is cut by sectional plane, perpendicular to VP, inclined at 30° to HP and bisects the axis. Draw the front view, sectional top view & true shape of the section.
30	A vertical cylinder of base diameter 50 mm and axis 65 mm long rests on HP. It is cut by a section plane perpendicular to VP, inclined at 45 degree to HP and at a height of 30mm from the base. Draw its sectional top view and true shape of the section.
31	A hexagonal pyramid 30mm sides of base and axis 70mm long is resting on its base on HP with one of the edges of the base parallel to VP. It is cut by sectional plane, perpendicular to VP, inclined at 30° to HP and bisects the axis. Draw the front view, sectional top view & true shape of the section.
32	A square pyramid base 40mm side and axis 65mm long has its base on HP and all the edges of the base are equally inclined to VP. It is cut to with an inclined plane so as the truncated surface at 45 degree to axis, bisecting it. Draw the development of the truncated pyramid.
33	A Hexagonal prism of base side 30mm and axis length 60mm resting on HP in such a way that two of its edges are parallel to VP. The prism is cut by a section plane which is perpendicular to the VP and inclined at 30º to the HP at a height of 35mm from the base. Draw the development of the lateral surface of the prism.
34	A pentagonal prism, 30 mm base side & 50 mm axis is standing on HP on its base whose one side is perpendicular to VP. It is cut by a section plane 45 degree inclined to HP, through mid-point of axis. Draw FV, sectional top view& sec. Side view. Also draw true shape of section and Development of surface of remaining solid.
35	A hexagonal pyramid 25mm side of base and axis 65mm long is resting on its base on HP with one of the edged of the base parallel to VP. It is cut by a section plane inclined at 60º to HP and perpendicular to VP and intersecting the axis at 30mm above the base. Draw the development of the remaining portion of the pyramid.
36	A cone of base diameter 40 mm and height 50 mm is placed centrally on the top of a square slab side 60 mm and height 25 mm. Draw the isometric projection of the combination.
37	A sphere of diameter 45mm rests centrally over a frustum of cone of base diameter 60mm,top diameter 40mm and height 50mm.Draw its isometric projections.
38	A cube of 35 mm placed centrally on a square slab of 50 mm and thickness 30 mm. Draw the isometric projection of the combination.
39	Draw the isometric projection of the combination. Draw isometric projection of a hexagonal prism of side of base 40mm and height 60mm with a right circular cone of base 40mm as diameter and altitude 50mm, resting on its top such that the axes of both the solids are collinear.
40	A rectangular pyramid of base 40mmx25mm and height 50mm is placed centrally on a rectangular slab side 100mmx60mm and thickness 20mm.Draw the isometric projection of the combination.

PROJECT BASED LEARNING

To enhance the skill-set in the integrated course, the students are advised to execute course-based design projects.

No.	Suggested Projects
1.	Model making of different solids by using Hardbound sheet.
2.	Using Hardbound sheet, prepare the different solids models by development and section methods.
3.	Prepare a demo model to show the principle of orthographic projection.
4.	Prepare the models for showing the method of Isometric projection.
5.	Problem based on Practical approach in view of orthographic projection of lines and planes.
6.	Collection or Interpretation of Engineering Drawing sheets Related to Manufacturing, Civil construction, Layouts, Plans and other Applications.
7.	Study on Comparison of 3D views and isometric Views.
8.	Drawing the Plan of students Home or building (2D)

Detailed Syllabus
Semester 2

<table>
<tr><td>Course Title</td><td colspan="4">Probability and Statistics</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0204</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>4</td><td>4</td><td>4</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>4</td><td>4</td><td>52</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course Probability and Statistics for Computer Science treats the most common discrete and continuous distributions, showing how they find use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions. Probability in the design and analysis of randomized algorithms. Common randomized algorithms are things like Quick sort and Quick select. Probabilistic method can also useful to prove various important results. Probabilistic methods used to prove some partition theorems that were then used to create efficient data structure.

COURSE COBJECTIVE (S):

The objectives of this course are to:

1. Describe Curve fitting and regression in various problems in Computer Science & engineering fields
2. Illustrate the applications of Probability and statistics in various computer sciences engineering Fields like data mining, classification problems etc.
3. Discuss Sampling theory concepts to solve various engineering problems like structured and unstructured Data models
4. Demonstrate Stochastic problem as Markov model as a problem solving methods for systematic model buildings.
5. Learn new algorithms and methods in probability and statistics and apply for suitable problem solving methods.
6. Create solutions for problem solving methods using algorithms to the complex problems, either individually Or as a part of the team and report the results with proper analysis.

COURSEOUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Solve the problems of Curve fitting and regression in various problems in Computer Science & Engineering fields.	1-6	1,2
CO2	Apply the concepts of Probability and statistics in various computer science engineering fields like data mining, classification problems etc.	1-6	1,2
CO3	Develop a stochastic problem as Markov model as a problem solving methods for systematic model buildings.	1-6	1,2
CO4	Make use of sampling theory concepts to solve various engineering problems like structured and unstructured data models.	1-6	1,2
CO5	Learn new algorithms and methods in probability and statistics and apply for suitable problem solving methods.	1-6	1,2
CO6	Create solutions for problem solving methods using algorithms to the complex problems, either individually or as a part of the team and report the results with proper analysis.	1-5,9	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1			✓			
CO2			✓		✓	
CO3			✓			
C04			✓	✓		
C05		✓				
C06			✓			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	1							3	3
CO2	3	3	3	3	3	1							3	3
CO3	3	3	2	2	2	1							2	2
CO4	2	3	2	2	3	1							1	1
CO5	3	3	2	2	1	1							2	1
CO6	2	3	3	3	1	1							2	1

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1
Curve Fitting: Curve fitting by the method of least squares and fitting of the curves of the form, *y = ax + b, y = ax2 + bx + c, y = aebx and y = axb* Statistical Methods: Measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression, problems. Rank correlation. Applications in computer science
UNIT – 2
Probability distributions: Recap of probability theory (definition, addition rule, multiplication rule, conditional probability). Random variables, Discrete and continuous probability distributions. Binomial, Poisson, exponential and normal distributions (derivation of mean and variance for all distributions). Applications in computer science.
UNIT – 3
Joint Probability distribution: Joint Probability distribution for two discrete random variables (both discrete and continuous cases), expectation, covariance, correlation coefficient. Stochastic processes- Stochastic processes, probability vector, stochastic matrices, fixed points, regular
UNIT – 4
Sampling theory:-Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. Applications in Computer Science.

TEXTBOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. ErwinKreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.
3. Seymour Lipschutz, John J. Schiller., "Schaum's Outline of Introduction to Probability and Statistics" McGraw Hill Professional, 1998, pp. 256.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19thprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa PublishingHouse, 4th edition, 2016.
3. V.Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 2009
4. Dr. B. Krishna Gandhi, Dr. T.K.V. Iyengar, Dr. M.V.S.S.N. Prasad&S. Ranganatham."Probability and Statistics", S. Chand Publishing, 2015.
5. J. K. Sharma "Operations Research theory and applications", Macmillan publishers, fifth

JOURNALS/MAGAZINES

1. https://www.hindawi.com/journals/jps/
2. https://www.journals.elsevier.com/statistics-and-probability-letters
3. http://www.isoss.net/japs/

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/data-science/probability-and-statistics\
2. https://nptel.ac.in/courses/111/105/111105041/

SELF-LEARNINGEXERCISES:

1. Curve fitting for application problems, Regression analysis for a bivariate data.
2. Probability distribution- Geometric, gamma- distributions, Joint probability distributions of continuous random variables.

Course Title	Physics for Computer Science				Course Type		Theory	
Course Code	B20AS0106	Credits	3		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

This course introduces the basic concepts of Physics and its applications to Computer Science Engineering courses by emphasizing the concepts underlying four UNITs: Wave Mechanics, Lasers and optical fibers, EM wave and spectrum, Display Technology and Quantum computation. The subject has basic laws, expressions and theories which help to increase the scientific knowledge to analyze upcoming technologies.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart the knowledge about wave mechanics, electromagnetic waves, and its applications
2. Demonstrate the different applications of lasers, and optical fibers
3. Discuss different types of display technologies, touch screen techniques and its applications
4. Explain the importance of quantum computation as an emerging technology.
5. Learn new tools and technologies Physics and its applications to Computer Science Engineering and Apply for suitable technologies.
6. Increase the scientific knowledge to analyze upcoming technologies.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply knowledge of wave mechanics, its importance, and applications	1-4	1
CO2	Classify EM waves based on the frequency range, optical fibers and derive expression for NA, number of Modes and attenuation.	1-4	1
CO3	Summarize capacitive and resistive Display Technologies.	1-4	2
CO4	Analyze the working and application of quantum computation	1-3	1
CO5	Learn new tools and technologies Physics and its applications to Computer Science Engineering and apply for suitable technologies.	1-4	2
CO6	Increase the scientific knowledge to analyze upcoming technologies.	1-3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1			√			
CO2		√				
CO3		√				
CO4			√			
CO5		√	√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1									3		
CO2	3	3	2	1									3		
CO3	3	3	2	1										3	
CO4	3	2	1										3		
CO5	3	2	2										3		
CO6	3	2	2										3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY

Contents
UNIT-1
Wave mechanics: Introduction to Wave mechanics, De-Broglie hypothesis. Expression for de-Broglie wavelength of an electron in terms of accelerating potential. Phase velocity and group velocity, Relation between phase velocity and group velocity. Quantum Physics: Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time- dependent and independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – energy Eigen values of a free particle, Particle in one dimensional infinite potential well with numerical examples. Application-Quantum computation.

UNIT-2
Lasers: Lasers Interaction between radiation and matter (induced absorption, spontaneous and stimulated emission). Expression for energy density at thermal equilibrium in terms of Einstein's coefficients. Characteristics of laser light, Conditions for laser operation (population inversion and Meta stable state). Requisites of laser system, semiconductor laser and its applications. Electromagnetic Waves: Basic idea of displacement current, Electromagnetic waves, their characteristics, Electromagnetic spectrum (7 types of EM waves) including elementary facts. Uses of EM waves in communications.
UNIT-3
Optical fibers: Construction and light propagation mechanism in optical fibers (total internal reflection and its importance), Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Condition for wave propagation in optical fiber, V-number and Modes of propagation, Types of optical fibers, Attenuation and reasons for attenuation, Applications: Explanation of optical fiber communication using block diagram, Optical source (LED) and detector (Photodiode) and their applications. Advantages and limitations of optical communications.
UNIT-4
Display technology: Touch screen technologies: Resistive and capacitive touch screen and Displays: CRT, Field emission display, Plasma display, LED display, OLED display, LCD display. Quantum Computation: Quantum wires (one dimensional), Quantum dots (zero dimensional); the idea of "qubit" and examples of single qubit logic gates- Classical bits, Qubit as a two-level system.

TEXT BOOKS:

1. William T. Silfvast, "Laser Fundamentals", Cambridge University press, New York, 2004
2. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley and Sons, New York, 10th edition 2013
3. R. K. Gaur and S.L. Gupta, "Engineering Physics", DhanpatRai Publications (P) Ltd, New Delhi. 53rd edition, 2014.
4. M.N. Avadhanulu and P.G. Kshirsagar, "A textbook of Engineering Physics", S. Chand and Company, New Delhi, 2014.
5. EM Waves and Fields: P. Lorrain and O. Corson.

REFERENCE BOOKS:

1. CharlsKittel, "Introduction to Solid State Physics", Wiley, Delhi,8th Edition, 2004
2. Arthur Beiser, "Concepts of modern Physics", Tata McGraw Hill publications, New Delhi, 8th Edition, 2011.
3. S. O. Pillai, "Solid State Physics", New Age International publishers, New Delhi, 2010
4. Chen, Wayne Cranton, Mark Fihn, "Handbook of Visual Display Technology", Springer Publication, Second edition 2012.

JOURNALS/MAGAZINE

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/1742-6596 / 423 / 1 / 012027
4. https://ieeexplore.ieee.org/document/4160250
5. Python for scientific computing

SWAYAM/NPTEL/MOOCs:

1. https://www.mooc.org/
2. https://www.coursera.org/

Course Title	Introduction to Data Science				Course Type		Integrated	
Course Code	B20CS0101	Credits	3		Class		II semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**4**	**4**	**26**	**26**	**50%**	**50%**

COURSE OVERVIEW:

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: Set Theory, Probability theory, Tools for data science, ML algorithms and demonstration of experiments by using MS-Excel.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of Excel.
2. Illustrate the use of basic concepts of Data Science in the real world applications.
3. Demonstrate the use of SQL commands in real world applications.
4. Discuss the functional components of Data Science for real world applications

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the concepts of Data Science in developing the real world applications.	1-4,11	1,2
CO2	Apply the SQL commands in developing the real-world applications.	1,2	2, 3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1-4	1, 2, 3
C04	Create the real world AI based solutions using different machine learning algorithms	1-4	1, 2
C05	Learn new tools and technologies in Data Science and apply for suitable application development.	1-5	1,2
C06	Develop solutions in the Data Science to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation	1-3	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1			✓			
CO2			✓			
CO3			✓	✓		
C04			✓	✓	✓	✓
C05		✓	✓			
C06			✓	✓		

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2							3	3	3	3	
CO2	2	2									2	2		3	3
CO3	3	3	3	3							3	3	3	3	2
C04	3	3	3	3							3	3	3	3	
C05	3	3	3	3									3	3	
C06	3	3	3	1									3	3	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1
Introduction to Microsoft Excel Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Filters, Grouping. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.
UNIT-2
Introduction to Data Science What is Data Science? Probability theory, Bayes theorem, Bayes probability; Cartesian plane, equations of lines, graphs; exponents. **Introduction to SQL** SQL: creation, insertion, deletion, retrieval of Tables by experimental demonstrations. Import SQL Database Data
UNIT-3
Data science components Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Description of linear regression and Logistic Regression. Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression.
UNIT-4
Data visualization using scatter plots, charts, graphs, histograms and maps Statistical Analysis: Descriptive statistics- Mean, Standard Deviation for Continuous Data, Frequency, Percentage for Categorical Data **Applications of Data Science** Data science life cycle, Applications of data science with demonstration of experiments either by using Microsoft Excel.

PRACTICE:

<table>
<tr><th>No</th><th>Title of the Experiment</th><th>Tools and Techniques</th><th>Expected Skill/Ability</th></tr>
<tr><td>1</td><td>The height (in cm) of a group of fathers and sons are given below, Find the lines of regression and estimate the height of son when the height of father is 164 cm.

Plot the graph.
Hgt of Fathers: 158 166 163 165 167 170 167 172 177 181
Hgt of Sons: 163 158 167 170 160 180 170 175 172 175</td><td>MS Excel</td><td>Create and perform operations on Excel data set by applying Linear regression</td></tr>
<tr><td>2</td><td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES, perform the following:
Plot a scatter diagram.
Determine the regression equation.
Plot the regression line (hint: use MS Excel's Add Trend line feature).
Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>3</td><td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.
Plot a scatter diagram.
Determine the regression equation.
Plot the regression line (hint: use MS Excel's Add Trend line feature).
Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>4</td><td>Apply multiple linear regression to predict the stock index price which is

year | month | interest rate | unemployment rate | stock index price
2020 | 10 | 2.75 | 5.3 | 1464</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>5.</td><td>Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10, 00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for a loan availed of Rs.10, 00,000 during 3 years.

Sl No. | A | B
1 | Principal | Rs.10,00,000
2 | Annual interest rate | 5.20%
3 | Year of the loan | 3
4 | Starting payment number | 1
5 | Ending payment number | 36
6 | total interest paid during period | ?</td><td>MS Excel</td><td>Create Excel data and perform EMI estimator</td></tr>
</table>

6	Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO, should not be NULL.	SQL	Creating Tables
7	Create the customer database of a big Market with CUSTOMER_ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_CODE. Store at least twenty customer's details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.	SQL	Creating and retrieving Tables
8	Apply linear regression to find the weather (temperature) of a city with the amount of rain in centimeters. Create your own database with following details. CITY Temperature in Centigrade Rain in Centimeters	MS Excel	Apply Linear regression
9	Use the linear regression technique to compare the age of humans with the amount of sleep in hours. Name Age in Years Sleep in hours Create your own database with above details.	MS Excel	Apply Linear regression
10	Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/ recorded in the matches. Assume your own database.	MS Excel	Apply Linear regression
11	Design the ER diagram and create schema of the REVA library management system.	Entity Relationship	Entity Relationship
12	Design the ER diagram and create schema for Hospital Management system.	Entity Relationship	Schema design

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Ramakrishnan and Gehrke, "Database Management systems", Third Edition, McGraw HillPublications,2003.
3. Mastering Data Analysis in Excel - https://www.coursera.org/learn/analytics-excel.
4. Kenneth N. Berk, Carey, "Data Analysis with Microsoft Excel", S. Chand & Company, 2004.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th edition, 2013.
2. ErwinKreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.
3. Seymour Lipschutz, John J. Schiller, "Schaum's Outline of Introduction to Probability and Statistics",McGraw
4. Hill Professional, 1998.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
2. https://www.springer.com/journal/41060- International Journal on Data Science and Analytics
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253-IEEE Magazine on Big data &Analytics

SWAYAM/NPTEL/MOOCs:

1. Excel Skills for Business: Essentials, Macquarie University (https://www.coursera.org/learn/excel-
2. Essentials)
3. SQL for Data Science, University of California, Davis (https://www.coursera.org/learn/sql-for-data-
4. science)
5. Data Science Math Skills, Duke University (https://www.coursera.org/learn/datasciencemathskills)
6. https://www.edx.org/course/subject/data-science
7. https://onlinecourses.nptel.ac.in/noc19_cs60/preview

SELF-LEARNINGEXERCISES:

1. Relational database management system.
2. Advanced MS-Excel

Course Title	Basics of Civil and Mechanical Engineering				Course Type		Integrated	
Course Code	B20CE0201	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

This course introduces the Mechanical and Civil Engineering concepts, underlying the fact that this knowledge is essential for all Engineers. The students are made to understand the concept of internal combustion engines and power transmission systems. The students are also exposed to the knowledge of mechanical machine tools with its operations on lathe, drilling, and CNC machines. The students are introduced to the domain of fabrication processes like Soldering, Welding and 3D printing technology. Along with this student are made to expose to scope of Civil engineering, role of civil engineers in different infrastructure & economic development of the country. Students will learn about basic concept of forces, friction, centroid and moment of inertia.

COURSE OBJECTIVE

This course enables graduating students

1. To develop the basic knowledge of IC engines, refrigeration-air conditioning and power
2. Transmission systems.
3. To incorporate the concepts of manufacturing processes using different machine tools, welding
4. Techniques, CNC and 3D printing technology.
5. To understand a broad concept of engineering mechanics.
6. To develop the basics of composition of coplanar forces and fluid mechanics
7. Learn concept of internal combustion engines and power transmission systems
8. Introduction to the domain of fabrication processes like Soldering, Welding and 3D printing technology.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the fundamentals of IC engines, refrigeration-air conditioning and power transmission systems.	1,2	3
CO2	Explain the manufacturing processes using lathe, drilling, welding, CNC machines and 3D printing technology	1,2	3
CO3	Describe the moment of force and couples and equivalent force-couple system.	1,2	3
CO4	Solve numerical problems on composition of coplanar concurrent and non-concurrent force system and basics of fluid mechanics	1,2	3
CO5	Learn concept of internal combustion engines and power transmission systems	1,2	1
CO6	Introduction to the domain of fabrication processes like Soldering, Welding and 3D printing technology.	1,5	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3	✓	✓	✓	✓	✓	
C04	✓	✓	✓			
C05		✓				
C06		✓				

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2													1
CO2	3	2													1
CO3	3	2													1
C04	3	2													1
C05	3	2													1
C06	3	2													1

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1
Introduction to Mechanical Engineering: Overview of Mechanical Engineering, Importance and applications of Mechanical Engineering in different fields. Thermal Energy Systems: Introduction to IC Engines, Classification, parts of IC Engine, working of 4-stroke Petrol engine with PV-diagram. Simple numerical on calculation of IP, BP and Mechanical efficiency, Introduction to refrigeration system, working of vapour compression refrigeration and window spit air conditioning system. Applications of refrigeration systems

UNIT-2

Power Transmission System: Introduction to drives, classification, belt drives (open and crossed-No derivations) and gear drives and types of gear, Numerical on gear drives.

Mechanical Machine Tools: Introduction- lathe, classification, major parts of engine lathe, operations, Drilling machine, classification working bench drilling machine and operations, CNC Machines-Block diagram and applications. Introduction to 3D Printing technology

Joining processes-Welding: Working of electric arc welding and soldering, Differences between welding and

UNIT-3

Introduction to Civil Engineering: Scope of Civil Engineering, Types of Infrastructure, Effect of Infrastructure facilities, Role of Civil Engineers in the Infrastructure and Economic Development of Country.

Introduction to Engineering Mechanics: Basic concepts, Newton laws of Motion Elements of force, system of forces, principles of physical Independence, superposition and Transmissibility of forces. Moment of force –Couple, Moment of couple and its characteristics, Equivalent Force – Couple system. Resolution and composition of forces.

Coplanar Concurrent Force System: Parallelogram Law of forces, principle of resolved parts, composition of

UNIT-4

Coplanar Non – concurrent forces: Varignon's principle of Moments, Resultant of Non – Concurrent force systems, Equilibrium of Coplanar Concurrent Force System: Type's forces acting on the body, free body diagrams, Equations of Equilibrium, Lami's theorem, Equilibrium of Non – concurrent forces equilibrium equations

Friction: Frictional forces, Law of friction, Angle of friction, Angle of Repose and Cone of Friction (Theory only)

Centroid: Center of Gravity, Center of Gravity of Flat Plate, Centroid, difference between Center of gravity and Centroid, Uses of Axis Symmetry, simple problems

Moment of Inertia: Moment of Inertia of Plane Figure, Polar Moment of Inertia and Moment of Inertia of Standard sections (Derivations not included). Simple problems.

Fluid Mechanics: Introduction, methods of describing fluid motion, definitions of types of fluid flow, streamline, path line, stream tube. General Continuity equation (problems).

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Dismantling and Assembly of 2-Wheeler (2–stroke) Engine	2-Stroke Engine (TVS Bike)	Hands on Experience
2	Study of Fitting tools and preparation of fitting model (1 Model)	Fitting tools	Hands on experience
3.	Study of sheet metal tools and development of Cylinder (1 Model)	Sheet metal tools and soldering tools	Hands on experience
4.	Study of sheet metal tools and development of Pen stand and funnel (2-Models)	Sheet metal tools and soldering tools	Creative Thinking
5.	Hands on training on basic welding joint (Butt Joint-1 Model)	Welding tools	Hands on experience
6.	To study the carpentry tools with one model (Half joint-Model)	Carpentry Tools (Marking, Sawing, Planning and Chiseling	Comprehend the different handling carpentry tools
7.	To study the carpentry tools with one model (Dovetail-Model)	Carpentry Tools (Marking, Sawing, Planning and Chiseling	Comprehend the different handling carpentry tools
8.	To study the carpentry tools with one model (T-Joint - Model)	Carpentry Tools (Marking, Sawing, Planning and Chiseling	Comprehend the different handling carpentry tools
9.	To Study the plumbing tools and to make threads on pipe and pipe fittings using plumbing tools	Plumbing Tools	Comprehend the different handling plumbing tools
10.	To Study the plumbing tools used for valves and sanitary fitting	Plumbing Tools	Comprehend the different handling plumbing tools

TEXTBOOKS:

1. K.R. Gopalkrishna ,“Elements of Mechanical Engineering”, 12th Edition, Subhash Publishers, Bengaluru, 2012.
2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, Mumbai, 2000.
3. Mikell P Groover : Automation, Production Systems, and Computer Integrated Manufacturing , Pearson India, 2007, 4th Edition

REFERENCE BOOKS:

1. SKH Chowdhary, AKH Chowdhary, Nirjhar Roy,”The Elements of Workshop Technology Vol I & II, 11th edition, Media Promotors and publisher, Mumbai, 2001.
2. AvikshitSaras, “3D Printing-Made Simple”, BPB Publications-New Delhi.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. International Journal of Refrigeration.

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/103/112103262/#
2. https://www.my-mooc.com/en/mooc/fundamentals-manufacturing-processes-mitx-2008x/
3. https://www.coursera.org/learn/3d-printing-applications

Course Title	Programming for Problem Solving				Course Type		Integrated	
Course Code	B20CS0102	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50%**	**50%**

COURSE OVERVIEW:

Algorithms and flowcharts are the fundamental tools for problem solving which can be used by the computers. The computer programs can be developed using algorithms and flowcharts to provide solutions to problems. C Language is a general-purpose, structured and procedure oriented programming language. It is one of the most popular computer languages today because of its structure and higher-level abstraction C. This course introduces algorithms, flowcharts and various C Programming language constructs for the development of real world applications.

COURSE OBJECTIVE (S):

1. Explain algorithms, flowcharts and different programming constructs of C to be used for Development of applications.
2. Illustrate the use of iterative statements and conditional Statements for solving the real world problems.
3. Demonstrate the use of functions with parameter passing mechanisms for solving the real world problems.
4. Discuss the use of structures, unions, pointers and file operations for solving the real world Problems.
5. Learn new algorithms and technologies in C Programming and apply for suitable application development.
6. Develop solutions by using C Programming to the complex problems, either individually or as a part of team and report the results.

COURSE OUTCOMES (COs)

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the programming constructs of C language to solve a given problem.	1-6	1
CO2	Apply the concepts of matrices to develop data processing and analysis solutions in various application domains.	1-5	1
CO3	Develop text processing based applications using string operations.	1-5	2,3
CO4	Create solutions for real world problems using Pointers, Union, Structures and file operations.	1-5	2,3
CO5	Learn new algorithms and technologies in C Programming and apply for suitable application development	1-5	2,3
CO6	Develop solutions by using C Programming to the complex problems, either individually or as a part of the team and report the results	1-5,9	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				✓		
CO2			✓			
CO3			✓			
CO4						✓
CO5		✓	✓			
CO6						✓

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	2	1							3		
CO2	1	3	2	2	1								3		
CO3	2	2	2	2	1									3	3
CO4	3	3	3	1	1									3	3
CO5	3	3	3	2	2	1									
CO6	3	3	3	2	2	2							3	3	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1
Algorithm: Definition, Purpose of writing an algorithm, Rules for writing an algorithm, Advantage of writing algorithm and examples. Flowchart: Definition, Notations used to write a flow chart, Advantage and disadvantages of writing the flowchart and examples. Introduction to "C": Introduction to GitHub, Structure of C program with example, C language & its features, C tokens, data types in C, variables, constants, input and output functions
UNIT-2
Operators and Expressions: Unary operator, assignment operator, arithmetic operator, relational operators, logical operators &bitwise operator, conditional operator, increment and decrement operator, special operator. Conditional Statements: if statement, if-else statement, nested if, switch statement. Unconditional Statements: break and continue statement, goto statement, return statement Iterative Statements (loops): while loop, do-while, for loop, differences between while, do-while and for loop.
UNIT-3
Arrays: one dimensional array, two dimensional array, Linear and binary search and bubble sorting. Functions: Structure of a function, types of functions, parameter passing mechanisms, Command line arguments. Strings: string operations with and without using inbuilt string functions.
UNIT-4
Structures & Union: Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, union, typedef. Pointers: Introduction to pointers. File Operations: Formatted Input & Output, Character Input and Output Functions, Direct Input and Output Functions, File Positioning Functions, Error Functions

PRACTICE:

PART A:			
No	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill /Ability**
1	Consider Loan applications in a bank consisting of various customer details such as Name, Organization, salary and loan amount applied. Segregate the loan applications based on income (low: <=5 lpa, medium: >5lpa <10lpa and high:>10lpa)	Condition checking	Apply if-else and switch
	Two files DATA1 and DATA2 contain sorted lists of integers. Write a C program to merge the contents of two files into a third file DATA i.e., the contents of the first file followed by those of the second are placed in the third file. Display the contents of DATA.	Files operations	Apply File concepts
2	Statistical measures are used for data analysis and interpretation. Develop program to determine the mean and stand deviation of data stored in an array.	Statistical Computing	Use Array and loops
	Consider the details of Airline passengers such as Name, PAN-No., Mobile-no, Email-id, Source, Destination, Seat-No and Air-Fare. Develop a program to read the details of airline passengers, store them in the structure "Airline" and List details of all the passengers who travelled From "Bengaluru to London".	Search technique	Apply Structures

3	Assume that Mr. Peterson shopped N items at Big Market and his Cart comprises of name of the item, cost of the item per UNIT and quantity. Read the details of shopping and store them in the structure "Shop". Compute the total amount spent on shopping at Big Market and also find out the item with minimum and maximum cost.	Statistical measure	Apply Structure and if then else
	b. Write a C program to define a structure named Student with name and DOB, where DOB in turn is a structure with day, month and year. Read the details of student and store them in the structure "Student". Display name and date of birth of students using the concept of nested structures.	Nested Structures	Apply Nested Structures
4	Consider a set of N students with SRN, name, and marks scored in 8 subjects. Read the details of students and store them in the structure "Student_Marks". Compute total marks and average marks of each student and display them with suitable headings.	Average computation and visualization	Apply Structure, Array and Loops
	b. Create the structure "Book" with book_id, title, author_name and price. Write a C program to pass a structure as a function argument and print the book details.	Functions	Passing structures to function
5	Assume that Ms. Jassica shopped N items at Amazon and the Cart comprises of name of the item, cost of the item per UNIT and quantity. Arrange the items in the increasing order of cost of the item per UNIT.	Sorting	Apply sorting the contents of structure.
	Write a C program to compute the monthly pay of "N" employees using each employee's name, Basic_Pay, DA and HRA. The DA and HRA are 80% and 30% of the Basic_Pay respectively. Gross-salary is computed by adding DA and HRA to Basic_Pay. Store all the details in an array of structures and print the name and gross salary of each employee.	Reading and storing data	Use structures for reading and storing data
6	a. Consider the details of "N" Faculty members consisting of Name, EMP-ID,name of the school, address and salary. Create a file to store the above details. Retrieve the contents of the file to perform following operations: (i) Display the details of the faculty based on salary range entered. (ii) Display the details of the faculty based on the EMP-ID entered.	File operations	Create file, store data and display details.
	b. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if else and switch case.	String operations	Apply string functions

PART B:			
	Project 1: Address Contact List with the following modules: User Add User(Name, Address, Primary contact number, secondary contact number, E-mail ID) Delete User Search for User Edit Find and replace the user name Edit the contact (Phone Number) details. Edit the Address of the user Report List of users based on the starting letter of their names. List of users based on first 2 digits of their mobile number. List of users based on the domain name of their E-mail ID.		
1	Develop a program in C to create the structure "Contact" with the fields, user_name, address, mobile, phone1 and email_id. Read the data into the structure "Contact" and store them in the file "Contact.txt".	Structures and Files	Develop the program using Structures and Files
2	Develop a program in C to open contact list from the file "Contact.txt" in read mode and delete contact details of the person based on name of the person by searching his/her details. Display the updated list.	String, File and Linear Search	Develop the program using String and File
3	Develop a program in C to input the string,"Str1"(which can be either a mobile no. or name of the user) and search for it in the file , "Contact.txt" and display the details if it is found else display an error.	String, File and Linear Search	Develop the program using String and File
4	Develop a program in C to input the name of the user into the string, "Str1" , search for it in the file "Contact.txt" and replace the content of "Str1" with the new data if found.	String, File and Linear Search	Develop the program using String, File and apply linear search
5	Develop a program in C to input the phone number of user into the string, "Str1", search for it in the file "Contact.txt" and edit it with new data if found and save the same.	String, File and Linear Search	Develop the program using String, File and apply linear search
6	Develop a program in C to input the address of the user and search for the same in the file, "Contact.txt" and edit the address with new address and save the same.	String, File and Linear Search	Develop the program using String, File and apply linear search
7	Develop a program in C to input a letter into "Letter", compare it with the details stored in "Contact.txt" and then display the list of the users whose name begin with "Letter ".	File operations	Develop the program using file
8	Develop a program in C to input first two digits of a mobile number into "Mobile", search for the same in "Contact.txt" and display the details of all the users whose mobile number begin with "Mobile".	File operations	Develop the program using file
9	Develop a program in C to input a domain name of email-id and search for the same in the file, "contact.txt" and list the details of the users whose email-id matches with the given domain name.	File operations	Develop the program using file

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, PRENTICE HALL
2. SOFTWARE SERIES, 2005.
3. Herbert Schildt, "C: The Complete Reference", 4th edition, TATA McGraw Hill, 2000.
4. B.S. Anami, S.A. Angadi and S. S. Manvi, "Computer Concepts and C Programming: A
5. Holistic Approach", second edition, PHI,2008.

REFERENCE BOOKS:

1. Balaguruswamy," Programming in ANSI C", 4th edition, TATA MCGRAW Hill, 2008.
2. Donald Hearn, Pauline Baker," Computer Graphics C Version", second edition, Pearson Education, 2004.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6294 (IEEE Journal/Magazine on IT Professional)
2. https://ieeexplore.ieee.org/document/1267572 (IEEE Computing in Science and Engineering)

SWAYAM/NPTEL/MOOCs:

1. https://online courses.nptel.ac.in/noc20_cs06/preview (Problem Solving through Programming in C)
2. https://www.edx.org/course/c-programming-getting-started (C Programming Getting started)
3. https://www.coursera.org/specializations/c-programming (Introduction to C programming)

SELF-LEARNINGEXERCISES

1. **Fundamentals of computer graphics**: output primitives–Line, Circle and Ellipse drawing algorithms- Attributes of output primitives.
2. **Inline Assembly Language Program:** Simple inline assembly, Extended Assembly Syntax Microsoft C Compiler.

Course Title	IoT and Applications				Course Type		Integrated	
Course Code	B20EC0101	Credits	2		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**2**	**3**	**3**	**13**	**26**	**30%**	**30%**

COURSE OVERVIEW

The Internet of Things (*IoT)* expands access to the world-wide web from computers, smart phones, and other typical devices to create a vast network of appliances, toys, apparel, and other goods that are capable of connecting to the Internet. This introductory course focuses on IoT architecture, its domains and communication protocols. The course is supported with hands on sessions that incorporates different types sensors interfaced with IoT board to build IoT projects to solve real time problems. The case study of deployment of IoT in various applications are provided.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Explain the architecture of Internet of Things.
2. Inculcate knowledge of IoT devices, Sensors and Communication Protocols in various application domains.
3. Gain expertise in interface of various sensors to IoT Boards.
4. Discuss the various applications of IoT.
5. Learn new technologies in the IoT and apply for suitable application development.
6. Develop simple IoT projects and modules.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the architecture of IoT eco-system	1	1,2
CO2	Identify IoT devices, architecture, sensors and Communication protocols	1	1,2
CO3	Demonstrate the interface of sensors to IoT board	1,5, 12	1,2
CO4	Realize various Applications of IoT through case studies	1,5, 12	1,2
CO5	Learn new technologies in the IoT and apply for suitable application development.	1,5,9, 12	1,2
CO6	Develop simple IoT projects and modules	1,5,6,9, 12	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2		√				
CO3			√			
CO4				√	√	
CO5			√			√
CO6						√

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3												3	3	
CO3	3				3							3	2	2	
CO4	3				3							3	1	1	
CO5	3		2		3				2				1	1	1
CO6	3				3				2			3	3	3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-I
IoT Basics: Introduction to IoT, How does Internet of Things Works, Features of IoT, Advantages and Disadvantages of IoT, Embedded Devices in IoT, IoT eco-system **IoT Architecture and IoT Devices**: Components of IoT architecture, Stages of IoT solution architecture, Smart Objects, IoT Devices.
UNIT-II
IoT boards in Market: Arduino, Arduino UNO, ESP8266, Raspberry Pi **IoT Platform:** Amazon Web Services (AWS) IoT platform, Microsoft Azure IoT platform, Google Cloud Platform IoT, IBM Watson IoT platform, Thing Work IoT platform Technologies Used in IoT: Bluetooth, Wi-Fi, Li-Fi, RFID, Cellular, Z-Wave

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Introduction to IoT Board	Hardware	Identifications of various parts of Arduino and Node MCU boards Study of Ethernet shield and connection to the board
	Arduino UNO		
	Arduino Nano		
	Node MCU		
	Ethernet Shield		
2.	Working with Arduino IDE (Integrated Development Environment)	Open source Arduino IDE	Download specified software Modify code as per the application
3.	a) Demonstration of Multi meter usage	Multi meter Breadboard Resistor packs	Measurement of voltage at various points in IoT boards Choose the value of Resistor for an application
	b) Demonstration of Breadboard connection for Voltage, Ground, series and parallel connections		
	c) Exercise to read the value of resistor using Color code chart		
4	Reading photo resistor sensor value connected to Arduino Board	Arduino UNO Arduino IDE LDR, Multi meter, Resistor	Interface of photo sensor to IoT board for light measurement applications
5	Reading temperature sensor value connected to Arduino Board	Arduino UNO, Arduino IDE, Temperature sensor, Multi meter	Interface of Temperature sensor to IoT board for temperature measurement application
6.	Reading motion detector sensor value connected to IoT board	Arduino UNO, ArduinoIDE, pyro-dielectric sensor,	Interface of Motion detector sensor to IoT board for motion detection applications
7	Reading distance measurement using Ultrasonic sensor Connected to IoT board	Arduino UNO, Arduino IDE, Ultrasonic sensor, Multi meter	Interface of Motion detector sensor to IoT board for motion detection
8	Interface relay to IoT board	Arduino UNO, Arduino IDE, relay Multi meter	Interface relay to IoT board for Switching applications
9	Connect Wifi-ESP8266 to Arduino UNO board , Send and receive data through smart phone.	Arduino UNO ESP8266, Arduino IDE Smart phone	Connect IoT board to Wifi network
9	Mini Projects Arduino Controlled Light intensity Thermometer Motion activated light lamp Touchless motion sensor trash can		

TEXTBOOK:

1. Vijay Madisetti, ArshdeepBahga," Internet of Things: A Hands-On- Approach", ISBN: 978 0996025515,2014.

REFERENCEBOOKS:

1. Raj Kamal," Internet of Things: Architecture & design Principle", McGraw Hill Education,2017.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/learn/iot
2. https://www.coursera.org/learn/interface-with-arduino

SELF-LEARNINGEXERCISES:

a) Create Arduino project hub

Course Title	ENTREPRENEURSHIP				Course Type		Theory	
Course Code	B20ME0104	Credits	1		Class		II semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Course Description: This is an *introductory course* is designed to provide the foundational concepts of *entrepreneurship*, including the definition of *entrepreneurship*, the profile of the *entrepreneur*, and the role of venture creation in society. The course also provides a bird's eye view on the steps to start a venture, financing, marketing as well as support by various institutions towards entrepreneurship.

COURSE OBJECTIVE

1. To understand the basic terms, concepts in Entrepreneurship Development
2. To apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand and explain the key terms, definitions, and concepts used in Entrepreneurship Development	1	1
CO2	Plan a startup and understand sources available for finance and the supporting schemes offered by state and central governments and other entrepreneurial development organizations	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√	√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2											2	1	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

Contents
UNIT-1 **INTRODUCTION TO ENTREPRENEURSHIP** Evolution of term 'Entrepreneurship', Factors influencing entrepreneurship', Psychological factors, Social factors, Economic factors, Environmental factors. Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc., Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving
UNIT-2 **INSTITUTIONAL SUPPORT FOR ENTREPRENEURSHIP** Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) licence, Environmental Clearance, National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs

TEXTBOOKS:

1. K. Ramachandran," Entrepreneurship Development", Tata Mc. Graw Hill, 2008.
2. Sangeeta Sharma, "Entrepreneurship Development", PHI Publications, 2016.

REFERENCE BOOKS:

1. Baringer and Ireland, "Entrepreneurship", 11th Edition, Pearson,2020.
2. P. Narayana Reddy, "Entrepreneurship – Text and Cases", Cengage Learning India, Iedition,2010
3. Paul Burns," Corporate Entrepreneurship: Building The Entrepreneurial Organization", Palgrave Macmillan.
4. Drucker F Peter,:"Innovation and Entrepreneurship", 1985.Heinemann,London.
5. Doanld F Kuratko & Richard M ,"Entrepreneurship in the New Millennium", India Edition.

JOURNALS/MAGAZINES

1. International Small Business Journal: https://journals.sagepub.com/home/isb
2. Journal of Development Entrepreneurship: https://www.worldscientific.com/worldscinet/jde

SWAYAM/NPTEL/MOOCs:

1. Entrepreneurship: https://nptel.ac.in/courses/110/106/110106141/

SELF-LEARNINGEXERCISES:

1. Introverts participate. If you have a few vocal students asking questions and little participation from others, anonymous questions lower student anxiety, which makes it easier for everyone to participate.
2. You learn what students are thinking about. Anonymity provides cover for students to ask questions they may be too afraid to ask but are curious about.
3. Discussions start. Anonymity means you can invite students to pose "challenging" questions. If you encourage your students to question what they're learning, why it's important, or why they should have to do the work you're assigning, you spark discussions about how entrepreneurship is relevant, which can often be the key to increasing engagement.

PROBLEMBASEDLEARNING

No.	
1	How to write a Business Plan
2	Creating Marketing, Financial and Organizational Plans.
3	How to apply for financial assistance via various schemes
4	How to file taxes as a Small Business and understand the importance of GST

Detailed Syllabus
Semester -3

<table>
<tr><td>Course Title</td><td colspan="4">Analog and Digital Electronics</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20CI0301</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This course covers basic concepts of Electrical Engineering. The course introduces the working of analog components and helps in understanding basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes and op amps. The course provides foundation on designing and implementation of logic circuits. Analog circuits are simulated using ORCAD tool and digital circuits using XILINX tool which helps in gaining experience in creating and testing of circuits.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
2. Describe the foundation on designing, building and testing of common combinational and sequential Digital logic circuits.
3. Explain the procedure required for simulation of digital logic circuits.
4. Analyze the working principle and designing of analog circuits using ORCAD tool
5. Analyze the working principle and designing of digial circuits using XILINIX tool
6. Demonstrate the use of general electronic instruments in design and testing of digital logic circuits.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the use of diodes in rectifiers, filter circuits and wave shaping	1 to 4	1
CO2	Apply the basic knowledge used in solid state electronics including diodes, and operational amplifiers for specific engineering applications.	1 to 3, 5	1
CO3	Identify the different families of digital integrated circuits build, and troubleshoot combinatorial circuits using digital integrated circuits	1 to 5	2
CO4	Analyze the working principle and designing of analog circuits using ORCAD tool	1 to 4	1
CO5	Analyze the working principle and designing of digital circuits using XILINIX tool	1 to 4	1
CO6	Develop the ability to analyze and design analog electronic circuits using discrete components	1,4,5	3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				√		
CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2									3		
CO2	3	2	3		2								3		
CO3	3	1	2	1	2									3	
CO4	3	1	1	2									3		
CO5	3	1	1	2									3		
CO6	3			2	2										3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Limiters and Oscillators: Clipping and clamping circuits using diodes, Oscillator operation, Phase shift Oscillator, Wien bridge Oscillator, Tuned Oscillator circuits, Crystal Oscillator. (BJT Version Only) Simple design methods of Oscillators.

UNIT- 2

Operational Amplifiers: Ideal Opamp versus Practical Opamp, Performance Parameters, Some Applications: Peak Detector Circuit, Absolute Value Circuit, Comparator, Active Filters-First order LPF and HPF, Phase Shifters, Instrumentation Amplifier, Non-Linear Amplifier-Log and antilog amplifier.

UNIT – 3

Principle and Minimization Techniques of combinational Circuits: Introduction to combinational logic, Minimization Techniques: Min term, Max term, Sum of Products (SOP), Product of Sums (POS), 3 and 4 Variable Karnaugh map.

UNIT – 4

Analysis of Combinational and sequential Circuits: Half adder, full Adder, Half Subtractor, full Subtractor, multiplexers and De multiplexers.

Introduction to Sequential circuits: flip-flops: SR, JK, D, T Characteristic tables and equations; Application of Shift register (Ring Counter and Johnson counter) .

TEXT BOOKS:

1. Anil K Maini, Varsha Agarwal," Electronic Devices and Circuits", Wiley, 2009.
2. Jacob Millman, Christos Halkias, Chetan D Parikh," Millman's Integrated Electronics – Analog and Digital Circuits and Systems", 2nd Edition, Tata McGraw Hill, 2010.
3. Donald P Leach, Albert Paul Malvino&GoutamSaha," Digital Principles and Applications", 7th Edition, Tata McGraw Hill, 2010.

REFERENCE BOOKS:

1. Stephen Brown, ZvonkoVranesic," Fundamentals of Digital Logic Design with VHDL", 2nd Edition, Tata McGrawHill, 2005.
2. R D Sudhaker Samuel, "Illustrative Approach to Logic Design", Sanguine-Pearson, 2010.
3. Charles H. Roth," Fundamentals of Logic Design", Jr., 5th Edition, Cengage Learning, 2004.
4. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss," Digital Systems Principles and Applications", 10th Edition, Pearson Education, 2007.
5. M Morris Mano," Digital Logic and Computer Design", 10th Edition, Pearson Education, 2008.
6. Jacob Millman, Christos Halkias, "Analog and Digital Circuits and Systems", 2nd Edition, Tata McGraw Hill, 2010
7. R. D. Sudhaker Samuel," Electronic Circuits", Sanguine-Pearson, 2010

JOURNALS/MAGAZINES

1. https://ieeexplore.ieee.org/document/1085417
2. https://www.academia.edu/Documents/in/Digital_Electronics
3. https://www.mdpi.com/journal/electronics/special_issues/circuit_machine_learning

SWAYAM/NPTEL/MOOCs:

1. https://technobyte.org/digital-electronics-logic-design-course-engineering/
2. https://www.udemy.com/course/digital-electronics-logic-design/

Course Title	Programming with JAVA				Course Type		Theory	
Course Code	B20CI0302	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

Java's unique architecture enables programers to develop a single application that can run across multiple platforms seamlessly and reliably. In this course, students gain extensive experience with Java, object-oriented features and advance Java programming skills. Students learn to create robust object-oriented applications with Java.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic data types and control structures of the Java language.
2. Illustrate the creation of classes and objects in Java.
3. Demonstrate the extending a class (inheritance) and use proper program anomaly handling structures.
4. Discuss the use of Java generics and collections.
5. Discuss object-oriented features and advance Java programming skills
6. Explain to create robust object-oriented applications with Java.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of array concepts in java to solve real world problems.	1 to 5	1
CO2	Apply the features of OOPS in java to solve the real-world problems.	1 to 5	1
CO3	Develop program for stack implementation using Exception Handling in java.	1 to 5	2, 3
CO4	Identify suitable data structures to solve real world applications.	1 to 5, 12	2
CO5	Discuss object-oriented features and advance Java programming skills	1 to 5	1
CO6	Explain to create robust object-oriented applications with Java.	1 to 5, 12	2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√	√		
CO4			√			
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1								3		
CO2	3	3	2	2	1								3		
CO3	3	3	1	1	1									3	3
CO4	3	3	3	1	2							1		3	
CO5	3	3	3	1	2								3		
CO6	3	3	2	2	2									3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Fundamental Programming Structures: Dissecting the "Hello, World" Program; Compiling and Running a Java Program; Primitive Types; Variables; Arithmetic Operations; Strings; Input and Output; Control Flow; Arrays; Functional Decomposition.

UNIT – 2

Object-Oriented Programming: Working with Objects; Implementing Classes; Object Construction; Static Variables and Methods, Packages; Nested Classes; Documentation Comments; Interfaces; Static, Default and Private Methods in interface; Lambda Expressions; Method and Constructor References; Local and Anonymous Classes.

UNIT – 3

Inheritance and Exceptions: Extending a Class; Object: The Cosmic Super class; Enumerations; Runtime Type Information and Resources; Exception Handling: Throwing Exceptions; The Exception Hierarchy; Declaring Checked Exceptions; Catching Exceptions; the Try-with-Resources Statement; The finally Clause; Re throwing and Chaining Exceptions; Uncaught Exceptions and the Stack Trace.

UNIT – 4

Generic Programming and Collections: Generic Classes; Generic Methods; Type Bounds; Type Variance and Wildcards; Restrictions on Generics; an Overview of the Collections Framework; Iterators; Sets; Maps.

TEXT BOOKS:

1. Cay S. Horstmann," Core Java® SE 9 for the Impatient", Addison Wesley, Second Edition, 2018.
2. HerbertSchild," Java™: TheCompleteReference",McGraw-Hill,TenthEdition,2018.
3. David Gallardo, Ed Burnette, Robert Mcgovern," Eclipse in Action a guide for java developers", Manning Publications,2003.
4. Ed Burnette;" Eclipse IDE Pocket Guide: Using the Full-Featured IDE", O'Reilly Media, Inc, USA,2005.

REFERENCE BOOKS:

1. Cay S. Horstmann," Core Java™ Volume I—Fundamentals", Prentice Hall, Tenth Edition, 2015
2. Joshua Bloch," Effective Java",Addison-WesleyProfessional, ThirdEdition,2017
3. Ken Kousen, " Modern Java Recipes", O'Reilly Media, Inc.,2017
4. Oracle Java Documentation. (https://docs.oracle.com/javase/tutorial/)

JOURNALS/MAGAZINES

1. https://ieeexplore.ieee.org/document/5464387
2. https://files.eric.ed.gov/fulltext/EJ1075126.pdf
3. https://www.sciencedirect.com/science/article/pii/S0167642304000590
4. https://www.informingscience.org/Publications/4322?Source=%2FJournals%2FJITEIIP%2FArticles%3FVolume%3D0-0
5. https://www.javadevjournal.com/
6. https://blogs.oracle.com/javamagazine/

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. https://www.classcentral.com/course/swayam-programming-in-java-12930
3. https://swayam.gov.in/explorer?searchText=java

Self-Learning Exercises:

1. The Eclipse-IDE
2. Streams
3. Concurrent Programming
4. Swing and JavaFX
5. Networking- JDBC, Database Access

Course Title	Data Structures				Course Type		Theory	
Course Code	B20CI0303	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

The course focuses on basic and essential topics in data structures, including array-based lists, linked lists, recursion, stack, queues, and binary trees, heaps, sorting and searching algorithms. It also covers analysis and design of fundamental data structures and engages learners to use data structures as tools to algorithmically design efficient computer programs that will cope with the complexity of actual applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the concept of Abstract Data Types (ADT)
2. Provide the knowledge of stacks and queues.
3. Understand the importance of Linked lists
4. Illustrate the operations of trees
5. Demonstrate the use of appropriate of data structures for a given problem.
6. Design a data structure application for real time problems.

COURSE OUTCOMES (COs)

After thecompletion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the Abstract Data Types, Structures.	1,3, 5,10,11	1
CO2	Formulate the solution for any computational problem using stacks and queues.	3,8	1,2
CO3	Analyze the importance of linked lists.	5,7,9	1,2
CO4	Solve real time problems using trees data structure.	1,2,7,8,9,10	1,2
CO5	Apply appropriate data structures to solve a given problem.	1 , 5,7,8,9,12	1
CO6	Compare the performance of various data structures.	2,7,8,9,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√				
CO3				√		
CO4			√			
CO5			√			
CO6					√	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1		2					1	2				
CO2			1					1							
CO3					2		2		2						
CO4	3	3					2	1	2	1					
CO5	1				1		2	2	2			2			
CO6		1					2	2	2			2			

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1
Introduction to Data structures and Algorithms: Data, Data Types, Abstract Data Types and Examples, Algorithms, Arrays: One Dimensional and Two Dimensional, Structures: Introduction to structures and nested structures.
UNIT – 2
Data Structures-1: Stacks, Evaluation of expressions: Infix, Prefix, postfix; Queues: Simple, circular and priority Queues.
UNIT – 3
Data Structures-2: Pointers; Dynamic memory allocation; Linked List: singly linked list, doubly linked list, stack using linked list, queue using linked list.
UNIT – 4
Data Structures-3: Trees: Binary Tree, Binary Tree Traversals, Binary search Tree

TEXTBOOKS:

1. Horowitz, Sahni, Anderson-Freed, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2007.
2. Joshi, Data Structures and Algorithms In C, Tata McGraw-Hill Education, 2010.

REFERENCEBOOKS:

1. The design and analysis of computer algorithms, 4th Edition Addison-Wesley
2. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, Addison-Wesley, 1987.
3. Richard Gilberg, Behrouz Forouzan, Data Structures: A Pseudo code Approach with C, Cengage Learning, 2004.
4. ACM Transactions on Data structures
5. ACM Journal of Algorithms and Computational Technology..

JOURNALS/MAGAZINES

1. https://www.imedpub.com/scholarly/data-structure-journals-articles-ppts-list.php
2. https://www.mdpi.com/journal/algorithms/special_issues/Efficient_Data_Structures
3. https://ieeexplore.ieee.org/document/4055607
4. https://ieeexplore.ieee.org/abstract/document/6312216
5. https://www.sciencedirect.com/science/article/pii/0022000083900065
6. https://www.sciencedirect.com/journal/journal-of-algorithms

SWAYAM/NPTEL/MOOCs:

1. Coursera – Data Structures and Algorithms Specialization
2. Coursera – Data Structures, University of California San Diego
3. Data Structures and Algorithms, National Research University Higher School of Economics
4. https://nptel.ac.in/courses/106/102/106102064/
5. https://nptel.ac.in/courses/106/106/106106127/
6. https://nptel.ac.in/courses/106/103/106103069/

Self-Learning Exercises:

1. Storing game entities in a array
2. Pseudo-random number generators
3. Reversing an array using a stack
4. Matching parentheses and HTML tags
5. Double ended queue
6. Application of tree traversals

Course Title	Discrete Mathematics and Graph Theory				Course Type		Theory	
Course Code	B20AS0302	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	3	3	3	39	-	50	50

COURSE OVERVIEW

Discrete Mathematics is the study of discrete objects. Discrete Mathematics is used to develop our ability to understand and create mathematical arguments and also used to provide the mathematical foundation for advanced mathematics and computer science courses. Graphs (abstract networks) are among the simplest mathematical structures, which are used in most of the areas of Computer Science to solve the complex problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain mathematical arguments using logical connectives and quantifiers.
2. Illustrate the operation on discrete structures such as sets, relations and functions.
3. Describe the theory and application of graphs, fundamental theorems and their proofs.
4. Demonstrate the use of graphs to model many types of relations and processes in physical, biological. Social and information system.
5. Explain to provide the mathematical foundation for advanced mathematics
6. Illustrate to use discrete mathematics to solve the complex problems in most of the areas of Computer Science

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct mathematical arguments using logical connectives and quantifiers	1 to 4	2
CO2	Apply the operations like union and intersection on discrete structures such as sets, relations and functions	1 to 3, 5,6	2
CO3	Make use of graph and fundamental theorems in real world applications	1 to 6	2
CO4	Develop a model using advanced concepts of graph for real world applications	1,2,4,5,6	2
CO5	Apply the mathematical foundation for advanced mathematics	1 to 3, 5,6	2
CO6	Solve the complex problems in most of the areas of Computer Science	1,2,3,4	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
C06					√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2										3	
CO2	3	2	3		2	1								3	
CO3	3	1	2	1	2	3								3	
CO4	3	2		2	2	2								3	
CO5	3	2	3		2	1								3	
C06	3	2	3	3											3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Set Theory and Logic: Fundamentals of Sets, Sub sets, Venn diagram, Operations on sets, Laws of set theory, Countable and Uncountable sets, Addition Principle, Extended Addition Principle, Propositions, Logical Connectives and truth tables (Illustrative Examples), Logical equivalence, Laws of logic, Duality, NAND and NOR connectives (Circuits), Converse, Inverse and Contra positive, Rules of Inference, Open statements, Quantifier, Logical implication involving quantifiers, Statement with more than one variable. Methods of Proofs and Disproof.

UNIT – 2

Relations and Functions : Cartesian product of sets (Illustrative Examples), Matrices and Digraph of the relations, Properties of relations, Equivalence relations, Partial ordered relations, Posets, Hasse diagrams, Extremal elements in posets, Types of Functions, properties of Functions, The pigeon hole principle, composite functions, invertible functions, Floor and ceiling functions, Sterling number of second kind.

UNIT – 3
Introduction to graph theory: Konigsberg's bridge problems, Utilities problem, Seating Problem, Graphs, Representation of Graphs. Directed graphs, Incidence, Adjacency, Degree, In degree, Out degree, Regular graphs, Complete graphs, Null Graph, Bipartite Graphs, Isomorphism, Directed Graphs, Sub graphs, Walk, Trail, Path, Circuit, Cycle, Connected and disconnected graphs, Components, Weakley connected and Strongly connected Components, Complement of graphs, Partition and Decompositions.
UNIT – 4
Euler and Hamiltonian graphs and Graph colouring: Operation on graphs, Definition of Euler Trail, Euler Graphs, Hamiltonian path, Hamiltonian Cycle, Hamiltonian Graphs, Standard Theorems on Euler and Hamiltonian graphs, planar graph, detection of Planarity, Dual of planar graphs, Euler formula for planar graph, Graph colouring, Chromatic polynomial, Map coloring, Four Color Theorem, Five Color Theorem, Matching, Network flow, and its applications, Cut set, Cut vertex, Chord, Properties of Cut Sets, Max Flow Min Cut Theorem.

TEXT BOOKS:

1. Ralph P Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, 2014.
2. Nasingh Deo, "Graph Theory with Applications to Engineering Computer Science", Prentice-Hall, 2014.

REFERENCE BOOKS:

1. Keneth H Rosen, "Discrete Mathematics and its applications", 5th Edition,, Tata McGraw Hill, 2014.
2. C L Liu, "Elements of Discrete Mathematics", 4th edition, Tata MacGraw Hill 2014.
3. Thomas Khoshy, "Discrete Mathematics with applications", Elsvier, 2012.
4. Ralph P Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Asia, 2015.
5. Frank Harary, "Graph Theory", Norosa, 2013.
6. J. A. Bondy and V. S. R. Murthy,"Graph Theory with Applications", Macmillan, London, 2013.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/discrete-mathematics
2. http://www.math.iit.edu/~kaul/Journals.html
3. https://www.siam.org/publications/journals/siam-journal-on-discrete-mathematics-sidma
4. https://onlinelibrary.wiley.com/journal/10970118
5. https://iopscience.iop.org/article/10.1088/1742-6596/1175/1/012069/meta
6. https://iopscience.iop.org/article/10.1088/1742-6596/1188/1/012065/meta
7. https://www.worldscientific.com/worldscinet/jml
8. https://www.scimagojr.com/journalsearch.php?q=12000154480&tip=sid

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/111/107/111107058/
2. https://nptel.ac.in/courses/106/103/106103205/
3. https://onlinecourses.swayam2.ac.in/cec20_ma02/preview
4. https://onlinecourses.nptel.ac.in/noc20_ma05/preview
5. https://onlinecourses.swayam2.ac.in/cec20_ma03/preview
6. https://www.coursera.org/learn/graphs

Course Title	Computer Organization and Architecture				Course Type		Theory	
Course Code	B20EK0301	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Computer organization and architecture is the science and art of selecting and interconnecting hardware components to create a computer that meets functional, performance, and cost goals. Computer organization defines the constituent parts of the system, how they are interconnected, and how they interoperate in order to implement the architectural specification. In this course, student will learn the basics of hardware components from basic arithmetic units to memory and I/O devices, instruction set architectures and assembly language, and designs to improve performance.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain architecture of ARM processor and write simple assembly programs.
2. Demonstrate the translation of assembly instructions into their binary representation.
3. Describe and understand the processor memory hierarchy.
4. Discuss basic understanding of interrupts, I/O devices, and I/O protocols

COURSE OUTCOMES(COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Make use of ARM processor instruction set for developing simple assembly Interpret the functional architecture of computing systems.	1,2,7,12	1
CO2	Interpret the functional architecture of computing systems.	1,2,4,10	1
CO3	Identify the issue related to instruction set architecture ,memory unit and control unit and I/O functions.	1,11	1
CO4	Develop a real world application using parallel processing concepts.	1,2,4,10,11	1,2
CO5	Learn new tools and technologies in the computer organization and architecture and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the computer organization and architecture to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3				√		
CO4	√				√	
CO5	√				√	
CO6		√				√

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3					3					1	3		
CO2	3	3		2						2			3		
CO3	3										2		3		
CO4	3	3		2						2	2		3	2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT-1

Introduction to ARM processor: Introduction to the architecture of Microprocessor, Microcontroller, Microcomputer and Internet of Things (IoT). ARM characteristics, Registerstructure, Addressing modes, Instructions, Assembly language, Operating Modes and Exceptions, Conditional execution of Instructions.

UNIT-2

Arithmetic unit: Addition and Subtraction of Signed Numbers**,** Multiplication of unsigned numbers, Multiplication of signed numbers, Fast multiplication, Integer division, Floating point numbers and operations, Arithmetic operations on floating point numbers.

UNIT-3

Memory System: Basic concepts, Synchronous RAM memories, Read-only memories, Direct Memory Access, Memory Hierarchy, Cache memories, Virtual memory.

UNIT-4

Input/output Organization: Bus structure, Bus operation, Arbitration, Interface circuits, Intercommunication standards.

Parallel processing: Hardware multithreading, Vector (SIMD) processing and Shared Memory multiprocessors.

TEXTBOOKS:

1. Carl Hamacher ,ZvonkoVranesic, SafwatZaky, NaraigManjikian, "Computer Organization and Embedded Systems", Sixth Edition, McgraHIll.

REFERENCEBOOKS:

1. Linda Null, Julia Labor, "The Essentials of Computer Organization and Architecture", Viva Publishers, 4th Edition, 2015.
2. William Stallings. "Computer organization and architecture: designing for performance". Pearson Education India, 2000.
3. David A. Patterson, John L. Hennessy. "Computer organization and design: the Hardware/software interface". Elsevier, 2011.
4. Peter Knaggs , "ARM Assembly Language Programming", April 2016.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1646340
2. https://ieeexplore.ieee.org/document/7160433
3. https://www.academia.edu/Documents/in/Computer_Architecture_and_Organisation
4. https://dl.acm.org/doi/10.5555/1610377

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/105/106105163/
2. Computer Architecture Overview -Coursera

SELF-LEARNINGEXERCISES:

Intel IA-32 architecture, Instruction Set Architecture of IA-32, Basic Input/Output, Basic processing unit and Pipelining

Course Title	Analog and Digital Electronics Lab				Course Type		Practical	
Course Code	B20CI0305	Credits	1		Class		III semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

COURSE OVERVIEW

This course covers basic concepts of Electrical Engineering. The course introduces the working of analog components and helps in understanding basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes and opamps.The course provides foundation on designing and implementation of logic circuits. Analog circuits are simulated using ORCAD tool and digital circuits using XILINX tool which helps in gaining experience in creating and testing of circuits.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
2. Describe the foundation on designing, building and testing of common combinational and sequential Digital logic circuits.
3. Explain the procedure required for simulation of digital logic circuits.
4. Analyze the working principle and designing of analog circuits using ORCAD tool
5. Analyze the working principle and designing of digital circuits using XILINIX tool
6. Demonstrate the use of general electronic instruments in design and testing of digital logic circuits.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the use of diodes in rectifiers, filter circuits and wave shaping	1 to 4	1
CO2	Apply the basic knowledge used in solid state electronics including diodes, and operational amplifiers for specific engineering applications.	1 to 3, 5	1
CO3	Identify the different families of digital integrated circuits build, and troubleshoot combinatorial circuits using digital integrated circuits	1 to 5	2
CO4	Analyze the working principle and designing of analog circuits using ORCAD tool	1 to 4	1
CO5	Analyze the working principle and designing of digital circuits using XILINIX tool	1 to 4	1

CO6	Develop the ability to analyse and design analog electronic circuits using discrete components	1,4,5	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				√		
CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	2									3		
CO2	3	2	3		2								3		
CO3	3	1	2	1	2									3	
CO4	3	1	1	2									3		
CO5	3	1	1	2									3		
CO6	3			2	2										3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1	To simulate a positive clipper, double ended clipper & positive clamper circuits using diodes	Orcad	Simulation of clipper and clamper electronic
2	To simulate a rectangular wave form generator (Op-amp relaxation oscillator) and compare the frequency and duty cycle with the design specifications	Orcad	Simulation of rectangular waveform generator
3.	To simulate a Schmitt trigger using Op-amp and compare the UTP andLTP values with the given specification	Orcad	Simulation of Schmitt trigger
4.	To simulate a Wien bridge Oscillator	Orcad	Simulation of wein bridge oscillator
5.	To determine the working of a power supply and observe the waveforms	Orcad	Simulationof power supply
6.	To build and simulate CE amplifier (RC coupled amplifier) for itsfrequency response and measure the bandwidth.	Orcad	Simulation of RC coupled amplifier and determining the frequency response
7.	Realization of Half/Full adder and Half/Full Subtractors using logic gates	ICs, Trainer kit and patch cords Create and perform the adder and subtractor circuits	ICs, Trainer kit and patch cords Create and perform the adder and subtractor circuits
8.	Design and develop VHDL code to realize Full adder and Full Subtractors	Xilinx	Simulation knowledge of the mentioned adders an
9.	.Given a 4-variable logic expression, simplify it using Entered Variable Map and realize the simplified logic expression using 8:1 multiplexer IC	ICs, Trainer kit and patch cords	Realization of a multiplexer
10.	Design and develop the VHDL code for an 8:1 multiplexer. Simulate and verify it's working	Xilinx	Simulation knowledge of combinational logic circuit
11.	Design and implement a ring counter using 4-bit shift register and demonstrate its working	ICs, Trainer kit and patch cords	Realization of shift register and ring counter
12.	Design and develop the Verilog / VHDL code for switched tail counter.	Xilinx	Simulation of ring counter

Course Title	Programming with JAVA Lab				Course Type		Practical	
Course Code	B20CI0306	Credits	1		Class		III semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

COURSE OVERVIEW

Java's unique architecture enables programmers to develop a single application that can run across multiple platforms seamlessly and reliably. In this course, students gain extensive experience with Java, object-oriented features and advance Java programming skills. Students learn to create robust object-oriented applications with Java.

COURSE OBJECTIVE (S):

The objectives of this course are to:

7. Explain the basic data types and control structures of the Java language.
8. Illustrate the creation of classes and objects in Java.
9. Demonstrate the extending a class (inheritance) and use proper program anomaly handling structures.
10. Discuss the use of Java generics and collections.
11. Discuss object-oriented features and advance Java programming skills
12. Explain to create robust object-oriented applications with Java.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of array concepts in java to solve real world problems.	1 to 5	1
CO2	Apply the features of OOPS in java to solve the real-world problems.	1 to 5	1
CO3	Develop program for stack implementation using Exception Handling in java.	1 to 5	2, 3
CO4	Identify suitable data structures to solve real world applications.	1 to 5, 12	2
CO5	Discuss object-oriented features and advance Java programming skills	1 to 5	1
CO6	Explain to create robust object-oriented applications with Java.	1 to 5, 12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√	√		
CO4			√			
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1								3		
CO2	3	3	2	2	1								3		
CO3	3	3	1	1	1									3	3
CO4	3	3	3	1	2							1		3	
CO5	3	3	3	1	2								3		
CO6	3	3	2	2	2									3	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	The sieve of Eratosthenes is one of the most efficient ways to find all primes smaller than n when n is smaller than 10 million. Given a number n, use JAVA to print all primes	Windows/Linux OS, IDE	Understanding conditional operators and statements
2.	The Gauss-Jordan method is also known as Gauss-Jordan elimination method is very useful in solving a linear system of equations. It is a technique in which a system of linear equations is resolved by the means of matrices. Develop a	Windows/Linux OS, IDE	Creating an array and performing some operations on array.
3.	To compute a square root of any positive number a, start with an initial guess x=x1 for √a; then calculate successive approximations x2,x3...,√a using the formula: $x_i = \frac{x_{i-1} + (a/x_{i-1})}{2}, i = 2, 3, \ldots$	Windows/Linux OS, IDE	Understanding conditional statements (if, if..else, etc)
4.	Model a lamp as a Java object. Make a Lamp class. This will contain atleast one instance variable which will be of type Boolean and will hold the state of the lamp: i.e., whether it is on or off. In addition, add methods to do the following things: switch the light on and off, and check its current state, i.e., whether it is on or off. Maintain proper encapsulation mechanism. Next, write a launcher class with a main() method to carry out the following tasks:	Windows/Linux OS, IDE	Object and class creation and its usage

5.	Given the following functional interface:
	interface MathOperation {
	int operation(int a, int b);
	}
	Develop an application that would implement the above interface using lambda expressions as to perform the
		Windows/Linux OS, IDE	Creation of interfaces and its usage.

6.	The String class in JAVA has a static method compare To Ignore Case, which compares two strings and the Arrays class has a static sort method. Build a JAVA program that creates an array of strings, use the sort function from Arrays class to sort the strings by passing the compare To Ignore	Windows/Linux OS, IDE	Creation of string class and its usage
7	XYZ technologies is firm that has 5 employees with 1 manager, and 4 technicians. XYZ wants to digitize its payroll system, the following requirements: Dearness Allowance is 70% of basic for all employees. House Rent Allowance is 30% of basic for all employees. Income Tax is 40% of gross salary for all employees. The annual increments to the employees are to be given of the following criteria: -Manager 10% of the basic salary, and Technicians 15% of basic. Develop the pay roll for XYZ. Implement a class hierarchy using	Windows/Linux OS, IDE	Creation multiple inheritance and its usage
8	Define a new Exception class named Odd Exception. Create a new class named Even Odd. Write a method called halfOf(), which takes an int as parameter and throws an Odd Exception if the int is odd or zero, otherwise returns (int / 2). Write a main method that calls halfOf() three times (once each with an even int, an odd int, and zero), with three	Windows/Linux OS, IDE	Creation of exception class and its usage
9	Implement a class named Fraction that represents fractions with numerator and denominator always stored reduced to lowest terms. If fraction is negative, the numerator will always be negative, and all operations leave results stored in lowest terms. Implement the addition, subtraction, multiplication and division operation for the Fraction class	Windows/Linux OS, IDE	Creation of exception class and its usage
10	Create a class Student that has instance variables as Name, Age, Address and access transmutation methods to access the instance variables along with display method to print the details of student. Next write a main() function that will create a collection of 10 students and reverse the list. Print	Windows/Linux OS, IDE	Object and class creation and its usage
11	Use generics to build a class Sort. Implement the bubble sort algorithm to sort an array of any type.	Windows/Linux OS, IDE	Creation of generics class and its usage
12	Write a generic method to count the number of elements in a collection that have a specific property (for example, odd integers, prime numbers, palindromes).	Windows/Linux OS, IDE	Creation of generics class and its usage

Sl. No.	Part B Mini Project
1	Develop a project for Airline reservation system List with the following modules: 1. PASSENGER a) Add member b) Delete member c) Search for member d) Edit member 2. FLIGHT a. Add Flight b. Delete Flight c. Search Flight d. Display Flights 3. RESERVATION a. Book b. Cancel Title: Airline Reservation system Problem Definition: *Airline Reservation System*" main aim is to provide the online ticket & seat reservation of National and International Flights and give the information about flight departures. Solution: Develop a project to implement an Airline reservation system with the following modules: 1. PASSENGER a. Add member b. Delete member c. Search for member d. Edit member 2. FLIGHT a. Add Flight b. Delete Flight c. Search Flight d. Display Flights 3. RESERVATION a. Book b. Cancel
List of Experiments:	
Sl.No	Name of the Experiment
1	Create a passenger class with the attributes Adhar_number, Passenger_name, Email_id, Phone, Address, DOB and the methods to facilitate Addition, Deletion, Search and Modify the passenger data. Store the details of the 10 passenger objects in "Passenger.txt" and Display. a. void Add_passenger() b. Display_details() c. void Delete_Passenger(Adhar_number) d. void Search_Passenger(Adhar_number) e. void Modify_Passenger(Adhar_number)
2	It is required to delete an existing passenger data based on the request from the passenger. Read adhar card number of the passenger to be deleted and delete the record from "passenger.txt" if found. Otherwise display an error message saying that "record does not exist". Develop a program to implement the above task.
3	It is required to modify an existing passenger data based on the request from the passenger. Read adhar card number of the passenger to be modified and modify the record from "passenger .txt" if found. Otherwise display an error message saying that "Record does not exist". Develop a program to implement the above task.

4	It is required to Search an existing passenger data based on the request from the passenger. Read Adhaar card number of the passenger to be searched for, search the record from "passenger .txt" and display the details of passenger if found. Otherwise display the error message "Record does not exist". Develop a program to implement the above task.
5	Create a Flight class with attributes Flight_number, Flight_name, Source, Destination, Departure_Timing and the methods Add_Flight(), Delete_Flight(), Search_Flight() and Display_Flight(). Store the details of any 5 Flights in a file called "Flights.txt" and display the same. Develop a program to achieve the above task.
6	It is required to delete the details a flight stored in "Flights.txt". Read the Flight_no and search for the same in "Flights.txt". If found, it should be deleted from "Flights.txt". Otherwise display the error message "Flight Does Not Exist". Develop a program to achieve the above task.
7	It is required to delete the search for a flight stored in "Flights.txt". Read the Flight_no and search for the same in "Flights.txt". If found, Display the details of Fllight, otherwise display the error message "Flight Does Not Exist". Develop a program to achieve the above task.
8	It is required to display the details of all the flights running from Source1 to Destination1. Read the name of source1 and destination1 and fetch from "Flights.txt" the details of all the flights running between Source1 and desitnation1 and display the same. Develop a program to achieve the above task.
9	Create a reservation class that facilitates booking and cancellation of domestic and international flights using the following methods and parameters. Develop a program to store the details of 10 bookings in "**Reservations.txt"** and display the same. a. Book_Ticket(Flight_Number, Flight_Name, Ticket_Number,Source, Destination, Adhar_number, Passport_number,Date, Departure_time, Class, Type_of_Travel(Domestic , International), Fare, Status) b. Cancel_Ticket(Ticket_Number)
10	A passenger would like to cancel the ticket due to a genuine reason. Read the ticket_no and search for the record in "Reservation.txt". Cancel the Ticket based on the request from passenger and update the status.

Course Title	Data Structures Lab				Course Type		Practical	
Course Code	B20CI0307	Credits	1		Class		III semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

COURSE OVERVIEW

The course focuses on basic and essential topics in data structures, including array-based lists, linked lists, recursion, stack, queues, and binary trees, heaps, sorting and searching algorithms. It also covers analysis and design of fundamental data structures and engages learners to use data structures as tools to algorithmically design efficient computer programs that will cope with the complexity of actual applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the concept of Abstract Data Types (ADT)
2. Provide the knowledge of stacks and queues.
3. Understand the importance of Linked lists
4. Illustrate the operations of trees
5. Demonstrate the use of appropriate of data structures for a given problem.
6. Design a data structure application for real time problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the Abstract Data Types, Structures	1 to 5	1
CO2	Formulate the solution for any computational problem using stacks and queues.	1 to 5	1,2
CO3	Analyze the importance of linked lists.	1 to 5	1,2
CO4	Solve real time problems using trees data structure.	1 to 5	1,2
CO5	Apply appropriate data structures to solve a given problem.	1 to 5	1
CO6	Compare the performance of various data structures.	1 to 5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5		√				
CO6			√			√

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1		2					1	2		3		
CO2			1					1					3	3	
CO3					2		2		2				3	3	
CO4	3	3					2	1	2	1			3	3	
CO5	1				1		2	2	2			2	3		
CO6		1					2	2	2			2	3	3	

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

1	Design, Develop and Implement a menu driven Program in C for the following Array operations a. Creating an Array of N Integer Elements b. Display of Array Elements with Suitable Headings c. Inserting an Element (ELEM) at a given valid Position (POS) d. Deleting an Element at a given valid Position(POS) e. Exit. Support the program with functions for each of the above operations.
2	Design, Develop and Implement a Program in C for the following operations on Strings a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation: c. Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. d. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Note: Don't use Built-in functions
3	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome

	d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations
4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^ (Power) and alphanumeric operands.
5	Design, Develop and Implement a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks 21 6 Design, Develop and Imp
6	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, PhNo a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion and Deletion at End of SLL d. Perform Insertion and Deletion at Front of SLL e. Demonstrate how this SLL can be used as STACK and QUEUE f. Exit
8	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue f. Exit
9	Design, Develop and Implement a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial P(x,y,z) = 6x2y2z-4yz5+3x3yz+2xy5z-2xyz3 b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10	Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Delete an element(ELEM) from BST e. Exit

Course Title	Management Science				Course Type		Theory	
Course Code	B20MGM301	Credits	2		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**2**	**2**	**2**	**26**	**-**	**50**	**50**

COURSE OVERVIEW

The course intends to familiarise students to understand the management principles and applications, which lays a strong foundation for managers and leaders in critical thinking and decisions making process. The course emphasises on giving an overview of the functional area of management

COURSE OBJECTIVE (S):

The objectives of this course are to:

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	To Plan organizational structure for a given context in the organisation carries out production operations through Work-study.	1-5	2
CO2	To carry out production operations through Work-study.	1-5	3
CO3	To Understand the markets, customers and competition better and price the given products Appropriately.	1-5	2
CO4	To Plan and control the HR function better.	1-5	2,3
CO5	To create foundation of decision making process and critical thinking	1-6	3
CO6	To emphasises on giving an overview of the functional area of management	2,4	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√	√	√	√	
CO2	√	√	√	√	√	
CO3	√	√	√	√	√	
CO4	√	√	√	√	√	
CO5	√	√	√	√	√	√
CO6		√		√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3									3	
CO2	1	1	3	3	3										3
CO3	1	3	2	3	1									3	
CO4	1	1	3	2	5									3	3
CO5	1	1	2	3	2	2									3
CO6		1		2										3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to Management and Organisation: Concepts of Management and organization- nature, importance and Functions of Management. Systems Approach to Management – Taylor's Scientific Management Theory- Taylor's Principles of Management, Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory– Hertzberg Two Factor Theory of Motivation – Leadership Styles, Social responsibilities of Management. Designing Organisational Structures: Basic concepts related to Organisation Departmentation and Decentralisation.

UNIT – 2

. **Operations and Marketing Management**: Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study –Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering(BPR) Statistical

Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis. Purchase Procedure, Stores Management and Store Records – JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix. And Marketing Strategies based on Product Life Cycle. Channels of distribution.

UNIT – 3

Human Resources Management (HRM): Concepts of HRM. HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR.. Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development. Placement, Wage and Salary Administration, Promotion. Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating -Capability Maturity Model (CMM) Levels – Performance Management System.

UNIT – 4

Strategic Management and Contemporary strategic Issues: Mission, Goals, Objectives, Policy, Strategy. Programes, Elements of Corporate Planning Process, Environmental Scanning. Value Chain Analysis, SWOT Analysis. Steps in Strategy Formulation and implementation, Generic. Strategy alternatives. Bench Marking and Balanced Score and as Contemporary Business Strategies.

TEXTBOOKS:

1. Kotler Philip and Keller Kevin Lane, Marketing Management, Pearson, New York, 15th Edition, 2012.
2. Koontz and Weihrich: Essentials of management, McGraw Hill, New Delhi, 11th Edition, 2012.

REFERENCEBOOKS:

1. Thomas N. Duening and John M. Ivancevich, Management – Principles and Guidelines, Dreamtech Press; 1st Edition, 2012.
2. Samuel C. Certo, Modern Management, Prentice Hall, New York, 9th Edition, 2012.
3. Schermerhorn, Capling, Poole and Wiesner, Management, Wiley, New York, 6th Edition, 2012.
4. John A. Parnell, Strategic Management – Theory and Practice, Cengage Publications, 2018.
5. Lawrence R Jauch, R. Gupta and William F. Glucek: Business Policy and Strategic Management Science, McGraw Hill, New York, 5th Edition, 2012.

Course Title	Environmental Science				Course Type		Theory	
Course Code	B20AS0301	Credits	2		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	2	2	2	26	-	50	50

COURSE OVERVIEW

This course intends to understand, analyze and execute the environmental conditions and the control measures on various types of pollutions can be recognized. This course also talks about the environmental degradation on global warming, acid rain formation, and waste management and how the energy and natural resources can be used effectively in ecosystem.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Graduates will be familiar with current and emerging environmental engineering and global issues, and have an understanding of ethical and societal responsibilities.
2. Graduates will have the ability to obtain the knowledge, and will recognize the need for engaging in life-long learning.
3. Will find the need of various types of energy (conventional & non-conventional) resources and natural resources.
4. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem.
5. Acquire knowledge about sources, effects and control measures of environmental pollution, degradation and waste management.
6. Explore the ways for protecting the environment

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Understand, analyse and execute favourable environmental conditions and the role of individual, government and NGO in environmental protection.	1-5	2
CO2	List the causes, effects & remedial measures and find ways to overcome them by suggesting the pollution-controlled products.	1-5	3
CO3	Classify different wastes, sources of waste and their effect on population	1-5	2,3
CO4	Get motivation to find new renewable energy resources with high efficiency through active research and innovation and critically analyse the ecological imbalances and provide recommendations to protect the environment.	1-5	2,3
CO5	To learn about increase in population growth and its impact on environment	2,3,4	3
CO6	To Gain knowledge about environment and ecosystem	1-5	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3				√		
CO4			√			
CO5		√	√	√		
CO6	√	√	√	√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3									3	
CO2	1	1	3	3	3										3
CO3	1	3	2	3	1									3	3
CO4	1	1	3	2	5									3	3
CO5		2	2	2											3
CO6	1	2	2	2	2										3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

ENVIRONMENT & ENVIRONMENTAL PROTECTION:

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations, Initiative and Role of Non-government organizations in India and world.

UNIT – 2

Environmental pollution, degradation & Waste management:

Environmental Pollution: Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile Pollution-Causes, Effects & control measures.

Environmental degradation: Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.

Waste management: Municipal solid waste, Bio medical waste and Electronic waste (E-Waste).

UNIT – 3

Energy & Natural resources:

Energy: Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Natural resources:

Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance.

Mineral resources - Types of minerals, Methods of mining & impacts of mining activities. Forest wealth - Importance, Deforestation-Causes, effects and controlling measures

UNIT – 4

Ecology, ecosystem & field work:

Ecology-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem - Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-a biotic and biotic, biological diversity.

Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

TEXTBOOKS:

1. R .J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, Co-authored &Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017. . R.J.
2. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, 2nd Edition, 2014
3. Benny Joseph, "Environmental Studies", Tata McGraw – Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008
4. Dr.S.M.Prakash, "Environmental Studies", Elite Publishers, Mangalore, 2nd Edition, 2009

REFERENCEBOOKS:

1. Rajagopalan R, "Environmental Studies – from Crisis to cure", Oxford University Press, New Delhi, 3rd Edition, 2016
2. Anil Kumar Dey and Arnab Kumar Dey, "Environmental Studies", New age international private limited publishers, New Delhi, 2nd Edition, 2007
3. Michael Allaby, "Basics of environmental Science", Routledge-Tayler & Francis e-library, New York, 2nd Edition, 2002
4. Dr.Y.K Singh, "Environmental Science", New age international private limited publishers, New Delhi, 1st Edition, 2006.

Self-Learning Exercises: Need for public awareness on the environment, Gaia Hypothesis

Course Title	ADVANCED KANNADA (or) Basics of Kannada				Course Type		Theory	
Course Code	B20AHM301 & B20AHM302	Credits	0		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	-	-	-	-	-	-	-

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡಿಗರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಪರಿವಿಡಿ

ಘಟಕ – 1 : **ಕವಿತೆಗಳು**

1. ಬೆಳಗು – ದ ರಾ ಬೇಂದ್ರೆ
2. ಕಲ್ಕಿ – ಕುವೆಂಪು

ಘಟಕ – 2 : **ಕಥೆಗಳು**

3. ಗಾಂಧಿ – ಬೆಸಗರಹಳ್ಳಿ ರಾಮಣ್ಣ
4. ಸೆರೆ – ಯಶವಂತ ಚಿತ್ತಾಲ

ಘಟಕ – 3 : **ವಿಜ್ಞಾನ ಲೇಖನಗಳು**

5. ಆನೆಹಳ್ಳದಲ್ಲಿ ಹುಡುಗಿಯರು – ಬಿ ಜಿ ಎಲ್ ಸ್ವಾಮಿ
6. ವೃತ್ತಿಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಮಾಧ್ಯಮ – ಎಸ್ ಸುಂದರ್

ಘಟಕ – 4 : ಪರಿಸರ ಲೇಖನಗಳು

7. ಚೀಂಕ್ರ ಮೇಸ್ತ್ರಿ ಮತ್ತು ಅರಿಸ್ಟಾಟಲ್ – ಕೆ ಪಿ ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ
8. ಗುಬ್ಬಚ್ಚಿಯ ಗೂಡು – ಪಿ ಲಂಕೇಶ್

- ಬಿ ಎಂ ಎಸ್ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಕನ್ನಡಿಗರಿಗೆ **'ಕನ್ನಡ ಕಲಿ'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಕರ್ನಾಟಕ ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ವಿಭಾಗ ಕನ್ನಡಿಗರಿಗೆ **'ಸಾಹಿತ್ಯ ಸಿಂಚನ'** ಪಠ್ಯ ಪುಸ್ತಕ
- ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ ಕನ್ನಡಿಗರಿಗೆ **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ

ಹಲವಾರು ಪಠ್ಯಪುಸ್ತಕಗಳು ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದಲ್ಲಿ ಕನ್ನಡ ಬೋಧನೆಗೆ ಬಳಕೆಯಲ್ಲಿದ್ದು ಜೊತೆಗೆ ಬಿಎಡ್ ಕನ್ನಡ ಕಲಿಕೆಯ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ರೇವಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ತಾಂತ್ರಿಕ ವಿಭಾಗದ ಕನ್ನಡಿಗರು ಮತ್ತು ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಇಷ್ಟವಾಗುವ ಮತ್ತು ಪ್ರಯೋಜನಕಾರಿಯಾಗುವ ಪಠ್ಯ ಪುಸ್ತಕವನ್ನು ತರಗತಿಗಳು ಪ್ರಾರಂಭವಾಗುವುದರ ಒಳಗೆ ಸಿದ್ಧಪಡಿಸಲಾಗುವುದು.

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡೇತರರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಭಾಷಾ ಕೌಶಲ್ಯಗಳು

ಘಟಕ – 1

1. ಆಲಿಸುವುದು

- ಆಲಿಸುವ ಕೌಶಲ್ಯ
- ಆಲಿಸುವಿಕೆಯಲ್ಲಿನ ದೋಷಗಳು
- ಉತ್ತಮ ಆಲಿಸುವಿಕೆ

ಘಟಕ – 2

2. ಮಾತನಾಡುವುದು

- ಸಂಭಾಷಣೆ
- ವ್ಯವಹಾರಿಕ ಸಂಭಾಷಣೆ
- ದೋಷಗಳು ಮತ್ತು ಪರಿಹಾರಗಳು

ಘಟಕ – 3

3. ಓದುವುದು

- ಓದು ಕಲಿಸುವಾಗ ಗಮನಿಸಬೇಕಾದ ಅಂಶಗಳು
- ಧ್ವನ್ಯಾಂಗಗಳ ಪರಿಚಯ
- ಓದಿನ ವಿಧಗಳು

ಘಟಕ – 4

4. ಬರೆಯುವುದು

- ವರ್ಣಮಾಲೆಯ ಸ್ವರೂಪ
- ಕಾಗುಣಿತ ಸ್ವರೂಪ
- ಕನ್ನಡ ಸಂಖ್ಯೆಗಳು

- ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ ಕನ್ನಡೇತರರಿಗೆ **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಬಿ ಎಂ ಎಸ್ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಕನ್ನಡೇತರರಿಗೆ **'ಕನ್ನಡ ಮನಸ್ಸು'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಕರ್ನಾಟಕ ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ವಿಭಾಗ ಇವರು **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ ತಂದಿದ್ದಾರೆ.

ಹಲವಾರು ಪಠ್ಯಪುಸ್ತಕಗಳು ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದಲ್ಲಿ ಕನ್ನಡ ಬೋಧನೆಗೆ ಬಳಕೆಯಲ್ಲಿದ್ದು ಜೊತೆಗೆ ಬಿಎಡ್ ಕನ್ನಡ ಕಲಿಕೆಯ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ರೇವಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ತಾಂತ್ರಿಕ ವಿಭಾಗದ ಕನ್ನಡಿಗರು ಮತ್ತು ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಇಷ್ಟವಾಗುವ ಮತ್ತು ಪ್ರಯೋಜನಕಾರಿಯಾಗುವ ಪಠ್ಯ ಪುಸ್ತಕವನ್ನು ತರಗತಿಗಳು ಪ್ರಾರಂಭವಾಗುವುದರ ಒಳಗೆ ಸಿದ್ಧಪಡಿಸಲಾಗುವುದು.

Detailed Syllabus

Semester-4

Course Title	Design and Analysis of Algorithm				Course Type		Theory	
Course Code	B20CI0401	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

In this course the study of fundamental algorithms to solve a variety of problems, including sorting, searching and graph algorithms are discussed. Techniques for analyzing time and space complexity of algorithms are discussed and hence evaluation of tradeoffs between different algorithms is done.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the mathematical foundation for the analysis of algorithms.
2. Illustrate the algorithms using brute force and divide and conquer design technique.
3 .Make use of greedy and dynamic algorithmic design techniques for a given problem.
4. Discuss the problems based on backtracking and branch and bound techniques.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of mathematical foundation for the analysis of algorithms.	1 to 5, 12	1,2
CO2	Develop a program to solve the given real world problems using brute force and divide and conquer design paradigm.	1 to 5,12	1,2
CO3	Make use of greedy and dynamic programming techniques for solving the given real world problem.	1 to 5,12	1,2,3
CO4	Utilize backtracking and branch and bound techniques to solve real world problems.	1,to 5,12	1,2,3
CO5	Learn new tools and technologies in the Desiging of algorithms and apply for suitable application development.	12	1
CO6	Develop solution to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	1							1	3	3	
CO2	2	2	1	2	2							2	3	3	
CO3	2	2	1	3	2							2	3	3	3
CO4	2	1	1	3	2							1	3	3	3
CO5												3	3		
CO6					3				3	2			3	3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1
Introduction-Notion of an Algorithm; Fundamentals of Algorithmic Problem Solving; Fundamentals of the Analysis of Algorithm Efficiency- The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive Algorithms, Mathematical Analysis of Recursive Algorithms.
UNIT – 2
Brute Force: Bubble Sort, Selection Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search, Depth-First Search and Breadth-First Search, Divide-and-Conquer: Merge sort, Quick sort, Multiplication of Large Integers, Decrease-and-Conquer- Insertion Sort, Topological Sorting.
UNIT – 3

Greedy Technique-Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm Dynamic Programming- Fibonacci numbers, Binomial coefficient, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms
UNIT – 4
Space and Time Trade-Offs- Sorting by Counting, Input Enhancement in String Matching,, Coping with the Limitations of Algorithm Power- Backtracking-n-Queens Problem, Subset-Sum Problem, Branch-and-Bound, Assignment Problem, Travelling Salesman Problem

TEXTBOOKS:

1. 1.Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson, 3rd Edition, 2012.
2. 2.Ellis Horowitz, SatrajSahni and Rajasekaran,"Computer Algorithms/C++", Universities Press, 2nd Edition, 2014.
3. 3.Kleinberg, "Algorithm Design", Pearson Education, 1st Edition, 2013.
4. 4.Michael Goodrich, Roberto Tamassia, "Algorithm Design and Applications", Wiley Publishers, 1st Edition, 2014.

REFERENCEBOOKS:

1.Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, "Introduction to Algorithms", PHI, 3rd Edition,

2. ACM Transactions on Algorithms.

3.ACM Journal of Algorithms and Computational Technology.

JOURNALS/MAGAZINES

1. https://www.mdpi.com/journal/algorithms
2. https://ieeexplore.ieee.org
3. https://www.springer.com/journal/453
4. https://ieeexplore.ieee.org/document/7990553

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.swayam2.ac.in/cec20_cs03/preview
2. https://iiiier.org/NPTEL-Local-Chapter
3. https://www.edx.org/course/algorithm-design-and-analysis

Self-Learning Exercises:

1. More exploration on GIThub

Course Title	Device Driver Programming	Course Type	Theory

Course Code	B20EK0401	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**		**50**	**50**

COURSE OVERVIEW:

This course explains the internal organization and design of kernel modules and device drivers. This course enables the student to design and implement hardware interfacing of Linux systems and provides an improved concurrent programming skill for configuration, compilation and installation of Linux kernel from sources

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Design and implement a kernel module and device driver
2. Implementation of hardware interfacing of embedded system
3. Understand how to compile and load drivers, debug driver, and addition of devices etc

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Design and describe the embedded Linux Kernel, Device Driver and Device Driver Modules.	1,2,3,9	1,2,3
CO2	Innovate design, analysis, and Implementation of hardware interfacing of embedded systems for Linux or Android platforms will be discussed	1,2,3,9	1,2,3
CO3	To implement race condition and concurrent programming.	1,2,3,9	1,2,3
CO4	To Configure, compile, and install a Linux kernel/kernel module from sources	1,2,3,9	1,2,3
CO5	Understandability in continuous learning with evolving technological development.	10,12	2,3
CO6	Apply various modules for solving future techniques using continuous learning in the field of device driver modules.	11,12	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2	√	√				
CO3		√	√			
CO4	√	√	√			
CO5		√			√	
CO6			√			√

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2						1				2	2	3
CO2	3	2	1						1				3	1	3
CO3	4	1	2						1				3	2	1
CO4	3	2	1						1				3	2	1
CO5	3		1							2		2		2	2
CO6	3	2	1								2	2		2	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT-1 **Fundamental Programming Structures:** Dissecting the "Hello, World" Program; Compiling and Running a Java Program; Primitive Types; Variables; Arithmetic Operations; Strings; Input and Output; Control Flow; Arrays; Functional Decomposition.
UNIT-2 **Character Drivers**: Char Driver Basics, Device Example: System CMOS, Sensing Data Availability, Talking to the Parallel Port, RTC Subsystem, Pseudo Char Drivers, Misc Drivers, Character Caveats
UNIT-3 **Serial Drivers** UART Drivers, TTY Drivers, Input Drivers, Input Event Drivers, Input Device Drivers, Universal Serial Bus, USB Architecture,Linux-USB Subsystem, Driver Data Structures, **Enumeration Device Example:** Telemetry Card, Class Drivers, Gadget Drivers, Debugging Video Drivers, audio drivers.

UNIT-4

Network driver: Ethernet, Asynchronous Transfer Mode, Network Throughput, Debugging Device Drivers ,Kernel Debuggers, Kernel Probes ,Kexec and Kdump, Profiling, Tracing

TEXTBOOKS:

1. SreekrishnanVenkateshwaran, “Essential Linux Device Driver”, Prentice Hall, 2008

REFERENCE BOOKS:

1. Jonathan Corbet, Alessandro Rubini and Greg Kroah-Hatman, “Linux Device Drivers”, 3rd edition. Oreilly, 2005.
2. Robert Love, “Linux system Programming- Talking directly to the kernel and C Library”, O’Reilly Media, Sept 2007.
3. Daniel P. Bovet and Marco Cessti, “Understanding the Linux Kernal”, 3rd Edition. Oreilly, 2000.

JOURNALS/MAGAZINES

1. https://dl.acm.org/doi/10.5555/500771
2. http://https://linux.tips/top-10/list-of-top-linux-magazines
3. https://ieeexplore.ieee.org/document/1625675
4. https://ieeexplore.ieee.org/document/7100338

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/102/106102132/
2. Coursera- Linux : Device and Drivers
3. Coursera – Drivers and Device interfaces

SELF-LEARNINGEXERCISES:

1. Debugging
2. Real-Time Operating System

Course Title	Operating Systems				Course Type		Theory	
Course Code	B20CI0402	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice				Theory	Practical	IA	SEE
	-	-	-	-				
	Total	3	3	3	39	-	**50%**	**50%**

COURSE OVERVIEW:

This course starts with a brief historical perspective of the evolution of operating system and then covers the major components of most of the operating systems. The operating system provides a well-known, convenient, and efficient interface between user programs and the bare hardware of the computer on which they run. The operating system is responsible for allowing resources (e.g., disks, networks, and processors) to be shared, providing common services needed by many different programs (e.g., file service, the ability to start or stop processes, and access to the printer) and protecting individual programs from one another.

COURSE OBJECTIVE(S):

1: Explain the major components and different services of Operating system

2: Implement process management and scheduling schemes.

3: Discuss synchronization and deadlock techniques in real time applications.

4: Demonstrate memory management techniques for a given machine architecture

COURSEOUTCOMES(COs)

On successful completion of this course; the student shall be able to:

CO#	CourseOutcomes	POs	PSOs
CO1	Identify the major components and different services of Operating system	1-3	1
CO2	Evaluate the Performance of different CPU Scheduling algorithm for the given real world applications	1-5	1
CO3	Build applications to overcome synchronization problems and to avoid deadlocks	1-3,5	2,3
CO4	Compare the physical and virtual memory management techniques and interpret the file systems concepts	1-5	2,3
CO5	Understand fundamental operating system abstractions such as processes, threads, files, semaphores, IPC abstractions, shared memory regions, etc.,	1-5	2,3
CO6	Explain the performance trade-offs inherent in OS implementation	1-5,9	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2					✓	
CO3			✓			
CO4				✓		
CO5		✓	✓			
CO6			✓			

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2		1							1	3		
CO2	3	2	3	1	1								3		
CO3	3	2	3	1	1				1			1		3	
CO4	2	2	2	2	2				2			2	3		
CO5	3	3	3	2	2	1									
CO6	3	3	3	2	2	2			3				3	3	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1 **Operating System Principles:** what Operating Systems do, Computer System organization, computer system architecture, Operating System structure, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure.
UNIT-2 **Process Management**: Process concept, process scheduling, Operations on processes, Inter process communication. Threads: Overview, Multicore programming, Multithreading models, Thread Libraries, threading issues. **Process Synchronization**: Background, The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization: The Bounded-Buffer Problem, The Readers–Writers Problem, The Dining-Philosophers Problem.

UNIT-3
CPU Scheduling: Basic concepts, scheduling criteria, Scheduling algorithms, Multiple Processor scheduling, thread scheduling. **Deadlock**: Definition, Deadlock characteristics, methods of handling deadlocks, Deadlock Prevention, Deadlock Avoidance: banker's algorithm, Deadlock detection and Recovery.
UNIT-4
Memory Management: Background, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation of frames, Thrashing. **File System Interface**: File concept; Access methods; Directory and disk structure; File system mounting; File sharing; Protection.

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 9th edition, Wiley-India, 2012.

REFERENCE BOOKS:

1. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
2. Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation. Prentice-Hall, Third edition, 2014.
3. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.
4. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE),2014.

JOURNALS/MAGAZINES:

1. S. Pamplona, N. Medinilla and P. Flores, "A Systematic Map for Improving Teaching and Learning in Undergraduate Operating Systems Courses," in *IEEE Access*, vol. 6, pp. 60974-60992, 2018, doi: 10.1109/ACCESS.2018.2871768.
2. Y. Liu, Z. Yu, B. Guo, Q. Han, J. Su and J. Liao, "CrowdOS: A Ubiquitous Operating System for Crowdsourcing and Mobile Crowd Sensing," in *IEEE Transactions on Mobile Computing*, vol. 21, no. 3, pp. 878-894, 1 March 2022, doi: 10.1109/TMC.2020.3015750.
3. P. Li, Binoy Ravindran, S. Suhaib and S. Feizabadi, "A formally verified application-level framework for real-time scheduling on POSIX real-time operating systems," in *IEEE Transactions on Software Engineering*, vol. 30, no. 9, pp. 613-629, Sept. 2004, doi: 10.1109/TSE.2004.45.
4. F. Ugalde Pereira, P. Medeiros de Assis Brasil, M. A. de Souza Leite Cuadros, A. R. Cukla, P. Drews Junior and D. F. Tello Gamarra, "Analysis of Local Trajectory Planners for Mobile Robot with Robot Operating System," in *IEEE Latin America Transactions*, vol. 20, no. 1, pp. 92-99, Jan. 2022, doi: 10.1109/TLA.2022.9662177.

SWAYAM/NPTEL/MOOCs:

1. https://archive.nptel.ac.in/courses/106/105/106105214/ (Operating System fundamentals)
2. https://www.coursera.org/courses?query=operating%20system (Introduction to operating system)
3. https://www.udacity.com/course/introduction-to-operating-systems--ud923 (Introduction to Operating System)

SELF-LEARNING EXERCISES

Virtual machines and Introduction to Linux Operating System, Introduction to Distributed computing, Parallel computing, grid computing, cloud computing.

Course Title	Database Management System				Course Type		Theory	
Course Code	B20CI0403	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW:

This course introduces topics such as conceptual data modelling, relational data model, relational query languages, and relational database design. It helps the students to gain fundamental concepts, techniques and applications in database.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Explain the basics of Database Management System.
2. Demonstrate the use of Relational model and Relational algebra.
3. Illustrate the use of different SQL statements.
4. Discuss the topics such as Database Design and Normalization.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Design conceptual entity relationship diagrams for the real world applications.	1 to 5, 10,12	1,2
CO2	Make use of the concepts of relational algebra to solve queries over database.	1 to 5,12	1,2
CO3	Construct the database for given real world application and solve queries over it using SQL commands.	1 to 5,12	1,2,3
CO4	Develop an optimized database using design guidelines and normalization technique.	1,to 5,12	1,2
CO5	Learn new tools and technologies in DBMS and apply for suitable application development.	12	1
CO6	Develop solutions and create better database, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√	√		

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2					1		1	3	3	
CO2	3	3	2	3	1							1	3	3	
CO3	3	3	2	3	3							1	3	3	3
CO4	3	3	2	3	1							1	3	3	
CO5												3	2		
CO6					2				3	2			3	3	

Note: 1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1
Introduction to databases and Conceptual Modelling: Introduction to database, characteristics of the database approach, data models, schemas, instances, database languages and interfaces, Using high-level conceptual data models for database design, a sample database application, entity types, attributes, keys, relationship types, weak entity types, ER diagrams, naming conventions, design issues. Introduction to various database tools and framework (commercial and open source)
UNIT – 2
Relational Data Model and Relational algebra: Relational model concepts, relational model constraints and relational database schemas, update operations, transactions, dealing with constraint violations, unary relational operations, select and project, relational algebra operations from set theory, binary relational operations, join and division, additional relational operations, examples of queries in relational algebra.
UNIT – 3
SQL: SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, insert, delete, update statements in SQL, additional features of SQL, schema change statements in SQL, Retrieving data using the SQL Select Statement, Restricting and sorting data, Using Single row functions, Joins, More complex SQL retrieval queries, views in SQL.
UNIT – 4
Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, and Normal forms based on primary keys, General definitions of second and third normal forms, Other Normal forms.

TEXTBOOKS:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Pearson Education, 5th Edition, 2007.
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", McGraw-Hill, 3rd Edition, 2003.
3. Phill Pratt, "Concepts of Database Management, Cengage Learning", 8th Edition, 2014
4. Jeffrey A Hoffer, "Modern Database Management, Pearson", 12th Edition, 2015

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: "Database System Concepts", 6th Edition, McGraw Hill, 2010.
2. C J Date, "Database Design and Relational Theory: Normal Forms and All that Jazz", O 'Reilly, April 2012.
3. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
4. IEEE Transactions on Knowledge and Data Engineering
5. Elsevier Data and Knowledge Engineering

JOURNALS/MAGAZINES

1. http://www.ijstr.org/final-print/june2019/Database-Management-System.pdf
2. https://www.dbjournal.ro/

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/courses?query=database%20management
2. https://onlinecourses.swayam2.ac.in/cec19_cs05/preview
3. https://www.edx.org/learn/databases
4. https://www.classcentral.com/course/swayam-data-base-management-system-9914

Self-Learning Exercises:

1. MONGODB
2. Transaction and concurrency control
3. UML

Course Title	Microprocessors and Interfacing				Course Type		Theory	
Course Code	B20EK0402	Credits	4		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

The course describes the architecture, programming and interfacing of 8086 Microprocessor. It helps the student in building simple assembly language programs for 8086 Microprocessor. It also gives instruction to advanced microprocessors, GPUs and DSPs.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the architecture, pin configuration of various microprocessors and Interfacing ICs,
2. Identify various addressing modes.
3. Illustrate 8086 assembly language Interrupt based real time applications.
4. Discuss 8086 programmingforinterfacingperipheraldevicesforcontrolapplications.
5. Describe the architecture of various advanced microprocessors.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Identify the suitable addressing modes and instructions formats of 8086 architecture to develop program for the given real world problem.	1,2,3,4,5	1
CO2	Make use of addressing modes and instructions formats of 8086 architecture	1,2,3,4,5	1,2
CO3	Develop 8086 program to interface peripheral devices for control applications.	1,2,3,4,5	2
CO4	Compare the architecture of various advanced microprocessors.	1,2,3,4,5	1
CO5	Learn new tools and technologies in the microprocessor and interfacing and apply for suitable application development.	12	1
CO6	Develop solutions in the microprocessors and interfacing to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,4,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				√		
CO2			√			
CO3						√
CO4				√		
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2								3		
CO2	3	2	3	3	2								3	3	
CO3	3	1	2	3	1									3	
CO4	3	1	3	3	2								3		
CO5	3		3	3	2								3	3	
CO6	3		3	3									3	3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT-1

Intel 8086 Microprocessor: Architecture of 8086, Register organization, Signal description, Physical memory organization, General bus operation, Input/output addressing capability, Special processor activities, Minimum and Maximum mode of 8086 system and timings.8086 Machine language Instructions: instruction formats, Addressing modes - Register, Immediate, Direct, Register indirect, Base plus index, Register relative and Base relative plus index addressing modes. Assembler directives -Symbols, variables, constants, different typesof directives, Introduction to IDE and MASMa Assembler Programming examples on debugging.

UNIT-2

Instruction Set Of 8086 Microprocessor: Data transfer instructions, Arithmetic and logical instructions, conditional and unconditional branch instructions, String instructions, Looping instructions, Machine control instructions, Shift and rotate instructions, Assembly language programming. Introduction to stack, Stack structure of 8086, Interrupts and interrupt service routines, Interrupt cycle of 8086, Non-maskable interrupt, Maskable interrupt (INTR).Interrupt programming, Timing and delays, Macros.

UNIT-3

Peripherals And Their Interfacing With 8086: Static and dynamic RAM interfacing, Input and output ports Interfacing, Stepper motor Interfacing, Interfacing of Analog to digital converter and Digital to analog converter. Programmable Input-Output Port 8255 (PPI): Modes of operation of 8255, Key board and display interfacing, Control of high power devices using 8255, programming examples.

UNIT-4

Introduction to Advanced Microprocessors: Introduction to Intel Microprocessors - 80186, 80286, 80386, 80486, Pentium, Pentium-II, Pentium-IV, Xeon. Overview of Architecture, Programming and Interfacing of these processors. Introduction to Kiel Software, Multicore programming, GPUs, SGX and DSP processors.

TEXTBOOKS:

1. A.K Ray and K.M. Bhurchandi," Advanced Microprocessor and Peripherals",Tata McGraw Hill, 2007.
2. K.R. Venugopal and Rajakumar, "Microprocessor X86 Programming", BPB Publications, 2003.

REFERENCEBOOKS:

1. Yu Cheng Liu & Glenn A Gibson, "Microcomputer systems 8086/8088 family, Architecture, Programming and Design -2nd Edition", Prentice Hall of India, 2003.
2. Douglas V Hall, "Microprocessor and Interfacing, Programming & Hardware", 2nd Edition, Penram International, 2006.
3. Barry. B. Bray, "The Intel Microprocessor - 4th Edition", Prentice Hall of India, 1997.
4. Springer Lecture notes in Electrical engineering -Embedded Microcontroller Interfacing.
5. Elsevier Journal of Microprocessors and Interfacing.

JOURNALS/MAGAZINES

1. https://dl.acm.org/doi/abs/10.5555/374824.374733
2. https://www.journals.elsevier.com/microprocessors-and-microsystems
3. https://ieeexplore.ieee.org/document/1213024

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ee41/preview
2. https://www.mooc-list.com/tags/microprocessors
3. Real time embedded systems -Coursera

SELF-LEARNINGEXERCISES:

Coding and decoding of 8086 instructions set with some examples, Explore Complete Instructions set of 8086

<table>
<tr><td>Course Title</td><td colspan="4">Numerical Methods and Optimization Techniques</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0401</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Numerical Methods and Optimization Techniques emphasizes on the development of numerical algorithms to provide solutions to common problems formulated in science and engineering. The primary objective of the course is to develop the basic understanding of the construction of numerical algorithms, and perhaps more importantly, the applicability and limits of their appropriate use. The emphasis of the course will be the thorough study of numerical algorithms to understand the guaranteed accuracy that various methods provide, the efficiency and scalability for large scale systems. and issues of stability. Optimization Techniques provide ability to solve real-world problems by finding the optimal solutions to the models subject to constraints.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain numerical methods to obtain approximate solutions to mathematical problems.
2. Examine numerical methods for various mathematical operations and tasks, such as interpolation and integration.
3. Illustrate the notation of vector spaces, sub spaces, linear independence, coordinate and change of coordinate.
4. Solve linear programming problems considering Transportation and Assignment Problems.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply numerical methods to obtain approximate solutions for mathematical problems.	1 to 3, 12	1
CO2	Determine suitable interpolation formula and quadrature formulae to find the solution for the given data.	1 to 4 ,12	2
CO3	Solve the matrix associated with liner transformation with respect to the given base and understand the relationship between the operation and linear transformations and their corresponding matrices.	1 to 5,	3
CO4	Develop mathematical equations with simplex method and Transportation-Assignment problem for linear programming	1 to 5,12	1,2,3
CO5	Learn new tools and technologies in the Numerical Methods and apply for suitable application development.	12	2,3
CO6	Develop solutions in the Numerical Methods to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,10	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2					√	
CO3			√			
CO4			√			
CO5			√			
CO6			√		√	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3									1	3		
CO2	3	3	3	3								1		3	
CO3	3	3	3	3	3							1			3
CO4	3	3	3	3	3							1	3	3	3
CO5												2			
CO6					2	3				3					

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Numerical Methods: Errors in Numerical Calculations Types of Errors-Significant Digits-Programming Errors-Numerical Solution of Non-Linear Equations-Bisection Method-Regula Falsi Method-Newton Raphson Method – Fixed Point Method of Iteration – Rates of Convergence of These Methods. Solutions of Algebraic Equations, Relaxation Method and Gauss Seidel Iteration Method.

UNIT – 2

Numerical Analysis: Finite Differences-Operators (Δ, ∇ and E), Interpolation, Newton-Gregory Forward Interpolation Formula, Central Difference, Stirling And Bessel's Interpolation Formulae, Lagrange's Interpolation Formula, Inverse Interpolation Formula, Divided Difference Formula, and Newton's Divided Differences Formula. Numerical integration: Newton-Cotes quadrature formulae: Trapezoidal, Simpson's rules and Weddle's rule.

UNIT – 3

Vector Spaces and Linear transformations: Bases, Echelon forms, Rank, and determinants. Gauss elimination and its complexity, Inner products, Gram-Schmidt orthogonalization. Linear transformations.

UNIT – 4

Linear Programming: Introduction, Canonical and Standard Form of LPP-Simplex Method-Big M Method- Two Phase Method-Principle of duality-Dual Simplex Method. Transportation Problem and Assignment problem.

TEXTBOOKS:

1. Sastry S.S., "Numerical Analysis", Prentice-Hall India (module I), 4th edition
2. K. Hoffman and R. Kunze," Linear Algebra", Prentice-Hall India, 1971.
3. R Panneerselvam," Operations research", 2nd edition, PHI

REFERENCES

1. KanthiSwarup, P.K. Gupta, Man Mohan, "Operations research", Sultan Chand & Sons. (module II), 5th edition.
2. Froberg, "Introduction to Numerical Analysis", Second Edition, Addition Wesley
3. Gerald and Wheatley, "Applied Numerical Analysis", Pearson Education Asia, Sixth Edition
4. S.S Rao, "Optimization Theory and Applications", Wiley Eastern
5. Grawin W. W, "Introduction of Linear Programming", McGraw Hill.

JOURNALS/MAGAZINES

1. https://onlinelibrary.wiley.com/journal/10970207
2. https://www.springer.com/journal/245
3. https://ijnao.um.ac.ir/
4. https://www.scimagojr.com/journalrank.php?category=2612

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/108/106108056/
2. https://www.coursera.org/learn/intro-to-numerical-analysis
3. https://nptel.ac.in/courses/122/102/122102009/
4. https://nptel.ac.in/courses/122/106/122106033/
5. https://www.edx.org/course/convex-optimization

Self-Learning Exercises:

1. Optimization Methods for Business Analytics
2. Numerical Methods and Optimization in Finance

Course Title	Design and Analysis of Algorithms Lab				Course Type		Practical	
Course Code	B20EJ0402	Credits	1		Class		IV semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

COURSE OVERVIEW

In this course the study of fundamental algorithms to solve a variety of problems, including sorting, searching and graph algorithms are discussed. Techniques for analyzing time and space complexity of algorithms are discussed and hence evaluation of tradeoffs between different algorithms is done.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the mathematical foundation for the analysis of algorithms.
2. Illustrate the algorithms using brute force and divide and conquer design technique.
3. Make use of greedy and dynamic algorithmic design techniques for a given problem.
4. Discuss the problems based on backtracking and branch and bound techniques.

COURSE OUTCOMES (COs):

After the completion o fthe course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of mathematical foundation for the analysis of algorithms.	1 to 5, 12	1,2
CO2	Develop a program to solve the given real world problems using brute force and divide and conquer design paradigm.	1 to 5,12	1,2
CO3	Make use of greedy and dynamic programming techniques for solving the given real world problem.	1 to 5,12	1,2,3
CO4	Utilize backtracking and branch and bound techniques to solve real world problems.	1,to 5,12	1,2,3
CO5	Learn new tools and technologies in the Desiging of algorithms and apply for suitable application development.	12	1
CO6	Develop solution to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	1							1	3	3	
CO2	2	2	1	2	2							2	3	3	
CO3	2	2	1	3	2							2	3	3	3
CO4	2	1	1	3	2							1	3	3	3
CO5												3	3		
CO6					3				3	2			3	3	

Note:1-Low,2-Medium,3-High

Exp. No	PROBLEM STATEMENT
1	Search for a given pattern in a text string using Brute Force String Matching.
2	Sort a set of elements in ascending order using Quick Sort algorithm.
3	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's
4	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithms. Differentiate the methods.
5	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijikstra's algorithm
6	Design and Implement 0/1 Knapsack problem using Dynamic Programming.
7	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm
8	Obtain the DFS ordering of vertices in a given digraph.
9	Implement Horspool's algorithm for String Matching and find the number of key comparisons in successful search and unsuccessful search
10	Sort a given set of elements in ascending order which has duplicate entries. Use the sorting by counting algorithm
11	Implement N Queen's problem using Back Tracking.
12	Write a program to sort all transactions of Big Mall by quantity of sales.
13	Write a program to find network of people of same location in Linkedin social network

Course Title	Operating Systems Lab				Course Type		Practical	
Course Code	B20CI0405	Credits	1		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory							
	Practice	1	2	2	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	1	2	2	-	26	**50%**	**50%**

COURSE OVERVIEW:

Operating system provides a practical case of operating systems for the user to understand and master deeply and tangibly the theory and algorithms in operating systems. It gives deeper insights into the hierarchical structure, principles, applications, shells, development, and management of the operation system multi-dimensionally, systematically and from the elementary to the profound. It makes the user to understand about how operating system functions.

COURSE OBJECTIVE (S):

The objective of this lab is to:

1. Provide the knowledge and skills required to understand Basics of UNIX Operating Environment
2. Describe process concepts and scheduling techniques.
3. Illustrate the use of different memory management techniques of operating system.
4. Describe the data structures and internal representation of files in operating system.

COURSEOUTCOMES(COs)

On successful completion of this course; the student shall be able to:

CO#	CourseOutcomes	POs	PSOs
CO1	Understand the scope of UNIX operating environment	1,3	1
CO2	Implementation of scheduling algorithm using C	1,4,5	1,3
CO3	Compare and analyze the performance of different memory management techniques	1,4,5	2,3
CO4	Make use of file types, file structure and file system implementation. .	1,2,4, 5	1,3
CO5	Learn new tools and technologies in the Designing of algorithms and apply for suitable application development.	1,2,4, 5	1,3
CO6	Develop solution to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3				✓		
CO4				✓		
CO5		✓				✓
CO6				✓		

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3										3		
CO2	1			2	2								3		1
CO3	2			2	1									3	3
CO4	3	3		1	1								1		3
CO5	3	3		2	2								1		3
CO6					2	2				3			3	3	

Note:1-Low,2-Medium,3-High

PRACTICE:

PART A:			
No	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill /Ability**
1	When the parent process creates a child process, child process can perform any task assigned to it. During the execution of child process, the parent process waits and vice versa. Develop a program in C to create a child process to read commands from the standard input and execute them.	Process creation using fork()	Programming with C
2	Multithreading is a technique, where each thread is assigned with a task and they get executed simultaneously. For instance, if there are two tasks, two threads are created, one for each task. When one thread is being executed, the other thread waits and vice versa.	Parallel Programming	Programming with C

	So, if there are N tasks, N threads can be created one for each task. It works on shared memory technique, where all the threads share the common memory for storing or retrieving the data. Build a program in C to carry out the following tasks i)create two functions, Generate() and Print() to generate the Fibonacci series and print them respectively. ii) Create a separate thread to execute each function. ii) Ensure the synchronization while executing above functions		
3	A policy is applied by a Scheduler to select a process for execution when there is more than one process ready for execution. The policy may be the process which arrives first is executed first **(First Come First Served-FCFS)** or the process which has shortest execution time **(Shortest Job First-SJF)** amongst the set of processes is executed first. Develop a program in C to carry out the following tasks: i) Read a set of processes along with the CPU burst time, arrival time (may be assumed as 0) for each process ii) Allocate the processor to the process which has arrived first (**apply FCFS)** and compute the average waiting time and average turnaround time. iii) Allocate the processor to the process which has shortest CPU burst time (**apply SJF**) and compute the average waiting time and average turnaround time. Compare the performance of both.	Scheduling concept	Programming with C
4	The scheduler may apply different policies to select a process for execution when there is more than one process ready for execution. The policy may be the process which has highest priority (**Priority based scheduling)** amongst all the processes arrived for execution. Develop a program for carrying out the following tasks i) read a set of processes along with the CPU burst time, arrival time (may be assumed as 0) and the priority for each process ii) allocate the processor to the process which has the highest priority and compute the average waiting time and average turnaround time	Scheduling concept	Programming with C
5	Given the list of processes and their CPU burst time, arrival time, the Scheduler may apply a different policy that "each process is given certain amount of execution time called time slice or quantum time" and after completion of time slice, another process in queue is taken for execution. This procedure repeats until all the processes in the list get	Scheduling concept	Programming with C

	executed for fixed amount of time. Later, the first process in the queue is selected for the execution once again. This process repeats until the completion of execution of all the processes. **This technique is called Round Robin Technique.** Develop a program for carrying out the following tasks i) read a set of processes along with the CPU burst time, arrival time (may be assumed as 0) and the time slice or time quantum ii) allocate the processor to the processes in the order of their arrival based on arrival time and execute each of them for fixed amount of time (Time quantum). iii) After completion of first round, if execution of processes is not completed, repeat the step ii) iv) compute the average waiting time and average turnaround time		
6	Consider an example of multi-process synchronization problem, where producer produces the data and stores at some location which will be accessed by another process called Consumer. Since, the producer and consumer share a common, fixed size buffer, there will be a synchronization problem. The solution can be obtained by using semaphores to establish inter process communication with synchronization. Develop a program in C to implement Producer-Consumer Problem by using semaphores to establish inter process communication with synchronization. Create two separate threads, one for producer and another one for consumer. When producer is getting executed, consumer must be in waiting state and vice-versa.	Process synchronization	Programming with C
7	Consider a set of processes, where each process holds some resources with it and requests for some more resources to complete its execution. But, when process P1 is requesting for resource R1 which is being used by P2 and if P2 is requesting for R2 which is held by P1, dead lock occurs and execution does not continue. Banker's Algorithm is used to avoid such deadlocks. Develop a program in C to implement Banker's Algorithm which finds whether the state is safe or not after allocating the resources requested by the processes.	Process synchronization	Programming with C
8	The operating system replaces the old page of a process whenever a new page of the same process is to be loaded into memory. To select the page for replacement, OS may choose a policy that "the page which has not been used for the longest period of time is to be replaced first". It is termed as Least recently used technique. Develop a C program to implement LRU page replacement algorithm.	Page replacement Algorithm	Programming with C

9	When a process with different size arrives to main memory for loading, Find the frame which is larger than the page arrived and store the page in that frame. This strategy is termed as First fit memory allocation technique. Develop a program in C to implement the First fit memory allocation technique.	Memory management	Programming with C
10	The operating system manages storage of information by creating and storing information in the file. The memory required for a new file may be allocated using one of the methods such as Linked list, Indexed or Contiguous method. Develop a C program to implement any one of the file allocation techniques (Linked, Indexed or Contiguous).	File Management	Programming with C

Course Title	Database Management System Lab				Course Type		Practical	
Course Code	B20CI0406	Credits	1		Class		IV semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

COURSE OVERVIEW:

This course introduces topics such as conceptual data modelling, relational data model, relational query languages, and relational database design. It helps the students to gain fundamental concepts, techniques and applications in database.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Explain the basics of Database Management System.
2. Demonstrate the use of Relational model and Relational algebra.
3. Illustrate the use of different SQL statements.
4. Discuss the topics such as Database Design and Normalization.

COURSE OUTCOMES(COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Design conceptual entity relationship diagrams for the real world applications.	1 to 5, 10,12	1,2
CO2	Make use of the concepts of relational algebra to solve queries over database.	1 to 5,12	1,2
CO3	Construct the database for given real world application and solve queries over it using SQL commands.	1 to 5,12	1,2,3
CO4	Develop an optimized database using design guidelines and normalization technique.	1,to 5,12	1,2
CO5	Learn new tools and technologies in DBMS and apply for suitable application development.	12	1
CO6	Develop solutions and create better database, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√	√		

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2					1		1	3	3	
CO2	3	3	2	3	1							1	3	3	
CO3	3	3	2	3	3							1	3	3	3
CO4	3	3	2	3	1							1	3	3	
CO5												3	2		
CO6					2				3	2			3	3	

Note: 1-Low,2-Medium,3-High

PRACTICE:

S.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1	Consider the following schema for Order Database: SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER (Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id) Write SQL queries to 1. Count the customers with grades above Bangalore's average. 2. Find the name and numbers of all salesmen who had more than one customer. 3. List all salesmen and indicate those who have and don't have customers in their cities (Use UNION operation.) 4. Create a view that finds the salesman who has the customer with the highest order of a day. 5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted	SQL PLUS	Solving queries using SQL

2	Specify the following queries on the Flight relational database schema using SQL Flights(*flno:* integer, *from:* string, *to:* string, *distance:* integer, *departs:* time, *arrives:* time) Aircraft(*aid:* integer, *aname:* string, *cruisingrange:* integer) Certified(*eid:* integer, *aid:* integer) Employees(*eid:* integer, *ename:* string, *salary:* integer) 1.Find the eids of pilots certified for some Boeing aircraft. 2. Find the names of pilots certified for some Boeing aircraft. 3. Find the aids of all aircraft that can be used on non-stop flights from Bonn to Madras. 4. Identify the flights that can be piloted by every pilot whose salary is more than $100,000. 5. Find the names of pilots who can operate planes with a range greater than 3,000 miles but are not certified on any Boeing aircraft. 6. Find the eids of employees who make the highest salary. 7. Find the eids of employees who make the second highest salary.	SQL PLUS	Solving queries using SQL

3	Solve the below queries by using SQL Student(snum, sname, major, level, age) Class(cname, meets at, room, fid) Enrolled(snum, cname) Faculty(fid, fname, deptid) The meaning of these relations is straightforward; for example, Enrolled has one record per student-class pair such that the student is enrolled in the class. Queries 1. Find the names of all juniors (Level = JR) who are enrolled in a class taught by I. Teacher. 2. Find the age of the oldest student who is either a History major or is enrolled in a course taught by I. Teacher. 3. Find the names of all classes that either meet in room R128 or have five or more students enrolled. 4. Find the names of all students who are enrolled in two classes that meet at the same time. 5. Find the names of faculty members who teach in every room in which some class is taught. 6. Find the names of faculty members for whom the combined enrollment of the courses that they teach is less than five. 7. Print the Level and the average age of students for that Level, for each Level. 8. Print the Level and the average age of students for that Level, for all Levels except JR. 9. Find the names of students who are enrolled in the maximum number of classes. 10. Find the names of students who are not enrolled in any class.	SQL PLUS	Solving queries using SQL

4	Solve the below queries by using SQL branch (branch-name, branch-city, assets) customer (customer-name, customer-street, customer-city) account (account-number, branch-name, balance) loan (loan-number, branch-name, amount) depositor (customer-name, account-number) borrower (customer-name, loan-number) employee (employee-name, branch-name, salary) 1. Find the names of all customers. 2. Find the names of all branches in the loan relation, don't display duplicates. 3. Display the entire Branch table. 4. Find the account number for all accounts where the balance is greater than $700. 5. Find the account number and balance for all accounts from Brighton where the balance is greater than $800. 6. Display the branch name and assets from all branches in thousands of dollars and rename the assets column to 'assets in thousands'. 7. Find the name of all branches with assets between one and four million dollars. 8. Find the name, account number, and balance of all customers who have an account. 9. Find the name, account number, and balance of all customers who have an account with a balance of $400 or less.	SQL PLUS	Solving queries using SQL
5	Consider the following schema for a Library Database: BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Name, Address, Phone) BOOK_COPIES (Book_id, Branch_id, No-of_Copies) BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH (Branch_id, Branch_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. 5. Create a view of all books and its number of copies that are currently available in the Library.	SQL PLUS	Solving queries using SQL

Course Title	Communication Skills				Course Type		Theory	
Course Code	B20AH0301	Credits	2		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**2**	**2**	**2**	**26**	**-**	**50%**	**50%**

COURSE OVERVIEW:

This course is to develop basic communication skills in English in the learners, to prioritize listening and reading skills among learners, to simplify writing skills needed for academic as well as work place context, to examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Develop basic communication skills in English.
2. Emphasize on the development of speaking skills amongst learners of Engineering and Technology
3. Impart the knowledge about use of electronic media such as internet and supplement the learning materials used in the classroom.
4. Inculcate the habit of reading and writing leading to effective and efficient communication.

COURSE OUTCOMES (Cos):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using	1 to 3, 12	1,3
CO2	Build inferences from the text.	1 to 4 ,12	2
CO3	Make use of accurate writing skills using different components of academic writing.	1 to 5,12	2
CO4	Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic	1 to 5,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2					√	
CO3			√			
CO4			√			

COURSE ARTICULATION MATRIX:

CO#/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3									1	3		1
CO2	3	3	3	3								1		3	
CO3	3	3	3	3	3							1		2	
CO4	3	3	3	3	3							1		3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1 Functional English: Grammar: Prepositions; Modal Auxiliaries, Reading Comprehension, Active and passive voice, Giving Instructions.
UNIT – 2 Interpersonal Skills: Grammar: Tenses; Wh-questions, Compound words; Phrasal verbs, Recommendations
UNIT – 3 Multitasking Skills Grammar: Conditional Sentences, Homonyms; homophones, Subject- verb agreement.
UNIT – 4 Communication Skills Grammar: Direct and indirect speech, Interpreting visual materials(line graphs, pie charts etc.), Single word substitutes.

TEXT BOOKS:

1. Green, David. Contemporary English Grammar Structures and Composition, NewDelhi: MacMillan Publishers,20l0,
2. Thorpe, Edgar and Showick, Basic Vocabulary. Pearson Education India, 20l2.
3. Leech, Geoffrey and Jan Svartvik, A Communicative Grammar of English, Longman,2003.

REFERENCES:

1. Murphy, Raymond " Murphy's English Grammar with CD",CambridgeUniversityPress,2004.
2. Rizvi,M .Ashraf, "Effective Technical Communication", New Delhi, TataMcGraw-Hill,2005.
3. Riordan, Daniel, "Technical Communication", New Delhi: Cengage Publications,20ll.
4. Senetal, "Communication and Language Skills" CambridgeUniversityPress,2015.

Course Title	Indian Constitution and Professional Ethics				Course Type		Theory	
Course Code	B20LS0301	Credits	2		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**2**	**2**	**2**	**26**	**-**	**50**	**50**

COURSE OVERVIEW

The Constitution of India lays down in defining fundamental political principles, establishes the structure, procedures, powers and duties of government institutions and sets out fundamental rights, directive principles and duties of citizen. It helps to know and understand the human rights and human values. It also helps to know the meaning of ethics and need of ethics in personal and professional life.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain basic knowledge required to understand Constitution of India.
2. Describe the Fundamental Rights, Duties and other Rights.
3. Discuss different types of ethics.
4. Explore ethical standards followed by different companies.

COURSE OUTCOMES (COs)

After thecompletion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution.	1 ,6,7,8,9, 12	1,3
CO2	Demonstrate the practicality of Constitution perspective and make them face the world as a bonafide citizen.	1 to 4,7,8 ,12	2
CO3	Illustrate the professional ethics and human values.	1 to 5, 7,8 ,12	2
CO4	Summarize ethical standards followed by different companies.	1 to 5,7,8,12	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2					√	
CO3			√			
CO4			√			

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2	2	2	2			1	3		1
CO2	3	3	3	3			3	3				1		3	
CO3	3	3	3	3	3		3	3				1		2	3
CO4	3	3	3	3	3		3	3				1		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Indian constitution: Sailent features, fundamental rights and duties (Directive principle and statepolicy), Legislature (Loka Sabha &Rajya Sabha), Executive (President& Governor) and Judiciary (Supreme court & high court), Composition and function of parliament, Council of ministers, prime minister, Speaker, Passing of bills.

UNIT – 2

Human Rights: Nature and Scope of human rights, Universal protection of human rights (UDHR),Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups (children, women & old-age).

Human values: Truth, Honesty, Loyalty, Love, Peace with examples, Difference between ethics, beliefs and morals.

UNIT – 3

Ethics: Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, human values(Good conduct, respect for elders), ethical human conduct (Gender equality), Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

Course Title	Universal human values				Course Type		Theory	
Course Code	B20AHM401	Credits	0		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	0	0	0	0	0	50%	50%

UNIT – 4

Engineering Ethics: Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence

TEXT BOOKS:

1.Kapoor, S.K., "Human rights under International Law and Indian Law", Prentice Hall of India, New Delhi, 2002.

2. Basu, D.D., "Indian Constitution", Oxford University Press, New Delhi, 2002.

3. Chakraborty, S.K., "Values and ethics for Organizations and Theory Practice", Oxford University Press, New Delhi, 2001.

REFERENCES BOOKS:

1. Meron Theodor, "Human Rights and International Law Legal Policy Issues", Vol. 1 and 2, Oxford University, Press, New Delhi, 2000.

2. M V Pylee, "An Introduction to Constitution of India", S Chand & Company, 5th Edition

3. Durga Das Basu, "Introduction to constitution of India", LexisNexis, 23rd Edition.

SELF-LEARNINGEXERCISES:

Abuse of Technologies: Hacking and other crimes, addiction to mobile phone usage, video games and social networking websites.

COURSE OVERVIEW

Universal human values help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.

2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

3. Strengthening of self-reflection.

4. Development of commitment and courage to act

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession	1 to 3, 12	1,3
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	1 to 4 ,12	2
CO3	Understand the role of a human being in ensuring harmony in society and nature.	1 to 5,12	2
CO4	Demonstrate the role of human being in the abetment of pollution	1 to 5,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level					
CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2					√	
CO3			√			
CO4			√			

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3									1	3		1
CO2	3	3	3	3								1		3	
CO3	3	3	3	3	3							1		2	3
CO4	3	3	3	3	3							1		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1
Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship, basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly, Method to fulfil human aspirations: understanding and living in harmony at various levels, Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seeker and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
UNIT – 2
Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family
UNIT – 3
Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.
UNIT – 4
Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

TEXT BOOKS:

1. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010

2. A.N Tripathy, Human Values, New Age Intl. Publishers, New Delhi, 2004.

3. R.R. Gaur, R. Sangal and G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi, 2010

4.Bertrand Russell, Human Society in Ethics & Politics, Routledge Publishers, London, 1992

REFERENCE BOOKS:

1.Corliss Lamont, Philosophy of Humanism, Humanist Press, London, 1997

2. I.C. Sharma, Ethical Philosophy of India Nagin & co Julundhar, 1970

3. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth, Navajivan Mudranalaya, Ahmadabad, 1993

4. William Lilly, Introduction to Ethics, Allied Publisher, London, 1955.

Detailed Syllabus

Semester 5

Course Name	Web Technologies & Applications				Course Type		Theory	
Course Code	B20EJ0501	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The basics of Web application tools such as HTML, XHTML and CSS are introduced. The course also provides knowledge about advanced research topics such as XML, Perland PHP.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Understand the various steps in designing a creative and dynamic website.
2. Describe the hierarchy of objects in HTML and XML.
3. Design dynamic and interactive web pages by embedding Java Script code in HTML.
4. Illustrate the advantages and use of different types of CSS.
5. Examine the HTML. Know how to use Dynamic HTML.
6. Familiarize server side scripting language like Perl &PHP.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the concepts of WWW including browser and HTTP protocol and summarize the various HTML tags and use them to develop the user- friendly web pages.	2,3,7,11	1,2
CO2	Define the CSS with its types and use them to provide the styles to the web pags at various levels.	2-5	2,3
CO3	Develop the modern web pages using the HTML and CSS features with different layouts as per need of applications.	1,4,8,9,11	2,3
CO4	Apply Java Script to develop the dynamic web pages and use server side Scripting with PHP to generate the web pages dynamically using the database connectivity.	1-4,11,12	2,3
CO5	Examine the HTML .Know how to use Dynamic HTML.	2,3,4,5	2,3
CO6	Familiarize server side scripting language like Perl & PHP.	2-5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2		√	√	√		
CO3			√			
CO4			√	√	√	
CO5		√	√	√	√	
CO6		√	√	√	√	

COURSE ARTICULATION MATRIX

CO#/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1				1				1		2	2	
CO2		2	3	1	1									3	1
CO3	1	2	1	2				3	1		1			2	1
CO4	1	2	3	1							1	1		2	1
CO5		2	2	3	1									2	2
CO6		1	2	3	1								1	2	

Note:1-Low,2-Medium,3-High

Course Contents

Theory

Contents
UNIT-1
Web Essentials: Clients, Servers, and Communication. The Internet- Basic Internet Protocols -The World Wide Web- HTTP request message- response message-Web Clients Web Servers-Case Study. Mark up Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics- Some Fundamental HTML Elements- Relative URLs- Lists- tables- Frames- Forms XML Creating HTML Documents. Representing Web Data: XML- Documents and Vocabularies-Versions and Declaration-Name spaces Java Script and XML

UNIT-2
Style Sheets: Lists, Tables, Forms, Frames CSS: Introduction, Levels of style sheets, Style specification formats ,Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. Java script: Over view of Java script, Object orientation and Java script, Syntactic characteristics, Primitives, operations, and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors.
UNIT-3
Perl, CGI Programming: Origins and uses of Perl, Scalars and their operations, Assignment statements and simple input and output, Control statements, Fundamentals of arrays, Hashes, References, Functions, Pattern matching, File input and output; Examples. The Common Gateway Interface; CGI linkage; Query string format; CGI.pm module; Cookies. Data base access with Perl and MySQL
UNIT-4
Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP. PHP and MySQL: Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, Altering tables, queries, deleting database, deleting data and tables.

TEXT BOOKS:

1. Robert.W.Sebesta,"Programming the World Wide Web",Fourth Edition,Pearson.
2. Education,2007 Jeffrey C .Jackson, "Web Technologies A Computer Science Perspective", Pearson Education, 2006. 2007.

REFERENCE BOOKS:

1. Deitel, Goldberg, "Internet & World Wide Web How to Program", Third Edition, PearsonEducation,2006.
2. Marty Hall and Larry Brown, “Core Web Programming” Second Edition, Volume I and II, PearsonEducation,2001.
3. Bates,“DevelopingWebApplications”,Wiley,2006.

JOURNALS/MAGAZINES:

1. International Journal of WebTechnology-ISSN:2278-2389
2. International Journal of Web & Semantic Technology (IJWesT)
3. ELSEVIER Journals with in "Internet And Web Technology”

SWAYAM/NPTEL/MOOCS:

1. Coursera-Web Design: Wire frames to Prototypes
2. Coursera–Web Application Technologies and Django
3. https://nptel.ac.in/courses/106/105/106105084/
4. https://www.edx.org/learn/web-development

SELF LEARNING EXERCISES:

HTML5, JQuery, XML, Ruby, Introduction to REST and REST ful API

Course Title	Computer Networks				Course Type		Theory	
Course Code	B20CI0501	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The main emphasis of this course is on the organization and management of local area networks(LANs).The course description include learning about computer network organization and implementation, obtaining a the or etical understanding of data communication and computer networks, and about Open Systems Interconnection(OSI) communication model with TCP/IP protocol; This course provides knowledge of error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing; and local and remote procedures. This course also emphasis on User Datagram Protocol, TCP Congestion Control; DNS Message Formatting and Remote Login. Protocols

COURSE OBJECTIVE(S):

The main objectives of this course are:

1. Explain the protocol stacks (OSI and TCP/IP) for data communication
2. Discuss the error detection & correction strategies for data transmission.
3. Design the connection establishment of network computing devices.
4. Illustrate the TCP, UDP protocols and explain Domain Name System.
5. Emphasis the management of local area networks
6. Learning about computer network organization and implementation

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the architectural principles of computer networking and compare different approaches to organizing networks.	1to6,12	1
CO2	Identify the good network design with simplicity, scalability, performance and the end-to-end principle.	1to6,12	1
CO3	Appraise the working principles of Internet.	1to6,12	1
CO4	Develop applications using network protocols.	1to6,12	1,2,3
CO5	Emphasis the management of local area networks	1to6,12	2,3
CO6	Learning about computer network organization and implementation	1to6,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1		√		√		√
CO2					√	√
CO3	√				√	√
CO4						√
CO5	√	√	√	√		
CO6	√	√	√	√	√	

COURSE ARTICULATION MATRIX

CO#/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1						1	3		
CO2	3	3	3	3	2	2						1	3		
CO3	3	3	3	3	2	1						2	3		
CO4	3	3	3	2	2	1						1	3	3	3
CO5	3	3	3	2	2	1						2		3	3
CO6	3	3	3	2	2	1						2	2	3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1 **Introduction to Data Communication and Networking:** Internet history and Internet today, Data Communications, Networks, Network Topologies, Classification of Networks, Protocols &Standards, Introduction to Network Tools-(WireShark, Packet Tracer, NS3, etc), Layered Tasks, The OSI model, Layers in OSI model, TCP/IP Protocol suite, Addressing. Introduction to switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks, Physical Layer – Periodic Analog signals, Digital signals, Request bit rate, Shannon capacity, performance, PCM, DM, Parallel transmission, serial transmission, ASK, FSK, PSK, QAM, AM, FM, PM.
UNIT-2 **Coding:** Line Coding and block coding. Multiplexing: FDM, WDM, TDM, FHSS, DSSS. Transmission Media. **Error Detection and Correction**: Introduction, cyclic Codes: Cyclic redundancy code generation. Frames, Packets, Data Link Protocols: HDLC, Point-to-Point Protocol. **MAC Protocols**: classification of MAC protocols, Random access (ALOHA, CSMA/CD, CSMA/CA), Controlled Access (Reservation, Polling, Token passing), Channelization Protocols (FDMA, TDMA, CDMA) **Introduction to Networking Devices**: Digital Subscriber line Modems, Cable modems, Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways, Virtual LAN.
UNIT-3 **Standards:** IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet. IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism. Bluetooth Architecture. Introduction to Wireless networks Wi-Fi, WiMAX, 4G, 5G, Satellite networks, MPLS, VPN, ATM. **Network Layer**: IPv4 addresses, IP Datagram format, ICMP Messages, Mobile IP, IPv6 addresses, IPv6 Packet Format, Transition from IPv4 to IPv6, Routing algorithms (Distance Vector, Link State and Path vector), Unicast Routing protocols(RIP, OSPF), Introduction to BGP, Introduction to Multicasting protocols, brief introduction to multicast protocols such DVMRP, MOSPF, PIM, IGMP.
UNIT-4 **Transport Layer:** Introduction to Go Back-N, Selective repeat N, Piggybacking. Services and port numbers, User Datagram Protocol (UDP): UDP Segment, Transmission Control. Protocol (TCP): TCP Segment, TCP Connection Set up, Application of TCP and UDP. TCP flow control, TCP error control, TCP Congestion Control and options. Introduction to SCTP services and features. **Application Layer**: Client server programming using UDP and TCP, Name/Address Mapping, DNS Message Format.

TEXT BOOKS:

1. Behrouz A Forouzan, “Data Communications and Networking”, 5th Edition, McGraw – Hill, 2016.
2. Nader F. Mir, “Computer and Communication Networks”, Pearson Education, 2009.

REFERENCE BOOKS:

1. Alberto Leon-Garcia and Indra idjaja, “Communication Networks – Fundamental Concepts and Key Architectures”, 2nd Edition Tata McGraw – Hill, 2004.
2. Andrew S. Tanenbaum, “Computer Networks”, 4th Edition, Pearson Education, 2005.
3. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A system Approach”, 5th Edition, Elsevier, 2012.
4. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2008.
5. Douglas E. Comer, “Internetworking with TCP/IP”, Vol.1, 6th Edition, Pearson, 1995.
6. IEEE Transactions on Networking.
7. Elsevier Journal of Computer Networks
8. Springer Journal of Communications and Information Networks.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Networking.
2. Elsevier Journal of Computer Networks
3. Springer Journal of communications and Information networks.

SWAYAM/NPTEL/MOOCS:

1. https://www.udemy.com/topic/computer-network/
2. https://www.coursera.org/courses?query=computer%20network
3. https://nptel.ac.in/courses/106/105/106105183/
4. https://www.edx.org/learn/computer-networking

SELF LEARNING EXERCISES:

Remote Login. Protocols: TELNET Protocol and SSH Protocol. Electronic Mail (E-Mail), World Wide Web (WWW).

Course Title	**Smart Sensors and Transducers**				**Course Type**		**Theory**	
Course Code	**B20EK0501**	**Credits**	**4**		**Class**		**V semester**	
Course Structure	TLP	Credits	ContactHours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice				Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**5**	**39**		**50**	**50**

COURSE OVERVIEW

The course provides overview of various types of sensors and transducers, and also discuss their performance characteristics. The course also describes the different types of intelligent sensors which are self-adapting and self-validating. The concepts like linearization, calibration and compensation for sensors are also explained.

COURSE OBJECTIVE (S):

To make student understand the operation principles of different sensors for industrial and environmental use.

To equip the students to characterize the sensors in terms of metrological criteria and evaluate their performance.

To instill the ability among students to choose the appropriate sensor for measurement, process control and environmental monitoring applications and apply it in a correct way.

To provide the skills to implement simple data acquisition systems and to analyze and evaluate the acquired data.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Understand the operation principles of different sensors for industrial and environmental use.	1,2,3, 4, 8, 9, 12	1
CO2	Characterize the sensors in terms of metrological criteria and evaluate their performance.	1,2,3, 5,9,12	1
CO3	Choose the appropriate sensor for measurement, process control and environmental monitoring applications and apply it in a correct way.	1,2,3,4,5, 9, 12	2
CO4	Implement simple data acquisition systems and to analyze and evaluate the acquired data.	1,4,5,9,12	1
CO5	Explain the working principle of various inductance and capacitance transducers	1,5,8,9,12	1
CO6	Discuss the operation and applications of modern industrial transducers.	4,9,12	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√	√		
CO4			√	√	√	√
CO5		√				
C06			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2				1	1			1	3		
CO2	3	2	3		2				1			1	3		
CO3	3	1	2	1	2				1			1	3	3	
CO4	3			2	2				1			1	3		
C05	2				2			2	2			2	2		
C06				2					2			2	2		

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT-1

Classical Sensors and Transducers: Classification, Self-Generating Transducers, Variable Parameter Transducers: Resistance or Conductance Variation, Capacitance Variation Magnetic Properties Variation, Pulse or Frequency-Generating Type; Semiconductor Sensors: Semiconductor Thermal Sensors, Semiconductor Pressure Sensors, Semiconductor Magnetic Sensors, Hall-Effect Sensors, Photodiodes and Phototransistors; **Array-Based Sensors:**Preprocessing, Feature Extraction, Classification and Decision Making; Biosensors, Actuating Devices: Electrical Solenoid, Electrical Motors.

Sensor Performance Characteristics: Introduction, Static Characteristics: Accuracy and Precision; Error, Correction and Uncertainty; Repeatability, Reproducibility and Hysteresis; Sensitivity, Offset, and Dead Band; Resolution and Linearity, Statistical Characteristics, Error Modeling; Dynamic Characteristics: Dynamic Error and Dynamic Sensitivity; Input–Output Impedances.

UNIT-2

Intelligent Sensors: Introduction: Classification; Smart Sensors: Monolithic Integrated Smart Sensor, Hybrid Integrated Smart Sensors; Soft or Virtual Sensors: Soft Sensor Secondary Variable Selection: Rough Set Theory; **Model Structures**: Artificial Neural Network Models; **Self-Adaptive Sensors**: Algorithmic Adaptation with Nonredundant Time of Measurement, Frequency to Digital Conversion Using Microcontroller; Self-Validating Sensors: **Functional Validation**: Numerical Method Artificial Intelligence for Sensor Validation, Neural Network–Based Approach; VLSI Sensors; Temperature Compensating **Intelligent Sensors**: Effects of Temperature on Sensors; Temperature Compensation Techniques: Circuit Compensation; Examples of Temperature Compensation in Sensor: Temperature Compensation of Thermal Flow Sensors, Temperature Compensation of Hot Film Crosswind Sensor, Integrated Hardware Compensation of Pressure Sensor,

Integrated Compensation for Pressure Sensor; **Microcontroller-Based Compensation**: Frequency Control, Sensitivity Slope Control.

UNIT-3

Linearization, Calibration, and Compensation: Introduction; Analog Linearization of Positive Coefficient Resistive Sensors: Linearization by Shunt Resistance: Positive Feedback OPAMP Circuit (Current Source), Positive Feedback OPAMP Circuit(Voltage Source), Linearization Using Feedback Amplifier; Nonlinear ADC- and Amplifier-Based Linearization: Nonlinear Counting–Type ADC; Interpolation: Linear Interpolation; Piecewise Linearization: Analog Processing, Digital Processing: Lookup Table–Based ADC, Piecewise Linear ADC; Microcontroller-Based Linearization: Lookup Table Method; Artificial Neural Network–Based Linearization; Nonlinear Adaptive Filter–Based Linearization; **Sensor Calibration**: Conventional Calibration Circuits, Resistor Adjustment–Based Analog Calibration, Digitally Programmable Resistor; Multiplying DAC Calibration; Offset Calibration; Pulse-Modulated Calibration; ADC Calibration: Sigma–Delta ADC Calibration; **Offset Compensation**: Improved Manufacturing Process; Error and Drift Compensation: Drift Simulation; Lead Wire Compensation: Self-Heating Method.

UNIT-4

Sensors with Artificial Intelligence: Introduction: Artificial Intelligence: Reasoning, Knowledge, Planning, Learning; Sensors with Artificial Intelligence: Multidimensional Intelligent Sensors: Gas Classification and Recognition, Localization and Spatial Distribution; AI for Prognostic Instrumentation: Identification of Failure Predictors, Sensors for Measurement of Conditions, Data Storage, Processing, and Analysis, Fault and Degradation Models, Estimation of Failure and Degradation and Artificial Intelligence–Based Prognostics; ANN-Based Intelligent Sensors: Linearization and Calibration by ANN, Compensation of Error by ANN, Soft Sensing by ANN, Fault Detection by ANN; Fuzzy Logic–Based Intelligent sensors.

TEXTBOOKS:

1. ManabendraBhuyan. “Intelligent Instrumentation-Principles and Applications”, CRC Press,2011.

REFERENCEBOOKS:

Randy Frank,” Understanding Smart Sensors”, ARTECH HOUSE, 2013.

JOURNALS/MAGAZINES

1. Smart Sensors, Measurement and Instrumentation, Springer.

SWAYAM/NPTEL/MOOCs:

1. Coursera - Sensors and Sensing Techniques.
2. https://onlinecourses.nptel.ac.in/noc21_ee32/preview

SELF-LEARNINGEXERCISES:

1. Signals and System Dynamics

2. Intelligent Sensor Standards and Protocols

Course Title	Machine Learning				Course Type		Theory	
Course Code	B20CI0502	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50%**	**50%**

COURSE OVERVIEW:

Course Description: Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can process through large volumes of data at high speed to make predictions or decisions without human intervention.

COURSE OBJECTIVES:

The objectives of this course are to:

1.Explain machine learning and problems relevant to machine learning.

2.Discuss the fundamentals of Decision trees learning and its issues

3.Illustrate neural networks, Bayes classifier and k nearest neighbour for problems appearing in machine learning.

4.Describe statistical analysis of machine learning techniques.

COURSE OUTCOMES (COs)

On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the basics of machine learning concepts.	1 to 5	1,2,3
CO2	Implement suitable classification technique for intelligent applications	1 to 5	1,2,3
CO3	Implement clustering algorithms for intelligent applications	1 to 5	1,2,3
CO4	Implement machine learning algorithms for intelligent applications	1 to 5	1,2,3
CO5	Learn new tools and technologies related to machine learning and apply for suitable application development.	10,12	2,3
CO6	Develop solutions using machine learning based algorithms for the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	11,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						√
CO2			√			√
CO3				√		√
CO4				√	√	√
CO5		√		√		
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1								3	3	3
CO2	3	2	3	1	2								3	3	3
CO3	3	1	2	1	2								3	3	3
CO4	3	2	2	2	2								3	3	3
CO5										2		3		2	2
CO6											3	3		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

Contents
Unit-1:
Introduction to Machine Learning: What is Machine Learning, challenges, Applications, methods of Machine Learning, performance metrics, Data preprocessing, Data Loading, Understanding data, Pre-Processing unit
Unit-2:
Classification – Decision Tree, K-nearest neighbor, logistic regression, support vector machine algorithm, naive Bayes algorithm, random forest algorithm
Unit -3:
Regression - linear regression, Random Forest Regression Clustering: overview, k – means clustering, mean shift clustering, hierarchical clustering, DBSCAN clustering algorithm.
Unit – 4
Introduction to neural networks: Biological Neuron, ANN Perception, Network Topology (Feed forward network, Feedback Networks), Adjustments of Weights or Learning, Activation Functions, Training Algorithm, Gradient descent algorithms - Batch Gradient Descent, Stochastic Gradient

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition McGraw Hill Education, 2013.

Websites:

1. https://www.tutorialspoint.com/machine_learning_with_python/index.htm
2. https://www.tutorialspoint.com/artificial_neural_network/index.htm

RECOMMENDED LEARNING RESOURCES (REFERENCE BOOKS):

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", 2nd edition, springer series in statistics.

2. Ethem Alpaydın, "Introduction to machine learning", second edition, MIT press.

JOURNALS/MAGAZINES:

1. Springer Journal of Machine Learning.

2. International Journal of Machine Learning and Computing.

SWAYAM/NPTEL/MOOCs:

1. Coursera – Machine Learning

2. Coursera – Deep Learning

3. https://onlinecourses.nptel.ac.in/noc19_cs53/preview

SELF-LEARNING EXERCISES:

Reinforcement Learning: Introduction, Learning Task, Q Learning

Course Title	Introduction to Robotics & Drones (PE-1)				Course Type		Theory	
Course Code	B20EKS501	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

This course introduces techniques, algorithms and principles of interactive computer graphicsand animation, this course also prepares for study in real-time rendering, realistic image synthesis, and computer animation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the fundamental concepts of Robotics.
2. Explain intelligent module for robotic motion control.
3. Demonstrate robotic vision system using transformation techniques.
4. Illustrate the working of innovative robotic devices.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Outline the fundamentals and architecture of robotics.	1,2,3,4,5	1, 2
CO2	Design an Intelligent module to control robotic system.	1,2,3,4,5	1, 2
CO3	Develop robotic vision system using transformation techniques and sensors.	1,2,3,4,5,9	1, 2
CO4	Make use of innovative robotic devices for industrial and socially relevant applications.	1,2,3,4,5	1, 2
CO5	Learn new tools and technologies in the introduction to drones and robotics and apply for suitable application development.	12	1, 2

CO6	Develop solutions in the introduction to drones and robotics to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				√
CO3				√	√	√
CO4			√		√	√
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2								3	3	
CO2	3	3	3	3	3								3	3	
CO3	3	3	3	3	3				1				3	3	
CO4	3	3	2	2	2								3	3	
CO5	3	3		2									3		3
CO6	3	3	2		2								3		3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1
Introduction: Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot- Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system.
UNIT-2
End effectors and robot controls: Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Illustration using ARDUINO Boards
UNIT-3
Robot transformations and sensors: Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, and Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors, Illustration using ARDUINO Boards
UNIT-4
Robot cell design and applications :Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot. Introduction to robotic operating system (ROS) .

TEXT BOOKS:

1. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education, 2009.

2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss,Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012.

REFERENCE BOOKS:

1. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin,“Robotics Engineering an Integrated Approach”, Phi Learning.,2009.

2. Francis N. Nagy, AndrasSiegler, “Engineering foundation of Robotics”, Prentice Hall Inc., 1987.

3. P.A. Janaki Raman, “Robotics and Image Processing an Introduction”, Tata McGraw Hill Publishing Company Ltd., 1995

4. Carl D. Crane and Joseph Duffy, “Kinematic Analysis of Robot manipulators”, Cambridge University press, 2008.

5. Craig. J. J., “Introduction to Robotics mechanics and control”, Addison- Wesley, 1999.

6. Elsevier Journal of Robotics and autonomous systems.

7. IEEE Journal on robotics and automation.

JOURNALS/MAGAZINES

Drones in humanitarian contexts, robot ethics, and the human–robot interaction, Springer Journal

SWAYAM/NPTEL/MOOCS:

1. Robotics: Aerial Robotics – Coursera
2. https://onlinecourses.nptel.ac.in/noc20_de11/preview

SELF-LEARNING EXERCISES:

MICRO/NANO ROBOTICS SYSTEM, MATLAB, NXT Software, Bio inspired Robots, Home automation Robots.

SELF- LEARNINGEXERCISES:

1. Experiment with problems on Kaggle.com
2. Tweak the given solutions with changes to hyper-parameters

Course Title	**Predictive Analytics Using Python (PE-I)**				**Course Type**		**Theory**	
Course Code	**B20EKS502**	**Credits**	**3**		**Class**		**Vsemester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course focuses on Predictive Analytics using Python. This course introduces basics of Python and code some simple programs. The purpose is to predict the future by using the programming concepts of Python, to help in making good decisions. It presents the enormous opportunities and power associated with our ability to interrogate complex datasets, extract useful information, derive knowledge, and provide actionable forecasting. Biomedical, healthcare, and social datasets will provide context for addressing specific driving challenges. Students will learn about modern data analytic techniques and develop skills for importing and exporting, cleaning and fusing, modelling and visualizing, analyzing and synthesizing datasets. This course benefits is to understand the basics of data science and the implementation of the Predictive Analytics for future decisions.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Outline the fundamentals of 'Python' programming.
2. Explore few statistical methods that can apply for data manipulation and importing techniques.
3. Discuss different Regression techniques.
4. Illustrate the working of clustering algorithms using Python.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Explain the fundamentals of Python Programming Language	1,2,3,4,5,6	1,2
CO2	Apply and compare basic machine learning techniques using Python for	1,2,3,4,5,6	1,2
CO3	Discover different data wrangling methods.	1,2,3,4,5,6	1,2
CO4	Justify the statistical concepts of predictive modeling.	1,2,3,4,5,6	2
CO5	Design and Develop algorithms to learn Regression techniques for data analysis	1,2,3,4,5,6	2
CO6	Propose different analytics and build models for real world data science problems	1,2,3,4,5,6	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√			√	
CO2			√			
CO3				√		
CO4					√	
CO5						√
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2							3	3	
CO2	3	2	3	2	2	1							3	3	
CO3	3	2	2	2	1	1							2	2	
CO4	3	2	3	3	2	1								3	
CO5	3	2	3	3	2	1								3	
CO6	3	2	2	3	3	1								3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

Contents
UNIT 1
A brief introduction to Python : Introduction to Python: Installing Python: Python on Windows; Python on RedHat Linux; Python Installation from source; The Interactive Shell Your First Python Program: Diving in; Declaring Functions; Documenting Functions; Everything Is an Object; Indenting Code; Testing Modules Native Datatypes: Introducing Dictionaries; Introducing Lists; Introducing Tuples; Declaring variables; Formatting Strings; Mapping Lists; Joining Lists and Splitting Strings The Power of Introspection: Diving In; Using Optional and Named Arguments; Using type, str, dir, and Other Built−In Functions; Getting Object References With getattr; Filtering Lists; Using lambda Functions; Using Packages like numpy, scipy, scikit learn, matplotlib etc.,
UNIT 2
Getting Started with Predictive Modelling: Introducing predictive modelling, Applications and examples of predictive modelling, Installing and downloading Python and its packages, Working with different IDEs for Python. Data cleaning: Reading the data, various methods of importing data in python, basics- summary, dimensions, and structure, handlingmissing values, creating dummy variables, Visualizing a dataset by basic plotting.

UNIT 3
Data Wrangling, Subsetting a dataset, Selecting columns, Selecting rows, Selecting a combination of rows and columns, Creating new columns, Generating random numbers and their usage, Various methods for generating random numbers, Probability density function, Cumulative density function, Uniform distribution, Normal distribution, Using the Monte-Carlo simulation to find the value of pi, Geometry and mathematics behind the calculation of pi, Generating a dummy data frame, Grouping the data – aggregation, filtering, and transformation, Random sampling – splitting a dataset in training and testing datasets, Concatenating and appending data, Merging/joining datasets **Statistical Concepts for Predictive Modelling**: Random sampling and the central limit theorem, Hypothesis testing, Null versus alternate hypothesis, Z-statistic and t-statistic, Confidence intervals, significance levels, and p-values, Different kinds of hypothesis test, A step-by-step guide to do a hypothesis test, An example of a hypothesis test, Chi-square tests, Correlation.
UNIT 4
Linear Regression with Python: Understanding the maths behind linear regression, Linear regression using simulated data, Fitting a linear regression model and checking its efficacy, Finding the optimum value of variable coefficients, Making sense of result parameters, p-values, F-statistics, Residual Standard Error, Implementing linear regression with Python, Multiple linear regression, Multi-collinearity, Variance Inflation Factor, Model validation, Training and testing data split, Linear regression with scikit-learn, Feature selection with scikit-learn, Handling other issues in linear regression, Handling categorical variables, Transforming a variable to fit non-linear relations, Handling outliers, Other considerations and assumptions for linear regression **Logistic Regression with Python:** Linear regression versus logistic regression, Understanding the math behind logistic regression Contingency tables, Conditional probability, Odds ratio, Moving on to logistic regression from linear regression, Estimation using the Maximum Likelihood Method, Building the logistic regression model from scratch, Making sense of logistic regression parameters, Implementing logistic regression with Python

TEXTBOOKS:

1. Ashish Kumar, “Learning Predictive Analytics with Python” :Packt Publishing, February 2016

2. Joseph Babcock, Ashish Kumar “Python: Advanced Predictive Analytics” Packt Publishing, December 2017.

3.JohnMaindonald, W. John Braun, “Data Analysis and Graphics Using R – an Example Based Approach”, 3rd Edition, Cambridge University Press, 2010.

4. Mark Pilgrim, Dive into Python, Copyright (C) 2000 Free Software Foundation

REFERENCE BOOKS:

1. Kenneth A. Lambert, Fundamentals of Python: First Programs (introduction to Programming), 1st Edition, CENAGELearning.

JOURNALS/MAGAZINES:

1. Springer, International Journal of Data Science and Analytics.

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_cs45/preview

2.Data Analysis with Python-Coursera

3.Python data products for Predictive Analytics -Coursera

SELF-LEARNING EXERCISES:

Data Visualization: Plotting line graph, bar graph, Scatter Plot & box plot

Course Title	**Cryptography & Network Security (PE-I)**				**Course Type**		**Theory**	
Course Code	**B20EKS503**	**Credits**	**3**		**Class**		**V semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Computers around the world are systematically being victimized by rampant hacking. The goal of the ethical hacker is to help the organization take preemptive measures against malicious attacks by attacking the system himself; all the while staying within legal limits. As technology advances and organization depend on technology increasingly, information assets have evolved into critical components of survival. If hacking involves creativity and thinking 'out- of-the-box', then vulnerability testing and security audits will not ensure the security proofing of an organization. To ensure that organizations have adequately protected their information assets, they must adopt the approach of 'defense in depth'. In other words, they must penetrate their networks and assess the security posture for vulnerabilities and exposure. This course helps develops individuals in the specific network security discipline of Ethical Hacking from a vendor-neutral perspective.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of cryptography.

2. Describe public key cryptography and message authentication.

3: Demonstrate the key distribution using Symmetric or Asymmetric encryption

4. Discuss security applications in the field of Information technology

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the fundamental concepts of cryptography.	1,2,3,4,5	1
CO2	Develop a program for implementing public key cryptography and	1,2,3,4,5	2
CO3	Build key distribution system using Symmetric or Asymmetric encryption	1,2,3,4,5	2, 3
CO4	Design and develop security applications in the field of Information technology.	1,2,3,4,5	2, 3
CO5	Implement encryption algorithms for real-wordapplications.	3,4,5	2,3
CO6	Differentiate many cryptography algorithms based on the requirement.	3,4,5	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√	√	√
CO3		√	√			√
CO4				√	√	√
CO5		√	√			
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1								3		
CO2	3	2	3	1	2									3	
CO3	3	1	2	2	3									3	3
CO4	2	2	2	1	1									3	3
CO5	2	2	2	1	1									3	3
CO6	2	2	2	1	1									3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1

Introduction: The OSI Security Architecture, Security Attacks, Security Services, mechanisms, Amodel for network security, symmetric encryption principles, Symmetric Block Encryption Algorithms, Data Encryption Standards, Strength of DES, Triple DES, Advanced Encryption Standard.

UNIT-2

Public-Key Cryptography and Message Authentication: Public key Cryptographic Principles,PublicKeyCryptographicAlgorithms(RSA, Diffie-Hellman), Approaches to MessageAuthentication, SecureHashFunctions(SHA-512), MessageAuthentication Codes, Digital Signatures. Introduction to Secure programming with the OpenSSL API: OpenSSL, Headers and initialization, Setting up an unsecured connection, Setting up a secure connection, Error detection.

UNIT-3

Network Security Applications: Symmetric key distribution using Symmetric encryption, Kerberos(Key Exchange), key distribution using Asymmetric encryption X.509 Certificate Format, Secure socket layer and transport layer security, PGP- Features of PGP, Key Rings in PGP, S/MIME, IP security Overview.

UNIT-4

System Security: Intrusion Detection, Password Management, Virus and threats, VirusCountermeasures, Firewalls, The Need for Firewalls, Firewall Characteristics, Types of Firewalls.Open Source Cryptography libraries -a C++98 crypto library, Mhash open source C library and Crypto ++.

TEXT BOOKS:

1.William Stallings, “Network Security Essentials Applications and Standards”, Fourth edition, Prentice Hall, 2011.

2.Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw Hill, 2007.

REFERENCE BOOKS:

1.William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson, Sixth edition, 2013

2. Joseph MiggaKizza,” Guide to Computer Security, Springer Science & Media In”c., Third edition, 2015

3.AndrewS.Tanenbaum, “Computer Networks”, Pearson, Fifth edition, 2015.

4.AtulKahate, “Cryptography and Network Security”, McGraw Hill, 2013.

JOURNALS/MAGAZINES:

1.Springer Journal of Cryptographic Engineering, ISSN 2190-8508

2.ACM,ACM- International Journal of Applied Cryptography, ISSN:1753-0563

3.IEEE, IEEE Transactions on Information Forensics and Security.

4.Elsevier, Journal of Information Security and Applications.

5. https://www.alienvault.com/blogs/security-essentials/open-source-network-security-tools-for-newbies.

SWAYAM/NPTEL/MOOCS:

1. Cryptography ad Network Security-Coursera

2. https://nptel.ac.in/courses/106/105/106105162/

SELF- LEARNING COMPONENT:

1. IOT complexity read to security issues and further DDOS attacks ,malware

2. Cloud security roles of AI and machine learning in cyber security

Course Title	Fuzzy Logic &Systems (PE-II)				Course Type		Theory	
Course Code	B20EAS504	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

Course Description: This course covers the introduction to Classical Sets, Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of Membership Functions, Fuzzification and Defuzzification, Development of Membership Functions, Decision Making with Fuzzy Information, Classification by Equivalence Relations, Fuzzy Pattern Recognition and to understand the difference between Logic and Fuzzy systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Provide insights about the basics of Classical Sets, Fuzzy Sets, Classical Relations and Fuzzy Relations.
2. Explain the Properties of Membership Functions, Fuzzification and Defuzzification and to identify the difference between Logic and Fuzzy systems.
3. Describe the Development of Membership Functions and to work with Decision Making using Fuzzy Information.
4. Classify Fuzzy System to know the interpretation of Fuzzy Pattern Recognition.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the fundamental concepts of Fuzzy sets, functions and classification to solve real world problems.	1,2,3,4,5	1, 2
CO2	Apply the different types of Fuzzy system and decision making with fuzzy.	1,2,3,4,5	1, 2
CO3	Develop Fuzzy logic to solve real life problems.	1,2,3,4	1, 2
CO4	Model the Fuzzy logic for the given problem domain.	1,2,3,4,5	1, 2
CO5	Learn new tools and technologies in the fuzzy logic and systems and apply for suitable application development.	12	1, 2

CO6	Develop solutions in to fuzzy logic and systems to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				√
CO2			√	√		
CO3				√		√
CO4				√	√	
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	1								3	3	
CO2	3	2	2	1	1								3	3	
CO3	3	2	2	1									3	3	
CO4	3	3	2	2	1								3	3	
CO5	3		2	2									3		
CO6	3	3	2										3	3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1
Introduction: Classical Sets and Fuzzy Sets: The Case for Imprecision, A Historical Perspective, The Utility of Fuzzy Systems, Limitations of Fuzzy Systems, The Illusion: Uncertainty and Accuracy, Uncertainty and Information, Fuzzy Sets and Membership, Chance versus Fuzziness, Sets as Points in Hypercube.
UNIT-2
Properties of Membership Functions, Fuzzification and Defuzzification: Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, Lambda -Cuts for Fuzzy Sets, Lambda - Cuts for Fuzzy Relations, Defuzzification to Scalars. **Logic and Fuzzy systems:** Part1 Logic, Part II Fuzzy Systems.
UNIT-3.
Development of Membership Functions - Membership Value Assignments. **Decision Making with Fuzzy Information:** Fuzzy Synthetic Evaluation, Fuzzy Ordering, Non - Transitive Ranking, Preference and Consensus, Multi Objective Decision Making, Fuzzy Bayesian Decision Method, Decision Making under Fuzzy States and Fuzzy Actions.
UNIT-4
Fuzzy Classification: Classification by Equivalence Relations - Crisp Relations, Fuzzy Relations, Cluster Analysis, Cluster Validity, c- Means Clustering - Hard c-Means (HCM), Fuzzy c-Means (FCM), Classification Metric, Hardening the Fuzzy c-Partition, Similarity Relations from Clustering. Fuzzy Pattern Recognition: Feature Analysis, Partitions of the Feature Space, Single-Sample Identification, Multifeature Pattern Recognition, Image processing

TEXT BOOKS:

1. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India, 3rd Edition, 2010.

2. George K Klirand and Bo Yuan, “Fuzzy Sets and Fuzzy Logic: Theory and Applications”, Prentice Hall, 1995.

REFERENCE BOOKS:

1. B Kosko, “Neural Networks and Fuzzy Systems: A Dynamical System Approach”, PHI, 1991.

JOURNALS/MAGAZINES:

1. https://wireilla.com/ijfls/
2. https://publons.com/journal/88623/international-journal-of-fuzzy-logic-systems-ijfls/
3. Springer,Fuzzy Logic in Intelligent System Design
4. Springer, Recent Advances in Intuitionistic Fuzzy Logic Systems

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc20_ee03/preview
2. Fuzzy Logical Model of Perception-Coursera

SELFLEARNING EXERCISES:

1. Automated Methods for Fuzzy System, Batch Least Squares Algorithm, Recursive Least Squares
2. Algorithm, Gradient, Fuzzy Systems Simulation, Nonlinear Simulation Using Fuzzy System

CourseTitle	**STORAGE AREA NETWORK (PE-I)**				**CourseType**		**Theory**	
CourseCode	**B20EKS505**	**Credits**	3		**Class**		**semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

This course provides an overview of storage network and data center networking technology. It reviews SAN concepts, Fibre Channel architecture, SAN topologies, SAN over Ethernet architectures, such as iSCSI, FCoE.Virtualization at the host, storage target and Fabric-Based Virtualization

COURSE OBJECTIVE(S)

The objective of this course is:

1. To introduce the mathematical basics of speech modeling, and its applications.
2. To understand the various applications of speech modeling
3. To comprehend the computational concepts learned in the lecture classes through numerical simulations and programming
4. To help the students extend their understanding of signal processing algorithms for speech processing.
5. To strengthen the research skills of students in speech processing.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify key challenges in managing information and analyze different storage networking technologies	1,2	1, 2
CO2	Understand components and the implementation of different storage networking technologies	1, 2,	2, 3
CO3	Analyze storage area network architecture and types of archives and forms of virtualization	1, 2, 4	2, 3
CO4	Illustrate the storage virtualization concepts at different levels	1, 2, 3	3
CO5	Develop an insight into the working of the storage network algorithms used for storage virtualization	1, 2, 3, 12	3
CO6	Develop solutions to the complex problems of storage virtualization, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√	√		
CO4			√	√		
CO5			√		√	
CO6				√		

COURSE ARTICULATION MATRIX

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2											2	2	
CO2	2	2												2	2
CO3	2	3		3										2	2
CO4	3	2	3												3
CO5	3	2	3									3			3
CO6					3				3	3					3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT 1
Introduction to Information Storage and Intelligent Storage Systems: Evolution of Storage Architecture Data Center Infrastructure Virtualization and Cloud Computing Components of an Intelligent Storage System, Storage Provisioning, Types of Intelligent Storage Systems
UNIT 2
Fibre Channel Storage Area Networks and IP SAN: Fibre Channel, The SAN and Its Evolution, Components of FC SAN, FC Connectivity , Switched Fabric Ports, Fibre Channel Architecture , Zoning FC SAN Topologies , Virtualization in SAN iSCSI

UNIT 3
FCoE : FCIP, FCoE , General-Purpose Servers versus NAS Devices , Benefits of NAS , File Systems and Network File Sharing , Components of NAS , NAS I/O Operation , NAS Implementations, NAS File-Sharing Protocols , Factors Affecting NAS Performance
UNIT 4
Virtualization at the Host: Logical Volume Management, Storage Metadata Servers , Server-Based Storage APIs, **Virtualization at the Storage Target:** Array-Based Virtualization, Array-Based Data Replication, Array-Based Point-in-Time Copy (Snapshot), Distributed Modular Array Virtualization, **Fabric-Based Virtualization:** Sentient SANs, Techniques for Switch-Based Virtualization, The Fabric Application Interface Standard (FAIS)

TEXTBOOKS:

1. Information Storage and Management,Author :EMC Education Services, Publisher: Wiley ISBN: 9781118094839
2. Storage Virtualization, Author: Clark Tom, Publisher: Addison Wesley Publishing Company ISBN : 9780321262516

REFERENCE BOOKS:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2003.
2. Rebert Spalding: Storage Networks, The Complete Reference, Tata McGraw Hill, 2003

JOURNALS/MAGAZINES

1. Journal of Network and Systems Management-Springer
2. Future Generation Computer System- Science Direct.

SWAYAM/NPTEL/MOOCs

1. http://www.virtualnuggets.com/emcs--storage-area-network.html
2. https://www.udemy.com/course/storageintro/
3. https://www.ibm.com/training/course/SN71G

SELF-LEARNING EXERCISES:

Case study, Assignments, MOOC / Coursera/Conference

Course Title	Digital System Design with Verilog (PE-I)				Course Type		Theory	
Course Code	B20EKS506	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course aims to provide students with the understanding of the different technologies related to HDLs, construct, compile and execute Verilog HDL programs using provided software tools. Design digital components and circuits that are testable, reusable, and synthesizable.

COURSE OBJECTIVE (S):

The objectives of this course is to:

1: Illustrate Verilog hardware description languages (HDL).

2: Discuss digital circuits required for various applications.

3: Explain the verification of Behavioral and RTL models.

4: Describe Synthesizing RTL models to standard cell libraries and FPGAs

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of Verilog hardware description languages (HDL) for Gate Level Modeling	1,2,3,4,5	1
CO2	Design digital circuits using Verilog for real world applications.	1,2,3,4,5	2
CO3	Make use of constructs of Verilog to design Shift registers and counters.	1,2,3,4,5	2
CO4	Develop Verilog code using Moore and mealy models for realizing Serial Adder.	1,2,3,4,5	2,3
CO5	Design digital systems that are reconfigurable for testing and test it on FPGA	1,2,5	1
CO6	Understandability in continuous learning with evolving technological development.	10,12	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2			√	√		
CO3	√	√				
CO4			√	√		
CO5			√	√		
CO6		√			√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2								3		
CO2	3	3	2	3	2									3	
CO3	3	3	2	3	2								3		
CO4	3	3	3	3	3									3	3
CO5	3	3			3								3		
CO6										3		3		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1
ASIC Design Flow, Introduction to Verilog, Language Constructs and Conventions in Verilog, Gate Level Modeling, Architecture of FPGA.
UNIT-2
Modeling at Data Flow Level, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators, Verilog for combinational Circuits, Design of Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter

UNIT-3
Behavioral Modeling: Operator and Assignments, Functional Bifurcation, Initial & Always Construct, Assignments with Delays, wait construct, Multiple always blocks, If and if-else, assign-deassign, repeat Construct, Loop Construct: for, while& forever, Parallel blocks, force- release construct, event Design of Flip flop, Shift register and Counters using Verilog.
UNIT-4
Functions, Tasks, user defined primitives, State Machine: Moore and mealy state model, Verilog code for Moore-type FSM, Specification of Mealy FSM using Verilog, Mealy-type and Moore-type FSM for Serial Adder.

TEXTBOOKS:

1. Brown & Z. Vransesic, "Fundamental of digital Logic with Verilog design", TMH, 2002

2.T.R. Padmanabhan& B. Bala Tripura Sundari, "Design through Verilog HDL", Wiley Publications, 2009.

REFERENCE BOOKS:

1. "Digital Design", F.rankVahid, Wiley, 2006.

2."Introduction to Digital Systems", , M. Ercegovac, T. Lang and L.J. Moreno, Wiley, 2000.

JOURNALS/MAGAZINES:

1. https://www.elsevier.com/books/digital-integrated-circuit-design-using-verilog-and-systemverilog/mehler/978-0-12-408059-1
2. https://www.elsevier.es/en-revista-journal-applied-research-technology-jart-81-articulo-a-new-design-methodology-for-S1665642313715293

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_ee39/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs72/preview
3. FPGA Design for Embedded systems- Coursera

SELF-LEARNING EXERCISES:

Mealy-type and Moore type FSM for Serial Adder.

Course Title	Introduction to AI (OE-1)				Course Type		Theory	
Course Code	B20CIO501	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces the basics of Artificial Intelligence (AI), AI problems and search strategies. The students can explore knowledge representation issues and methods. This course provides planning methods /algorithms for, problem solving and controlling the knowledge and also demonstrates various learning methods for constructing knowledge and taking decisions

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe the basics of Artificial Intelligence (AI).
2. Illustrate knowledge representation issues and methods
3. Explain planning methods/algorithms in problem solving
4. Discuss the application of AI in Robot.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Solve AI problems using AI search strategies and production system	1,2,3,4,5	1,2
CO2	Develop knowledge base for representing the given real world data using logic and reasoning methods	1,2,3,4,5	1,2
CO3	Make use of planning and probability to solve uncertainty problems.	1,2,3,4,5	1,2
CO4	Design and develop an intelligent agent for robotics in a specific environment to solve real world problems.	1,2,3,4,5	1,2,3
CO5	Explain planning methods/algorithms in problem solving	1,2,3,4,5	1,2
CO6	Discuss the application of AI in Robot .	1,2,3,4,5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2						√
CO3			√			
CO4			√			√
CO5						√
CO6				√		√

COURSE ARTICULATION MATRIX:

CO#/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3								3	3	
CO2	3	3	3	2	3								3	3	
CO3	3	2	3	3	3								3	3	1
CO4	3	2	2	2	2								3	3	3
CO5	3	3	3	2	3								3	3	
CO6	3	2	3	3	3								3	3	1

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT- 1
Problems and search: What is AI, AI Problems; AI Techniques; Problem Space and Problem Search techniques; Defining the problem as a state space search, production systems; Problem characteristics, production system characteristics, Issues in the design of search programs; Heuristic search techniques, generate-and-test; Hill climbing, BFS, DFS; Problem reduction; Constraint satisfaction.
UNIT- 2
Knowledge Representation: Knowledge representation Issues, representations and mappings; Approaches to knowledge representation; Issues in knowledge representation; Using Predicate logic: Representing simple facts in logic; Representing Instance and ISA relationships; Computable functions and predicates; Representing Knowledge using Rules; Procedural versus declarative knowledge; Resolution Forward versus backward reasoning; Matching
UNIT- 3
Planning: A simple planning agent; Representations for planning; A partial-order planning example; A partial-order planning algorithm; Planning with partially Instantiated operators; Knowledge Engineering for planning; Uncertainty: Sources of Uncertainty; Probability Theory, Issues with Probability; Advantages & Disadvantages of Bayesian Network
UNIT- 4
Robotic Sensing and Manipulation: Introduction to robotics, Sensing, Manipulation, Human-robot interaction **Mobile Robots:** Navigation and path planning, Learning and robotics: Reinforcement learning, Case study: Autonomous vehicles technologies and impacts

TEXTBOOKS:

1. Russell &Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition, Prentice-Hall, 2010.
2. Elaine Rich, Kevin Knight, “Artificial Intelligence”, “, 3rdedition, TataMcgraw Hill, 2009

REFERENCE BOOKS:

1. Nils J.Nilsson, Elsevier, “Principles of Artificial Intelligence”, 1980. “Artificial Neural Networks”,

2. Krishan Mehrotra, Chilkuri K. Mohan, Sanjay Ranka, “Artificial Neural Networks”, Penram International Publishing, 1997.
3. B.Yegananarayana, “Artificial Neural Networks”, PHI, 2001.

JOURNALS/MAGAZINES:

1. Springer- Springer transaction for security based intelligent systems
2. IEEE transaction for computational Intelligence
3. ACM, ACM transaction on Multi-Agent System.
4. Boston Dynamics videos, 2018 ,https://www.youtube.com/user/BostonDynamics
5. Priday, R. “What’s Really Going on in those Boston Dynamics Videos,” Wired, February 18,
6. 2018https://www.wired.co.uk/article/bostondynamics-robotics-roboticist-how-to-watch ○ RAND Institute, “Autonomous
7. RAND Institute, “Autonomous Vehicle Technology: A Guide for Policymakers”, 2016
8. https://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443- 2/RAND_RR443-2.pdf

SWAYAM/NPTEL/MOOCS:

1 https://onlinecourses.nptel.ac.in/noc21_cs42/preview

2 Introduction to Artificial Intelligence -Coursera

SELF-LEARNING EXERCISES:

Natural Language Processing, Deep Learning

<table>
<tr><td>Course Title</td><td colspan="4">OOPS USING C++(OE-1)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20CIO502</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course introduces the basic concepts of object-oriented programming. Familiarizes with object creation and accessing members of object. OOPs concepts such as data abstraction, information hiding Encapsulation), overloading operations, inheritance mechanisms, virtual functions, friend functions and are discussed. FileI/O operations, Templates and exception handling mechanisms are also introduced.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts of objects and classes for a real-world application.
2. Illustrate the use of operator overloading/function overloading for given applications.
3. Demonstrate the use of inheritance in real world applications.
4. Describe I/O streams and Templates and Exception Handling

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of objects and classes for a real world application	2,3,7,11	1,2
CO2	Develop applications by implementing operator overloading and function overloading.	2,3,4,5	2,3
CO3	Make use Inheritance feature of OOPs to develop a real world application	1-4,8,9,11	2,3
CO4	Build the real-world application using exception handling and templates	1-4,11,12	2,3
CO5	Understand the difference between the top-down and bottom-up approach	2,3,4,12	1,2
CO6	Illustrate the process of data file manipulations using C++	2,3,6,11	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1		√				
CO2	√	√				
CO3		√	√			
CO4		√	√	√		√
CO5		√				
CO6		√		√		

COURSE ARTICULATION MATRIX:

CO#/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1				1				1		2	2	
CO2		2	3	1	1									3	1
CO3	1	2	1	2				3	1		1			2	1
CO4	1	2	3	1							1	1		2	1
CO5		2	2	2								2	2	2	
CO6		2	1			2					2		1	2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1
Introduction: Introduction to object-oriented concepts: Encapsulation, Abstraction, Inheritance, Polymorphism, Overview of OOP, Introduction to object-oriented modelling, Introduction to variables in C++, I/O operators, Function overloading, Inline function, Recursive function. **Classes & Objects:** Introduction to Classes, Member Functions and Member data, Constructors and Destructors, Static Class members.
UNIT-2
Operator overloading: Introduction to Objects, Array of Objects, Dynamic Objects, Pointers to objects, Friend Function, Access specifiers. The scope resolution operator, Generic functions and classes, Operator overloading using Friend function: Unary operator '+' & binary operator, Copy constructor.
UNIT-3
Inheritance: Base Class, Inheritance and Protected members, inheriting multiple base classes, Constructors, Destructors and Inheritance, Virtual base classes. Virtual functions and Polymorphism: Virtual functions, pure virtual functions, Early and late binding.
UNIT-4
Templates and Exception handling: Template Functions, Template Classes, Fundamentals of Exception handling, handling derived class exceptions.

TEXT BOOKS:

1. Herbert Schildt," The Complete Reference C++", 4th Edition, Tata McGraw Hill, 2003.
2. SanleyB.Lippmann, JoseeLajore, "C++ Primer", 4th Edition, Pearson Education, 2005.

REFERENCE BOOKS:

1. Paul J Deitel, Harvey M Deitel, "C++ for Programmers", Pearson Education, 2009.
2. K R Venugopal, RajkumarBuyya, T Ravi Shankar, "Mastering C++", Tata McGraw Hill,l999.

JOURNALS/MAGAZINES:

1. International Journal of Web Technology-ISSN:2278-2389
2. International Journal of Web & Semantic Technology (IJWesT)
3. ELSEVIER Journals with in" Internet And Web Technology"

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.swayam2.ac.in/nou20_cs05/preview
2. https://nptel.ac.in/courses/106/105/106105084/

SELF LEARNING EXERCISES:

The student is expected to study more about the following topics: Rails and Angular JS.

Course Title	Web Technology (OE-1)				Course Type		Theory	
Course Code	B20CIO503	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW:

This course covers features of HTML 5 and CSS 3, controls and web services of ASP.Net and database access with MYSQL, basics of AngularJS, basics of AJAX and JQuery AJAX library, basics of Ruby, controls and RESTful web services. These concepts are used in the development of Client-Server technology.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the various steps in designing a creative and dynamic website.
2. Describe the hierarchy of objects in HTML and XML
3. Design dynamic and interactive web pages by embedding Java Script code in HTML.
4. Illustrate the advantages and use of different types of CSS.
5. Examine the HTML. Know how to use Dynamic HTML.
6. Familiarize server-side scripting language like Perl & PHP.

COURSE OUTCOMES (COs):

CO#	Course Outcomes	POs	PSOs
CO1	Describe the concepts of WWW including browser and HTTP protocol and summarize the various HTML tags and use them to develop the user-friendly web pages.	2,3,7,11	1,2
CO2	Define the CSS with its types and use them to provide the styles to the web pages at various levels.	2-5	2,3
CO3	Develop the modern web pages using the HTML and CSS features with different layouts as per need of applications.	1,4,8,9,11	2,3
CO4	Apply JavaScript to develop the dynamic web pages and use server-side scripting with PHP to generate the web pages dynamically using the database connectivity.	1-4,11,12	2,3
CO5	Create a server side java application called JSP to catch form data sent from client and store it on database.	1,4,5,11,12	2,3
CO6	Develop a dynamic web page by the use of java script and DHTML.	1,4,8,9,11	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1	√	√				
CO2		√	√	√		
CO3			√			
CO4			√	√	√	
CO5		√				√
CO6		√		√		√

COURSE ARTICULATION MATRIX:

CO#/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1				1				1		2	2	
CO2		2	3	1	1									3	1
CO3	1	2	1	2				3	1		1			2	1
CO4	1	2	3	1							1	1		2	1
CO5	1	2	3	1	2						1	1		2	1
CO6	1	2	1	2				3	1		1			2	1

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

Contents
UNIT-1
Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide W-eb-HTTP request message-response message-Web Clients Web Servers-Case Study. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics- Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-XML Creating HTML Documents. Representing Web Data: XML-Documents and Vocabularies-Versions and Declaration - Namespaces JavaScript andXML
UNIT-2
Style Sheets: Lists, Tables, Forms, Frames CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. **JavaScript:** Overview of JavaScript, Object orientation and JavaScript, Syntactic characteristics, Primitives, operations, and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors.
UNIT-3
Perl, CGI Programming: Origins and uses of Perl, Scalars and their operations, Assignment statements and simple input and output, Control statements, Fundamentals of arrays, Hashes, References, Functions, Pattern matching, File input and output; Examples. The Common Gateway Interface; CGI linkage; Query string format; CGI.pm module. **Cookies**. Database access with Perl and MySQL
UNIT-4
Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP. PHP and MySQL: Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables.

TEXTBOOKS:

1. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, PearsonEducation, 2008.
2. JeffreyC. Jackson,"WebTechnologies--AComputerSciencePerspective",PearsonEducation,2006.

REFERENCE BOOKS:

1. Deitel, Deitel, Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education,2006.
2. Marty Hall and Larry Brown, “Core Web Programming” Second Edition, Volume I and I, Pearson Education,2001.

JOURNALS/MAGAZINES:

1. International Journal of Web Technology-ISSN:2278-2389
2. International Journal of Web & Semantic Technology(IJWesT)

SWAYAM/NPTEL/MOOCS:

1 https://onlinecourses.swayam2.ac.in/nou20_cs05/preview
2 https://nptel.ac.in/courses/106/105/106105084/

SELF LEARNING EXERCISES:

The student is expected to study more about the following topics: Rails and Angular JS.

<table>
<tr><td>Course Title</td><td colspan="4">Web Technologies and Applications Lab</td><td colspan="2">Course Type</td><td colspan="2">Practical</td></tr>
<tr><td>Course Code</td><td>B20EJ0504</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">V semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13weeks/Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>0</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The basics of Web application tools such as HTML, XHTML and CSS are introduced. The course also provides knowledge about advanced research topics such as XML, Perland PHP.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Understand the various steps in designing a creative and dynamic website.
2. Describe the hierarchy of objects in HTML and XML.
3. Design dynamic and interactive web pages by embedding Java Script code in HTML.
4. Illustrate the advantages and use of different types of CSS.
5. Examine the HTML. Know how to use Dynamic HTML.
6. Familiarize server side scripting language like Perl &PHP.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs

CO1	Describe the concepts of WWW including browser and HTTP protocol and summarize the various HTML tags and use them to develop the user- friendly web pages.	2,3,7,11	1,2
CO2	Define the CSS with its types and use them to provide the styles to the web pages at various levels.	2-5	2,3
CO3	Develop the modern web pages using the HTML and CSS features with different layouts as per need of applications.	1,4,8,9,11	2,3
CO4	Apply Java Script to develop the dynamic web pages and use server side Scripting with PHP to generate the web pages dynamically using the database connectivity.	1-4,11,12	2,3
CO5	Examine the HTML .Know how to use Dynamic HTML.	2,3,4,5	2,3
CO6	Familiarize server side scripting language like Perl & PHP.	2-5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2		√	√	√		
CO3			√			
CO4			√	√	√	
CO5		√	√	√	√	
CO6		√	√	√	√	

COURSE ARTICULATION MATRIX

CO#/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1				1				1		2	2	
CO2		2	3	1	1									3	1
CO3	1	2	1	2				3	1		1			2	1
CO4	1	2	3	1							1	1		2	1
CO5		2	2	3	1									2	2

CO6		1	2	3	1								1	2	

Note:1-Low,2-Medium,3-High

Practice:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	In today's digital world, information dissemination through printed documents consumes lot of time. To overcome this drawback, it is better to adopt digital technology for information dissemination, like e-journals, e-books, e-advertisements, etc. Information dissemination through Internet in the form of web content is essential and convenient option. Design and develop static web pages for an online Book store. The pages should resemble like www.amazon.com The website should consist of. Home page, Registration & Login, User profile page, Books catalogue, Shopping cart, Payment by credit card, and order confirmation.		
2.	Internet or online services works on clients and server model. A client is a web browser through which users make requests, which contain input required, for service from the server to perform tasks. Server is a program running on a dedicated computer. Performance of any service or server depends on its throughput. Server throughput deteriorates when users send more and more invalid requests for service and thus results in wastage of server resources that are very precious. As a solution to this problem design a web page that takes student details such as Name, branch, Semester, University, date of admission, mobile number, email id and check for validity or correctness of the input data by writing a JavaScript to validate these fields.		
3.	Clients interact with servers by sending service requests that contain input required to complete the requested task or service. Input required for requested service may be collected through a web page, that acts as an interface between users and the server, in the form of text fields, text areas, radio buttons, push buttons and so on. Hence it is better to instruct or help clients to input correct data through web page by displaying appropriate error messages or alerts as and when users supply wrong input using event handlers. To demonstrate this task, design and develop a web page using JavaScript, XHTML that collects the SRN (Valid format is: Any letter followed by two digits, followed by two letters then followed by three digits). Include event handler for the form elements that collects information to validate the input. Messages must be produced in the alert windows as and when errors are detected.		
4.	Dynamic web content is the information that is retrieved from one or more web servers depending upon what information client have requested for, and composed in response to users' requests. Advanced web technologies play a vital role in storage, processing and retrieval of dynamic web content from web servers. Hence it is important to use advanced web technologies such as XML to improve the efficiency in data retrieval. Create and save XML document for students information and display the same using cascaded style sheet.		

5.	. Information technology has become part and parcel of humanity to such an extent that people can shop anything online, from anywhere, at any time using an electronic device that has access to Internet. This has brought in the concept of virtual stores which provide products at less cost. To improve sales it is mandatory to organize items catalog based on item name, item price, and manufacturer so on. For such online shopping sites, look and feel is an obvious requirement which can be achieved using CSS & XSLT. Design a document using CSS and XSLT to create a catalog of items for an online electronic shopping.		
6.	In any business organization, employees keep traveling across different geographical locations and at the same time they want to be connected to their organization's computing resources such as email server, database server, file server, etc. to retrieve information such as sales details, assigning tasks to employees, and upload inspection site details, so on. Using PHP develop a web page that accepts book information such as ISBN number, title, authors, edition and publisher and store information submitted through web page in MySQL database. Design another web page to search for a book based on book title specified by the user and displays the search results with proper headings.		
7.	Using computers without graphical user interfaces require the knowledge about syntax of computer commands and programming languages, also this makes users to feel that the use of computers is difficult and cumbersome. This impression of users on computers can be changed by providing good and easy-to-use graphical user interfaces which play vital role in use of computer applications or software without worrying about syntax of programming languages or computer commands. In fact computer software with good and easy-to-use graphical user interfaces will have large number of users. a) Design HTML page that takes UNIX command as input in a text field and submit it to a Perl program that executes given command and display the output on the web page b) Write a Perl program to keep track of the number of visitors to a web page and display the count of visitors with proper headings.		
8.	Databases are the storage systems used by most of the business and information technology enterprises as back end. When users generate data using GUI, for ex. personal information, data are sent to back end database for storage and also users can retrieve this data as and when required from the back end (database) to the front GUI. In the real world there are several databases such as Oracle, DB2, MySQL, SQL Server, MS-Access, DBMongo, etc. To illustrate the process of generating data from the front end and store it on back end database then retrieve the available data from the back end database, write a Perl program to read personal information of a person such as first name, last name, age, permanent address and pin code entered by the user into a table created in MySQL. Read the same information from the database and display on the front end.		
9.	Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page.		

Course Title	**COMPUTER NETWORKS** Lab				Course Type		Practical	
Course Code	**B20CI0506**	Credits	1		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

COURSE OVERVIEW

The main emphasis of this course is on the organization and management of local area networks (LANs). The course description include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and about Open Systems Interconnection (OSI) communication model with TCP/IP protocol; This course provides knowledge of error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing; and local and remote procedures. This course also emphasis on User Datagram Protocol, TCP Congestion Control; DNS Message Formatting and Remote Login Protocols.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the protocol stacks (OSI and TCP/IP) for data communication.
2. Discuss the MAC protocols, error detection & correction strategies for data transmission over the networking devices.
3. Describe the standards for data communication with routing protocols.
4. Illustrate the client server communication using TCP or UDP protocols and other application level protocols

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the architectural principles of computer networking and compare different approaches to organizing networks.	1 to 6, 12	2
CO2	Discover the good network design with simplicity, scalability, performance and the end-to-end principle	1 to 6, 12	2
CO3	Appraise the working principles of Internet.	1 to 6, 12	3
CO4	Compile the effectiveness of existing or similar network protocols.	1 to 6, 12	3
CO5	Design a component or a product applying all the relevant standards and with realistic constraints	5,6,9,10	2
CO6	Compare various congestion control mechanisms and identify appropriate Transport layer protocol for real time applications	5,6,9,10	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√	√		
CO3			√	√	√	
CO4			√	√	√	√
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1						1		3	
CO2	3	3	3	3	2	2						1		3	
CO3	3	3	3	3	2	1						2			3
CO4	3	3	3	2	2	1						1			3
CO5					2	3			2	3				3	
CO6					2	3									3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part - A			
1	a) Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.	RJ-45 connector, IO Connector, Crimping Tool, Twisted pair Cable, Cable Tester.	Cable Crimping, Standard Cabling and Cross Cabling, IO connector crimping and testing the crimped cable using a cable tester can be done successfully
	b) Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.	NIC, Adapter	Installation and configuration of Wired and Wireless (remotely) NIC and transfer files between systems in LAN and Wireless LAN between two systems in a LAN can be done successfully.
	c) Install and configure Network Devices: HUB, Switch and Routers.	HUB, Switch, Router and configuration software.	Gain the knowledge on configuring the different connecting devices
	d) Connect the computers in Local Area Network.	Computer Systems with connecting media.	Interconnection and building a simple LAN
2	a) Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.	Computer Systems with connecting media.	Configuration of peer to peer network communication
	b) Configure Internet connection and use IPCONFIG, PING / Tracer and Net stat utilities to debug the network issues.	Connected Computer Systems.	Configure Internet connection
	c) Transfer files between systems in LAN using FTP Configuration, install Print server in a LAN and share the printer in a network	Connected Computer Systems with printer.	File *t*ransfer between systems in LAN using FTP Configuration.
	d) Study of basic network command and Network configuration commands	Command Prompt	Network configuration
3	In information theory and coding theory with applications in computer science and telecommunication, error detection and correction or error control are techniques that enable reliable delivery of digital data over unreliable communication channels. Many communication channels are subject to channel noise, and thus errors may be introduced during transmission from the source to a receiver. Error detection techniques allow detecting such errors, while error correction enables reconstruction of the original data in many cases. Write a Program for Implementation of any one mechanism for Error Detection / Error Correction Techniques.	CRC Hamming Code	Error detection and control in data transmission.
4	A routing algorithm is a procedure that lays down the route or path to transfer data packets from source to the destination. They help in directing Internet traffic efficiently. ... Routing algorithm mathematically computes the best path, i.e. "least – cost path" that the packet can be routed through Write a Program for Implementation of any routing algorithms.	Distance vector & Link state routing	Routing in networks before the communication begins.
Part B: Mini Project 1: Design of Corporate Network			

1	Configuring a Switched network and Study of VLAN's and assigning a PC based on the VLAN.	Windows/Linux OS, Packet Tracer	Switch and VLAN Configuration.
2	Implementing an IP Addressing Scheme Configuring WEP on a Wireless Router. Interpreting Ping and Traceroute Output	Windows/Linux OS, Packet Tracer	Router configuration and connectivity checking.
3	Configuring Static Routing. Configuring Dynamic Routing protocols RIP, OSPF.	Windows/Linux OS, Packet Tracer	Static and Dynamic Routing over a network
4	Examining Network Address Translation (NAT). Configuring a Cisco Router as a DHCP Server	Windows/Linux OS, Packet Tracer	Configuration and working of NAT with setup of DHCP server.
Part C: Mini Project 2: Performance Analysis of TCP and UDP applications over the different Topologies of network			
1	Consider Six nodes and demonstrate the different ways of connecting them in topology methods. Also specify the different transmission media with specific channel specifications.	Python, NS3, Ubuntu.	Create an interface between the devices using different topologies.
2	Configure the IP address of the nodes in the specified network. Achieve the port specifications for different applications. Apply and Demonstrate the TFTP on the specified network using UDP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using UDP based applications
3	Apply and Demonstrate the FTP and TELNET on the specified network using TCP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using TCP based applications
4	Apply and Demonstrate the Congestion and Error Controlling mechanism in the specified networks. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the congestion and error controlling in TCP based applications

Course Title	**MACHINE LEARNING** Lab				Course Type		Practical	
Course Code	**B20CI0505**	Credits	1		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

COURSE OVERVIEW:

Course Description: Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can process through large volumes of data at high speed to make predictions or decisions without human intervention.

COURSE OBJECTIVES:

The objectives of this course are to:

1.Explain machine learning and problems relevant to machine learning.

2.Discuss the fundamentals of Decision trees learning and its issues

3.Illustrate neural networks, Bayes classifier and k nearest neighbour for problems appearing in machine learning.

4.Describe statistical analysis of machine learning techniques.

COURSE OUTCOMES (COs)

On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the basics of machine learning concepts.	1 to 5	1,2,3
CO2	Implement suitable classification technique for intelligent applications	1 to 5	1,2,3
CO3	Implement clustering algorithms for intelligent applications	1 to 5	1,2,3
CO4	Implement machine learning algorithms for intelligent applications	1 to 5	1,2,3
CO5	Learn new tools and technologies related to machine learning and apply for suitable application development.	10,12	2,3
CO6	Develop solutions using machine learning based algorithms for the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	11,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						√
CO2			√			√
CO3				√		√
CO4				√	√	√
CO5		√		√		
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1								3	3	3
CO2	3	2	3	1	2								3	3	3
CO3	3	1	2	1	2								3	3	3
CO4	3	2	2	2	2								3	3	3
CO5										2		3		2	2
CO6											3	3		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

LAB:

1	**Decision Tree Classifier** Implement and demonstrate a Decision Tree Classifier to classify the instances of dataset. Display the classification results. Also, try the same algorithm to classify the instances for any given medical diagnosis dataset.
2	**Feature extraction using Principal Component Analysis (PCA)** Implement and demonstrate the Principal Component Analysis algorithm for dimensionality reduction for any dataset.
3	**K nearest neighbour (KNN)** Implement and demonstrate the k-Nearest Neighbour algorithm (k-NN) to classify the iris data set. Display the Confusion matrix and classification report. Also, try the same algorithm of the social networks dataset to predict a customer can purchase an item or not.
4	**Support Vector Machine (SVM)** Implement and demonstrate a Support vector machine classifier to classify the instances of any dataset. Display the classification results. Also, try the same algorithm to classify the instances for any given dataset
5	Short Title: **Regression** Implement and demonstrate linear regression and logistic regression algorithms for any given dataset(s). Visualize the results using graphs. (Salary prediction, Price Prediction)
6	**Random Forest (RF)** Implement and demonstrate a Random Forest classifier to classify the instances of dataset. Display the classification results. Also, try the same algorithm to classify the instances for any given dataset
7	**K-Means Clustering** Implement and demonstrate the k-means clustering algorithms. Visualize the results using graphs.
8	**Hierarchical clustering** Implement and demonstrate the hierarchical clustering algorithms. Visualize the results using graphs.
9	**DBSCAN clustering** Implement and demonstrate the hierarchical clustering algorithms. Visualize the results using graphs.
10	Short Title: **Artificial Neural Networks (ANN)** Implement and demonstrate the two hidden layer multilayer perceptron neural network to any given dataset for classification. Apply two different optimizers or activation functions and compare the results.

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition McGraw Hill Education, 2013.

Websites:

1. https://www.tutorialspoint.com/machine_learning_with_python/index.htm
2. https://www.tutorialspoint.com/artificial_neural_network/index.htm

RECOMMENDED LEARNING RESOURCES (REFERENCE BOOKS):

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, 2nd edition, springer series in statistics.

2. Ethem Alpaydın, “Introduction to machine learning”, second edition, MIT press.

JOURNALS/MAGAZINES:

1. Springer Journal of Machine Learning.

2. International Journal of Machine Learning and Computing.

SWAYAM/NPTEL/MOOCs:

1. Coursera – Machine Learning

2. Coursera – Deep Learning

3. https://onlinecourses.nptel.ac.in/noc19_cs53/preview

SELF-LEARNING EXERCISES:

Reinforcement Learning: Introduction, Learning Task, Q Learning

<table>
<tr><td>Course Title</td><td colspan="4">Technical Documentation</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20CI0503</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">V semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">CIE</td><td rowspan="3">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="4"></td><td>13</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The goal of this course is to prepare engineering students with the individual and collaborative technical writing, presentation, and research skills necessary to be effective technical communicators in academic and professional environments

COURSE OBJECTIVE (S):

The objectives of this course are:

1. Understanding the characteristics of technical writing and the importance of purpose, audience, and genre for written communication in technical fields.
2. Planning, drafting, revising, editing, and critiquing technical and professional documents through individual and collaborative writing.
3. Writing effective technical documents that are grammatically and stylistically correct.
4. Explain the knowledge and skills required for undertaking a research project, for presenting a conference paper and for writing a scientific article.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the characteristics of technical writing and	1 to4,8,9,12	1
CO2	Develop professional documents through individual	1to3,5,9,12	1
CO3	Write effective technical documents that are grammatically and Stylistically correct	1 to5,9,12	2
CO4	Writing effective paper for conference or journal publication	1,4,5,9,12	1
CO5	Understand the current resources for locating secondary information, and also understand the strategies of effective primary data gathering.	1to3,5,9,12	2
CO6	Explore different format features in both print, multimedia and html documents, and develop document design skills	1 to5,9,12	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1			√			
CO2			√			
CO3			√	√		
CO4						√
CO5		√				
CO6					√	

COURSE ARTICULATION MATRIX

CO#/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2				1	1			1
CO2	3	2	3		2				1			1
CO3	3	1	2	1	2				1			1
CO4	3			2	2				1			1
CO-5	3	2	3		2				1			1
CO6	3	1	2	1	2				1			1

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

Contents
-UNIT-1
Introduction Technical Reports: Importance of Reports, Objectives of Reports , characteristics of a Report , Categories of Reports, Informative Reports , Analytical Reports , Periodic and Special Reports , Oral and Written Reports , Long and Short Reports , Formal and Informal Reports , Individual and Group Reports , Formats , Prewriting , Purpose and Scope , Audience, Sources of Information , Organizing the Material , Interpreting Information , Making an Outline , Structure of Reports (Manuscript Format), Prefatory Parts , Main Text , Supplementary Parts , Types of Reports , Writing the Report , First Draft , Revising, Editing, and Proofreading. **Technical Proposals:** Introduction, Definition and Purpose, Types, Characteristics, Structure of Proposals, Prefatory Parts, Body of the Proposal, Supplementary Parts, Style and Appearance, Evaluation of Proposals. **Research Papers and Technical Descriptions**: Introduction, Research Paper, Characteristics, Components, Technical Description, Guidelines for Writing Good Descriptions, Checklist.

TEXTBOOKS:

1. Meenaxi Raman and Sangeetha Sharma, “TechnicialCommunication”, Oxford University press, 2015.
2. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
3. R. Panneerselvam, Research Methodology, New Delhi: PHI, 2005.
4. P. Oliver, Writing Your Thesis,New Delhi:Vistaar Publications, 2004.
5. F. Mittelbach and M. Goossens,The LATEX Companion, 2nd. ed. Addison Wesley, 2004.

Detailed Syllabus

Semester 6

Course Title	IOT and Cloud Programming				Course Type		Integrated	
Course Code	B20EK0602	Credits	3		Class		VIISemester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces the basics of building IoT applications and second section follows a project-based approach. The Internet of Things (IOT) has managed to attract the attention of researchers and tech enthusiasts, since it powerfully combines classical networks with instruments and devices. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe about the Python languages and packages of Interest for IoT.
2. Elaborate the Physical IoT devices and its interfaces.
3. Describe the Java Programming for IoT applications
4. Illustrate the development environment of Blynk, configure the setup and describes the connection of sensor onMobile Device.

COURSE OUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the components required for developing an IOT application.	1,3,4,7,10	2,3
CO2	Analyse the working of heterogenous sensors in the given real world applications.	1,2,4,4,7,10	2,3
CO3	Develop IoT application using Java or python programming.	1,2,3,4,7,10,11,12	2,3
CO4	Build a real world application using Blynk tool.	1,2,4,5,7,10,11,12	2,3
CO5	Learn new tools and technologies in the domain of IoT and cloud and apply for suitable application development.	12	2

CO6	Develop solutions in the field of IoT and cloud to the complex problems, either individually or a part of the team and report the results with proper analysis and interpretation. (map this with P	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			√
CO4						√
CO5			√		√	
CO6			√			√

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2	3			2			2				3	3
CO2	3	3		3	2		2			1				3	3
CO3	3	2	3	2	2		1			2	3	2		3	3
CO4	3	1		2	2		1			2	3	2		3	3
CO5	1		2		2							2		2	
CO6					3				2	2				2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
IoT Logical Design using Python: Introduction, Installing Python, Data types and Data structures ,Control flow, Functions, Modules, Packages, File Handling, Date/Time Operation, Classes, Python Packages of Interest for IoT.
UNIT-2
IoT Physical Devices: What ia an IoT Devices, Exemplary Device: Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry pi with Python, ,Other IoT Devices.

UNIT-3
Java Programming for IoT Application : IoT Communication Protocol, IoT Platform,IoT Security,Java IoT with Raspberry Pi,An Oracle Java ME Embedded Client,Other Java IoT Uses.
UNIT-4
Introduction to Blynk and Connecting with sensors on Mobile device: Setting up a development environment, what is Blynk, The Blynk appbuilder, Getting part, Setting up software on Raspberry pi, Installing prerequisite software on Raspbian, Connecting Raspberry Pi with Blynk cloud. Building your first Blynk Application.Using controller widgets: creating a project, slider ,step, ZeRGBa, Joystick.Using Display widgets: value display, LED, Using Notification Widgets: Twitter, email, Accelerometer, Light Sensor, Proximity Sensor.

TEXTBOOKS:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands on Approach”, Universities Press, First Edition, ISBN 978 81 7371 9547.
2. Perry Xiao,”Practical Java Programming For IoT,AI And Blockchain”,WILEY 2019 ISBN 978-1-119-56001-2.
3. Pradeeka Seneviratne ,“Hands on Internet of Things with Blynk”, packt publishinh Ltd, First edition ,ISBN 978-1-78899-506-1.

REFERENCEBOOKS:

1. David Hanes, Gonzalo Salgueiro ,Patrick Grossetete, Rob Barton ,Jerome Henry,”IoT Fundamentals Networking Technologies ,Protocols and Use Cases for the Internet of Things”,Ciscopress.com, Person India Education Services Pvt Ltd.ISBN 978 81 7371 9547.
2. Adrian McEwen ,Hakim Cassimally “Designing he Internet of Things”,WILEY Indian Pvt Ltd. ISBN:978-81-265-5686-1.

JOURNALS/MAGAZINES

1. https://link.springer.com/article/10.1007/s11227-018-2652-7
2. https://journalofcloudcomputing.springeropen.com/
3. https://ieeexplore.ieee.org/document/7600359
4. https://www.ijedr.org/papers/IJEDR1902052.pdf

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. IoT (Internet of Things) Wireless & Cloud Computing Emerging Technologies -Coursera

SELF-LEARNINGEXERCISES:

Data Analytics for IoT, Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture,Productivity Applications Setting up a personal Blynk server, Controlling a Robot with Blynk.

Course Title	Big Data Analytics				Course Type		Theory	
Course Code	B20EA0601	Credits	4		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

This course provides practical foundation level training that enables immediate and effective participation in big data projects. The course provides grounding in basic and advanced methods to big data technology and tools, including Hadoop and Spark.

COURSE OBJECTIVE (S):

1. Explain the concepts of Big Data and its Business Implications.
2. Describe the framework for Scala and Spark for Big-Data Analytics.
3. Discuss the use of features of Apache Spark for Data Analytics.
4. Demonstrate solving of Business Problems with Machine Learning in Spark and Scala

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make us of the concepts of Big Data in real world application.	1,2,3,4,5,9,12	2
CO2	Apply the theories of Hadoop in Scala for Big Data Analytics.	1,2,3,4,5,9,12	2
CO3	Design a Data Analytics Framework using Apache Spark with Scala.	1,2,3,4,5,9,12	1
CO4	Develop a real world application using Apache Spark with Scala.	1,2,3,4,5,9,12	1
CO5	Learn new tools and technologies in the big data analytics and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the big data analytics to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			

CO2			√			
CO3						√
CO4				√	√	√
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2					1			3		3	
CO2	3	3	3	3					1			3		3	
CO3	3	3	3	3					1			3	3		
CO4	3	3	3	3					2			3	3		
CO5	3	3		3									3		
CO6	3	3		3								3		3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1
The Age of the Data Product: What Is a Data Product?, Building Data Products at Scale with Hadoop, Leveraging Large Datasets, Hadoop for Data Products, The Data Science Pipeline and the Hadoop Ecosystem, Big Data Workflows. **An Operating System for Big Data**: Basic Concepts, Hadoop Architecture, A Hadoop Cluster, HDFS, YARN, Working with a Distributed File System, Basic File System Operations, File Permissions in HDFS, Other HDFS Interfaces, Working with Distributed Computation,
UNIT-2
MapReduce: A Functional Programming Model, Implemented on a Cluster, Beyond a Map and Reduce: Job Chaining, Submitting a MapReduce Job to YARN. **Scala Programming:** Functional Programming Aspects, What Is Functional Programming? Scala Programming Features, Functional Programming Aspects of Scala.
UNIT-3
Introduction to Apache Spark and Spark Core: What Is Apache Spark?, Why Apache Spark?, Spark vs. Hadoop MapReduce, Apache Spark Architecture, Spark Components, Spark Shell. **Spark Core:** RDD, RDD Transformations,

RDD Actions, Working with Pair RDDs, Direct Acylic Graph in Apache Spark, Persisting RDD Shared Variables, Simple Build Tool (SBT).
UNIT-4 **Spark SQL, DataFrames, and Datasets**: What Is Spark SQL?, Spark Session, Creating DataFrames. **Introduction to Spark Streaming:** Data Processing, Streaming Data, Introduction to Spark Streaming, Spark Streaming Example Using TCP Socket, Stateful Streaming, Streaming Applications Considerations. **Spark Machine Learning Library:** What Is Spark MLlib?, Spark MLlib APIs, Vectors in Scala, Basic Statistics, Extracting, Transforming, and Selecting Features, ML Pipelines.

TEXT BOOKS:

1. Sridhar Alla, “Big Data Analytics with Hadoop 3”, published by Packt Publishing Ltd, May 2018
2. SubhashiniChellappan, DharanitharanGanesan,” Practical Apache Spark Using the Scala API”, A Press, 2018.

REFERENCE BOOKS:

1. Michael Minelli, Michele chambers, AmbigaDhiraj,” Big data, big analytics”, Wiley,2013
2. P. Tan, M. Steinbach, V. Kumar, “Introduction to Data Mining”, Addison-Wesley, 2005.
3. J. Han, M. Kamber, “Data Mining: Concepts and Techniques”, 2nd ed. Morgan Kaufmann 2005.
4. IEEE,Introduction to the IEEE Transactions on Big Data
5. Elsevier, Big data research journal Elsevier
6. Springer, Journal on Big Data Springer.
7. ACM DL,The Journal of Machine Learning Research-ACM

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/big-data-research
2. Springer, Big data analytics: a survey
3. Springer, Big Data Analytics
4. Data Science and Analytics,https://www.springer.com/journal/41060

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
2. Introduction to Big data-Coursera

SELF LEARNING EXERCISES:

Spark Real-Time Use Case: Data Analytics Project Architecture, Data Ingestion, Data Storage, Data Processing, Data Visualization

Course Title	Text and Web Mining (PE-II)				Course Type		Theory	
Course Code	B20EKS601	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course in web and text data mining covers basic concepts and techniques of the data mining and application of these techniques in text data and web data for various types of analysis. The course also introduces some research topics which can be used for implementation in projects.

COURSE OBJECTIVE (S):

1. Discuss various data mining techniques for different applications.
2. Describe different clustering techniques for text data.
3. Demonstrate the classification techniques for text data.
4. Illustrate web data retrieval techniques.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Choose the Data mining techniques to extract data from given dataset.	1,2,3,4,5	1
CO2	Apply appropriate classification algorithm to analyze the given data.	1,2,3,4,5	1
CO3	Identify suitable Web Mining technique to perform social network analysis.	1,2,3,4,5	1
CO4	Design web crawlers for information retrieval from web.	1,2,3,4,5	2, 3
CO5	Learn new tools and technologies in the text and web mining and professional ethics and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the text and web mining to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√		√		
CO2			√	√		
CO3				√		
CO4				√		√
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	2	3								3		
CO2	2	3	1	2	1								3		
CO3	2	1	1	2	1								3		
CO4	2	2	1	3	3									3	3
CO5	2	2		3	3										
CO6		2	1	3	3									3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1
Introduction to Data Mining Techniques: Text Extraction and Document Clustering. Introduction to data mining, Classification, Clustering, Association Analysis, Introduction to key extraction methods, Rapid automatic keyword extraction, Benchmark evaluation, Stoplist generation, Evaluation on news articles, Algebraic techniques for multilingual document clustering: Introduction, Experimental setup, Multilingual LSA.
UNIT-2
Text Data Classification: Content-based spam email classification using machine-learning algorithms: Introduction, Naive Bayes, LogitBoost, Support vector machines, Augmented latent semantic indexing spaces, Radial basis function networks, Data pre-processing, Feature selection, Message representation Evaluation of email classification, Utilizing nonnegative matrix factorization for email classification problems: Introduction, Nonnegative matrix factorization.
UNIT-3
Web Mining - I: Information Retrieval and Web Search:Basic Concepts of Information Retrieval,Information Retrieval Models, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Link Analysis: Social Network Analysis, Co-Citation and Bibliographic Coupling.
UNIT-4
Web Mining - II:Web Crawling: A Basic Crawler Algorithm: Breadth-First Crawlers, Preferential Crawlers, Implementation Issues: Fetching, Parsing, Stop word Removal and Stemming Link Extraction and Canonicalization, Spider Traps, Page Repository, Concurrency, Universal Crawlers: Scalability, Coverage vs Freshness vs Importance, Focused Crawlers, Topical Crawlers: Topical Locality and Cues.

TEXT BOOKS:

1.Michael W. Berry and Jacob Kogan, “Text Mining: Applications and Theory”, Wiley, 2010

2.Bing Liu, “Web DataMining: Exploring Hyperlinks, Contents and Usage Data”, springer, 2007.

REFERENCES BOOKS:

1.Jiawei Han, MichelineKamber, Jian Pei, “Data Mining: Concepts and Techniques”, Elsevier, 2011.

2.ACM Transactions on Knowledge Discovery from Data (TKDD)

3.IEEE Transactions on Knowledge and Data Engineering.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1306945, Web mining : research and practice
2. https://www.ijert.org/a-review-on-web-mining
3. https://arxiv.org/ftp/arxiv/papers/1304/1304.3563.pdf

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/105/106105174/
2. Data mining Specialization-Coursera

SELFLEARNING EXERCISES:

PageRank for Social network analysis and Focused Crawlers

Course Title	High Performance Computing (PE-II)				Course Type		Theory	
Course Code	B20EKS602	Credits	3		Class		VIsemester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	3	3	3	**39**	**0**	**50**	**50**

COURSE OVERVIEW

The goal of this course is to give students solid foundations for developing, analyzing, and implementing parallel and locality-efficient algorithms. This course focuses on theoretical underpinnings. To give a practical feeling for how algorithms map to and behave on real systems and will supplement algorithmic theory with hands-on exercises on modern HPC systems, such as Cilk Plus or OpenMP on shared memory nodes, CUDA for graphics co- processors (GPUs) and OpenMPIfor message passing.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the features of Modern processors and parallel computers
2. Describe different levels of parallelism along with the synchronization and scheduling
3. Demonstrate the use of features of OpenMP programming.
4. Illustrate the use of features of Open MPI programming.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify different levels of parallelism that can be applied to solve the given real world problems.	1,2,3,4,5, 9 ,12	1,2
CO2	Develop the programs using different levels of parallelism to solve the real world problems.	1,2,3,4, 9 ,12	1,2
CO3	Make use of features of OpenMP to develop parallel programs for solving	1,2,3,4,5, 9 ,12	3
CO4	Apply the features of Distributed-memory parallel programming with openMPI for solving real world problems.	1,2,3,4,5, 9 ,12	3
CO5	Learn new tools and technologies in the high performance computing and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the high performance computing to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

COURSE ARTICULATIONMATRIX

	Bloom's Level														
	Remember			Understand		Apply			Analyze		Evaluate		Create		
CO# **CO#/ POs**	**PO1**	**PO2** (L1)	**PO3**	**PO4** (L2)	**PO5**	**PO6**	**PO7** (L3)	**PO8**	**PO9** (L4)	**PO10**	**PO11** (L5)	**PO12**	**PSO1**	**PSO2** (L6)	**PSO3**
CO1				√					√					√	
CO1 CO2	3	2	2	1	2				3 √		√	1	3	3 √	
CO2 CO3	3	2	1	1 √					3			1	3	3	
CO3 CO4	3	2	2	2	2		√		3			1			3
CO4 CO5	3	2	2	2	3		√		2			2			3
CO5 CO6	3	2	2		3		√					2			3
CO6	3	2	2									2			3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

CONTENTS
UNIT-1 Modern Processors: Stored-program computer architect; General-purpose cache-based microprocessor architecture Memory hierarchies; Multicore processors; Multithreaded processors; Vector processors. Parallel computers: Taxonomy of parallel computing paradigms; Shared-memory computers; Distributed-memory computers; Hierarchical (hybrid) systems; Networks.
UNIT-2 **Basics of parallelization:** Why parallelize; Parallelism; Parallel scalability.

UNIT-3
Shared-memory parallel programming with OpenMP: Introduction to OpenMP; Case study: OpenMP-parallel Jacobi algorithm; Advanced OpenMP: Wavefront parallelization. Efficient OpenMP programming: Profiling OpenMP programs; Performance pitfalls; Case study: Parallel sparse matrix-vector multiply.
UNIT-4
Distributed-memory parallel programming with MPI: Message passing; A short introduction to MPI; Example: MPI parallelization of a Jacobi solver. Efficient MPI programming: MPI performance tools; Communication parameters; Synchronization, serialization, contention; Reducing communication overhead; Understanding intranode point-to-point communication.

TEXT BOOKS:

1. Georg Hager, Gerhard Wellein,"Introduction to High Performance Computing for Scientists and Engineers", CRC Press,2011.

REFERENCE BOOKS:

1. .Rohit Chandra , Leo Dagum , DrorMaydan , David Kohr, Jeff McDonald , Ramesh Menon,"Parallel Programming in OpenMP",Morgan Kaufmann,2000
2. Shameem Akhter and Jason Roberts 6,"Multi-core programming,Increase performance through software multiyhreading", IEEE Transactions on Knowledge and Data Engineering.
3. Kai Hwang ",Advanced Computer Architecture: Parallelism, Scalability, Programmability", TATA McGraw Hill, 1993
4. George S. Almasi and Alan Gottlieb,"Highly Parallel Computing".
5. AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar ,"Introduction to Parallel Computing", Addison-Welsey,2003.

JOURNALS/MAGAZINES:

1. https://journals.sagepub.com/home/hpc
2. https://dl.acm.org/journal/sage-hpca
3. Springer, https://link.springer.com/book/10.1007/978-3-319-20119-1
4. Springer,https://www.springer.com/gp/book/9780792383406

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/108/106108055/
2. Introduction to High-Performance and parallel computing-Coursera

SELF- LEARNING EXERCISES:

More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.

Course Title	**Distributed & Parallel systems (PE-II)**			**Course Type**	**Integrated**
Course Code	**B20EKS603**	**Credits**	**4**	**Class**	**III Semester**

	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
Course Structure	Theory	3	3	3	Theory	Practical	CIE	SEE
	Practice	-	-	-				
	-							
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

The students will gain an understanding of the principles and techniques behind the design of distributed and parallel systems, such as, synchronization and communication across networks. Students will gain practical experience in designing, implementing, and debugging real time distributed systems. The major themes this course will teach include process distribution and communication, data distribution, scheduling, memory sharing, distributed synchronization models, distributed file systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

- To learn the principles, architectures, algorithms and programming models used in distributed and parallel systems.
- To examine state-of-the-art distributed systems.
- To design and implement sample distributed systems.

COURSEOUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the requirements for distributed and parallel systems and how they can be used to facilitate the programming of concurrent systems.	1-5,8,9,12	1
CO2	Acquire knowledge of distributed and parallel system techniques, methodologies and Algorithms	1-5,8,9,10	1
CO3	To apply the knowledge of distributed and parallel systems algorithms	1-6,8,9,10,12	1
CO4	Understand the memory hierarchy and cost-performance tradeoffs.	1-6,9,10	1
CO5	To learn the knowledge of synchronization and process management	1-5,8,9,11	2

CO6	To gain experience in the design, development, and performance analysis of distributed and parallel applications	1-6,8-12	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3		√	√			
CO4		√		√		
CO5		√		√		
CO6			√	√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	0	0	2	2	0	0	3	3	0	0
CO2	3	3	2	3	3	0	0	3	3	2	0	0	3	0	0
CO3	3	3	3	2	3	2	0	3	2	3	0	3	3	0	0
CO4	3	3	3	2	2	3	0	0	3	3	0	0	3	0	0
CO5	3	2	3	3	3	0	0	3	3	0	2	0	0	3	0
CO6	3	3	3	3	3	2	0	3	2	3	2	2	0	3	0

Note: 1-Low,2-Medium,3-High

COURSE CONTENT

UNIT-1

Distributed Systems: Definition, Issues, Goals, Types, Models, Hardware concepts, Software Concept, Client Server model. Communication: Layered Protocols, Remote Procedure Call, Remote Object Invocation, Message Oriented Communication, Stream Oriented Communication.

UNIT-2

Process in Distributed System: Threads, Scheduling, Fault Tolerance, Real Time distributed System

Synchronization: Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm,

Token Based Algorithms: Suzuki-Kasami's Broardcast, Singhal's Heurastic, Raymond's Tree based

Non Token based Algorithms: Lamport, Ricart–Agrawala's, Maekawa's Algorithm.

UNIT-3

Shared Memory: on chip memory, Bus Based multi processor, Ring based multi processor, switched processor, Numa Multi processor. Page Based Distributed Shared Memory, Shared Variable Distributed Shared Memory, Object based Distributed Shared Memory

Distributed File System: File models, File Accessing models, File-Caching Schemes, Replication, Network File System (NFS).

UNIT-4

Parallel Systems: Parallel Computing; Parallel Architecture, Classifications, Performance Metrics, Parallel Programming Models, Serial and Parallel Algorithms; Pipelining: Types, Design, Hazards; SIMD: Architecture and Programming Principles, SIMD Parallel Algorithms, Data Mapping and memory in array processors, Case studies of SIMD parallel Processors.

TEXTBOOKS:

4. A.S.Tanenbaum, M.Van Steen, "Distributed Systems", Pearson Education, 2004.
5. Parallel and Distributed Systems, 2ed, Arun Kulkarni, Nupur Prasad Giri, Nikhilesh Joshi, Bhushan Jadhav ISBN: 9788126565825.

REFERENCEBOOKS:

8. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Third Edition, Pearson Education Asia, 2002.
9. Andrew S. Tannenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Pearson, 2007.
10. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, "Distributed Systems: Concepts and Design", Fifth Edition, Addison Wesley, 2011.
11. James E. Smith, and Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", First Edition, Morgan Kaufmann, 2005.
12. Fault-Tolerant Parallel and Distributed Systems, Dimiter R. Avresky, David R. Kaeli (auth.) ISBN: 9781461554493, Springer US, 1998.

JOURNALS/MAGAZINES

1. IEEE Transactions on Parallel and Distributed Systems (https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=71)
2. International Journal of Parallel, Emergent and Distributed Systems (https://www.tandfonline.com/toc/gpaa20/current)
3. International Journal of Distributed Systems and Technologies

(igi-global.com/journal/international-journal-distributed-systems-technologies/1164)

SWAYAM/NPTEL/MOOCs

3. https://onlinecourses.nptel.ac.in/noc21_cs87
4. https://www.coursera.org/courses?query=distributed%20systems
5. https://www.mooc-list.com/tags/distributed-computing

Course Title	Block Chain Technology (PE-II)				Course Type		Theory	
Course Code	B20EJS604	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Block chain is the distributed and decentralized database technology behind this crypto currency. This course explores the fundamentals of the public, transparent, secure, immutable and distributed database called block chain. Block chains can be used to record and transfer any digital asset not just currency. This course will introduce students to the workings and applications of this potentially disruptive technology. Its potential impact on financial services, government, banking, contracting and identity management.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe the basic concepts of Cryptography and Blockchain technology.
2. Explain the features of Ethereumblockchain technology, decentralised applications and smart contract.
3. Demonstrate building of decentralised applications by deploying Smart Contracts
4. Analyze different Blockchain Platforms that can be used in real world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the concepts of Blockchain technology suitable for given real world application.	1,2,3,4,5, 12	1
CO2	Compare the performance of POW and POS mining consensus algorithm with respect to given real world application..	1,2,3,4,5, 12	1
CO3	Build a decentralised application by implementing smart contract using solidity programming language.	1,2,3,4,5, 12	2
CO4	Apply various blockchain platforms for solving real world problems.	1,2,3,4,5, 12	2,3

CO5	Learn new tools and technologies in the introduction to data mining techniquesand apply for suitable application development.	12	1, 2
CO6	Develop solutions in the introduction to data mining techniques to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1	√	√				
CO2				√	√	
CO3						√
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2							1	3		
CO2	3	3	2	3	2							1	3		
CO3	2	3	3	2	2							1		3	
CO4	2	3	3	2	2							1		3	3
CO5	2	3		2	2									3	
CO6		3		2										3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1

Introduction to cryptography and Blockchain: Introduction to cryptography-Symmetric- key cryptography, Public-key cryptography, Digital Signatures and Elliptic Curve Cryptography. Introduction to Blockchain: Types of Blockchain, Structure of a Block, BlockHeader, Block Header Hash and Block Height, Genesis Block, Linking Blocks in the Blockchain, Merkle Trees, Constructing the Block Header. Introduction to tools: solidity, Geth and Mist.

Mining and Consensus: The Byzantine general's Problem, Consensus mechanism-proof of work & proof of stake, Bitcoin mining and Blockchain Forks
UNIT-2 **Overview of Ethereum**: What Is Ethereum? Compared to Bitcoin, Ethereum: A General-Purpose Blockchain, Ethereum Accounts (Externally Owned Accounts and Contracts), Ethereum and Turing Completeness, Decentralized Applications, Decentralized Autonomous Organizations, Smart Contract Introduction, Life Cycle of a Smart Contract.
UNIT-3 **Dapp development on Ethereum**: Programming Solidity: Structure, Basic Data Types & Statements, Specific Data Types, Data Structures, Memory vs Storage, Access Modifiers, Contract Definition, Functions, Contract Constructor, The Ethereum Contract ABI, Events, Run EthereumDapps, Develop a simple smart contract.
UNIT-4 **Enterprise Blockchains and Applications:** Enterprise Blockchains: Hyperledger, R3 Corda, **QuorumBlockchain Applications:** Identity management, Auction, Food industry supply chain and Blockchain in Health care.

TEXT BOOKS:

1.Joseph J. Bambara Paul R. Allen," Blockchain,A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill Education Professional , Second edition, 2018

2.Melanie Swan "Blockchain: Blueprint for a New Economy", O'Reilly Media, Third edition, Aug 2015.

3.Andreas M. Antonopoulos, Gavin Wood "Mastering Ethereum", O'Reilly Media, Inc., November 2018

4.Joseph Holbrook "Architecting Enterprise Blockchain Solutions", Sybex, February 2020

REFERENCE BOOKS:

1.Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smartcontracts" Packt , 2nd edition 2018.

2.Jimmy Cooper,"Blockchain Blueprint: Guide to Everything You Need to Know About Blockchain Technology and How It Is Creating a Revolution ",CreateSpace Independent Publishing Platform, 2017.

3.Deepak Puthal; Nisha Malik; Saraju P. Mohanty; Elias Kougianos; Chi Yang "The Blockchain as a Decentralized Security Framework [Future Directions]" Volume: 7, Issue: 2 , Pages: 18 – 21,Year: 2018.

4.ValentinaGatteschi; FabrizioLamberti; Claudio Demartini; Chiara Pranteda; Víctor Santamaría" To Blockchain or Not to Blockchain: That Is the Question "Volume: 20, Issue: 2 Pages: 62 - 74 ,2018.

5.Tien Tuan Anh Dinh; Rui Liu; Meihui Zhang; Gang Chen; Beng Chin Ooi; Ji Wang "Untangling Blockchain: A Data Processing View of Blockchain Systems" , Volume: 30, Issue: 7 ,Pages: 1366 – 1385 , Year: 2018.

6.Mingjun Dai; Shengli Zhang; Hui Wang; Shi Jin "A Low Storage Room Requirement Framework for Distributed Ledger in Blockchain" Volume: 6, Pages: 22970 – 22975, Year: 2018.

7.Ruiguo Yu, Jianrong Wang, Tianyi Xu, Jie Gao Yongli An Gong Zhang, And Mei Yu "Authentication With Block-Chain Algorithm and Text Encryption Protocol in Calculationof Social Network ",Volume: 5,pp: 24944 – 24951, 09 November 2017.

8.AshiqAnjum; Manu Sporny; Alan Sill " Blockchain Standards for Compliance and Trust" , Volume: 4, Issue: 4 ,Pages: 84 – 90,Year: 2017.

9.Morgen E. Peck; Samuel K. Moore "The blossoming of the blockchain" , Volume: 54, Issue: 10 Pages: 24 – 25, Year: 2017.

JOURNALS/MAGAZINES:

1. Ledger Journal of Cryptocurrency and Blockchain Technology.
2. Inderscience Journal of blockchain and cryptocurrency.
3. https://link.springer.com/bookseries/16276
4. https://www.springer.com/gp/book/9789811387746

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/104/106104220/lock
2. Chain Specialization,Introduction to Block Chain Technologies -Coursera

SELF-LEARNING EXERCISES:

Distributed Ledger inBlockchain, Decentralized Applications.

<table>
<tr><td>Course Title</td><td colspan="4">System-on-Chip Design
(PE-II)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EKS605</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13 weeks / Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

The course tells about the basics of system on chip. It discusses the fundamentals of system on chip design with introduction to the different processor and memory structures. It also briefs about the different interconnection mechanism used in system on chip

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Learn the basics of system on chip design.
2. Study the different types of processors that are used in the concept system on chip.
3. Look into the different types of memory used in the system on chip design.
4. Understand the different interconnection mechanism used in system on chip based design.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the basic design of a system on chip-based design.	1,2,3,4,5	1,3
CO2	Classify the different processors used in a system on chip-based design.	1,2,3,4,5	1,3
CO3	Make use of the different memory technologies used in the concept of	1,2,3,4,5	1,3
CO4	Categorize the basic interconnection mechanism in a system on chip	1,2,3,4,5	1,3
CO5	Understand IP cores and application specific design	9,11,12	2,3
CO6	Appreciate issues in system-on-chip design associated with co-design, such as intellectual property, reuse, and verification.	1,2,3,4,5	1,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4		√				
CO5		√		√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	3								3		3
CO2	2	3	3	3	3								3		3
CO3	2	3	3	3	2								3		3
CO4	2	3	2	3	2								3		3
CO5									2		3	3			3
CO6	2	3	2	3	2								3		3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1
Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.
UNIT-2
Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.
UNIT-3
Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.
UNIT-4
Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. **SOC Customization**: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

TEXTBOOKS:

1. Michael J. Flynn and Wayne Luk, “Computer System Design System-on-Chip”, Wiley India Pvt. Ltd.
2. Steve Furber, “ARM System on Chip Architecture “, 2nd Edition, 2000, Addison Wesley Professional.

REFERENCE BOOKS:

1. Ricardo Reis, “Design of System on a Chip: Devices and Components”, 1st Edition, 2004, Springer
2. Jason Andrews, “Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)”, Newnes, BK and CDROM.
3. Prakash Rashinkar, Peter Paterson and Leena Singh L, “System on Chip Verification – Methodologies and Techniques”, 2001, Kluwer Academic Publishers.

JOURNALS/MAGAZINES

1. IEEE Embedded Systems Letters
2. IEEE Transactions on Computer-Aided Design of Integrated Circuits &Systems
3. IEEE Transactions on Very Large Scale Integration (VLSI)Systems
4. IEEE Transactions on Circuits and Systems II: Express Briefs

SWAYAM/NPTEL/MOOCs:

1. Advanced Computer Architecture : NPTEL
2. Introduction to FPGA Design for Embedded Systems :Coursea
3. Hardware Description Languages for FPGA Design :Coursea

SELFLEARNINGEXERCISES:

Application Studies / Case Studies: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

<table>
<tr><td>Course Title</td><td colspan="3">Neural Networks and Deep learning (PE-II)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EJS606</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

Neural Networks are an effective programming paradigm that enable a computer to learn from observed data. They simulate biological learning of the nervous system and have been demonstrated to increase the power of known

machine learning models by stacking them as computational graphs. This is different from conventional programming where human programmers define the set of tasks to be carried out by a computer to solve a problem. Deep learning is a subset of machine learning that uses many layers of neural networks to accomplish tasks like image recognition, text procession, speech recognition, natural language processing etc. This course aims at giving the students the knowledge and the skills required to model the solutions to real world problems using neural networks and deep learning.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of neural network-based paradigm to problem solving.
2. Inculcate knowledge of concepts involved in training of neural networks.
3. Discuss the concepts and issues in deep neural networks.
4. Explain generalizability of deep neural networks and introduce prominent deep neural architectures.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the fundamental architecture of neural network and the concepts involved.	1,2,3,4,5	1,2
CO2	Apply the shallow neural network models - Perceptron, Least-Squares Regression, Logistic Regression, Support Vector machines to solve real	1,2,3,4,5	1,2
CO3	Develop simple deep neural networks to solve problems in unsupervised learning.	1,2,3,4,5	1,3
CO4	Create deep neural models like CNN and RNN to solve problems.	1,2,3,4,5	1,3
CO5	Illustrate the applications of CNN for solving real world Problems	1,2,3, 11, 12	1,3
CO6	Illustrate the applications of CNN for solving real world Problems	1,2,3, 11, 12	1,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2			√	√		√
CO3			√	√		√
CO4			√	√	√	√

CO5			√	√		
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1								2	2	
CO2	3	2	3	1	2								2	2	
CO3	3	1	2	1	2								2		2
CO4	3	2	2	2	2								2		2
CO5	3	2	2								1	1			
CO6	3	2	3								1	1			

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1

Introduction to Neural Networks: The basic architecture of Neural Networks – Single computational layer – The Perceptron, What Objective Function Is the Perceptron Optimizing? , Relationship with Support Vector Machines Choice of Activation and Loss Functions, Some Useful Derivatives of Activation Functions Choice and Number of Output Nodes multilayer neural network, The Multilayer Network as a Computational Graph, Training a Neural Network with Backpropagation, Practical Issues in Neural Network Training -The Problem of Overfitting, The Vanishing and Exploding Gradient Problems

Common Neural Architectures - Simulating Basic Machine Learning with Shallow Models, Radial Basis Function Networks, Restricted Boltzmann Machines, Recurrent Neural Networks, Convolutional Neural Networks, Two Notable Benchmarks - The MNIST Database of Handwritten Digits, The ImageNet Database

UNIT-2
Machine Learning with Shallow Neural Networks - Neural Architectures for Binary Classification - Revisiting the Perceptron, Least-Squares Regression, Logistic Regression, Support Vector machines, Neural Architectures for Multiclass Models - Multiclass Perceptron, Weston-Watkins SVM, Multinomial Logistic Regression (Softmax Classifier), Hierarchical Softmax for Many Classes, Auto encoder: Basic Principles, Nonlinear Activations, Deep Auto encoders, Application to Outlier Detection, When the Hidden Layer Is Broader than the Input Layer, Word2vec: An Application of Simple Neural Architectures, Simple Neural Architectures for Graph Embeddings
UNIT-3
Deep Neural Networks – Introduction, Backpropagation - Backpropagation with the Computational Graph Abstraction, Backpropagation with Post-Activation Variables, Backpropagation with Pre-activation Variables, Examples of Updates for Various Activations, Loss Functions on Multiple Output Nodes and Hidden Nodes, Setup and Initialization Issues - Tuning Hyper-parameters, Gradient-Descent Strategies- Learning Rate Decay, Momentum-Based Learning -Nesterov Momentum, Parameter-Specific Learning Rates –AdaGrad, RMSProp, Adam, Gradient Clipping, Second-Order Derivatives, Batch Normalization.
UNIT-4
Prominent Deep Learning Models - **Restricted Boltzmann Machines** – The Boltzmann Machine, How a Boltzmann. Teaching Deep Learners to Generalize- The Bias-Variance Trade-Off, Generalization Issues in Model Tuning and Evaluation, Issues with Training at Scale, Penalty-Based Regularization - L1-Regularization, L1- or L2-Regularization, Penalizing Hidden Units: Learning Sparse Representations, Ensemble Methods-Bagging and Subsampling, Parametric Model Selection and Averaging, Randomized Connection Dropping, Dropout, Data Perturbation Ensembles, Early Stopping. **Prominent Deep Learning Models** - **Restricted Boltzmann Machines** – The Boltzmann Machine, How a Boltzmann Machine Generates Data, Training the RBM, **Recurrent Neural Networks** - The Architecture of Recurrent Neural Networks, Long Short-Term Memory (LSTM), **Convolutional Neural Networks** - The Basic Structure of a Convolutional Network Training a Convolutional Network, **Deep Reinforcement Learning** - The Basic Framework of Reinforcement Learning

TEXTBOOKS:

1. Charu Aggarwal, “Neural Networks and Deep Learning”, Springer, 2018.

2. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press

REFERENCEBOOKS:

1. Francis Chollet, “Deep Learning with Python”, Manning, 2018.
2. Jacek M. Zurada, Introduction to Artificial Neural Systems, PWS Publishing Company, 1995.
3. Simon Haykin, Neural Networks: A Comprehensive Foundation, Macmillan College Publishing Company, 1994.
4. Mohamad H. Hassoun, Fundamentals of Artificial Neural Networks, The MIT Press, 1995.

5. LaureneFausett, Fundamentals of Neural Networks: Architectures, Algorithms, and Applications, Prentice Hall International, Inc., 1994.
6. B. D. Ripley, Pattern Recognition and Neural Networks, Cambridge University Press. 1996.

JOURNALS/MAGAZINES

1. IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385
2. IEEE Transactions on Pattern Analysis and Machine Intelligence
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf
4. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x
5. http://www.charuaggarwal.net/neural.htm
6. http://neuralnetworksanddeeplearning.com/
7. https://github.com/mnielsen/neural-networks-and-deep-learning
8. deeplearning.stanford.edu
9. http://yann.lecun.com/exdb/mnist/
10. University of California Irvine Machine Learning Repository - https://archive.ics.uci.edu/ml/datasets.php
11. https://peterroelants.github.io/posts/rnn-implementation-part01/
12. https://victorzhou.com/blog/keras-rnn-tutorial/

SWAYAM/NPTEL/MOOCs:

1. SwayamNptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview
2. Coursera – Neural Networks and Deep Learning Andrew Ng
3. Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

<table>
<tr><td>Course Title</td><td colspan="3">Computer Vision and Applications (PE-III)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EJS607</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Computer Vision is one of the fastest growing and most exciting AI disciplines in today's academia and industry. This course is designed to open the doors for students who are interested in learning about the fundamental principles and important applications of computer vision. The course, introduces a number of fundamental concepts in computer vision, expose students to a number of real-world applications that are important to our daily lives. More importantly, students will be guided through a series of well-designed projects such that they will get to implement using few interesting and cutting-edge computer vision algorithms. The course benefit is to apply computer vision algorithms to solve real world problems.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1.Explain the fundamentals of Computer vision.

2. Discuss various segmentation techniques and their applications.

3. Demonstrate the use of techniques for registration and classification of images.

4. Describe the object detection and recognition process in a given application

COURSEOUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Utilize linear filters to enhance the quality of images in given real world application	1-5, 7,8,9	1,2
CO2	Develop Segmentation technique to solve real world problems.	1- 5, 6-10	1,2
CO3	Design and Develop program for registration and classification of images in the real-world application Compare the various performance of protocols used for authentication.	1-11	1,2
CO4	Apply object detection and recognition techniques to solve real world problems.	1-10	1,2
CO5	Analysis the new algorithms applied for applications	1-12	2
CO6	Create a new application for image processing	1-12	3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				
CO3				√		
CO4			√			
CO5				√	√	
CO6			√	√		

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	0	1	3	3	0	0	0	3	3	0
CO2	3	2	2	2	3	3	2	3	2	1	0	0	3	3	0
CO3	3	2	3	3	3	2	3	2	3	3	3	0	3	3	0
CO4	3	2	3	3	3	2	2	3	2	3	0	0	3	3	0
CO5	2	3	3	2	1	2	3	2	3	2	2	3	0	0	3
CO6	2	3	1	3	2	1	2	3	2	2	3	2	0	0	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

Theory

Contents
UNIT-1
Introduction: What is computer vision? A brief history. Image formation: Geometric primitives and transformations, Geometric primitives, 2D transformations,3D transformations, 3D rotations, 3D to 2D projections, Lens distortions, Photometric image formation, Lighting, Reflectance and shading, The digital camera, Sampling and aliasing, Color, Compression.
UNIT-2
Image processing, Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization, Feature detection and matching, Points and patches, Feature detectors, Feature descriptors, Feature matching, Feature tracking, Edges, Edge detection, Edge linking, Application: Edge editing and enhancement, Lines, Successive approximation, Vanishing points, Hough transforms, Application: Rectangle detection.
UNIT-3
Segmentation: Active contours, Snakes, Dynamic snakes and CONDENSATION, Scissors, Level Sets, Application: Contour tracking and rotoscoping, Split and merge, Watershed, Region splitting (divisive clustering), Region merging (agglomerative clustering), Graph-based segmentation, Probabilistic aggregation, Mean shift and mode finding, Normalized cuts Graph cuts and energy-based methods.
UNIT-4
High-Level Vision Registration: Registering Rigid Objects, Model-based Vision: Registering Rigid Objects, Registering Deformable Objects .Learning to Classify: Classification, Error, and Loss, Major Classification Strategies, Practical Methods for Building Classifiers, Classifying Images: Building Good Image Features, Classifying Images of Single, Image Classification in Practice detecting Objects in Images: The Sliding Window Method, Detecting Deformable Objects, The State of the Art of Object Detection Topics in Object Recognition: What Should Object Recognition Do?.

TEXT BOOKS:

1. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", 2nd Edition, University of Illinois at Urbana-Champaign Jean Ponce, Ecole Normale Superieure, Paris©2012, Pearson.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
3. 3.David Marr, Tomaso A. Poggio, Shimon Ullman "A Computational Investigation into the Human Representation and Processing of Visual Information", eBook - Amazon.com, 2010.

REFERENCE BOOKS:

1. Gary Bradski, Adrian Kaehler, "Learning OpenCV: Computer Vision with the OpenCV Library" Amazon, 2008.

JOURNALS/MAGAZINES:

1. International Journal of Computer Vision, Springer, https://www.springer.com/journal/11263
2. Image and Vision Computing, Elsevier, https://www.journals.elsevier.com/image-and-vision-computing
3. Computer Vision and Image Understanding, Elsevier, https://www.journals.elsevier.com/computer-vision-and-image-understanding
4. IEEE Transactions on Image Processing, https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=83
5. IEEE Transactions on Pattern recognition and machine intelligence, https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=34

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/courses?query=computer%20vision
2. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs58/

SELF-LEARNINGEXERCISES:

Artificial Neural Networks, Convolution Neural Network.
Implementation of applications using the above topics.

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Topics in Wireless Networks (PE-III)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EJS608</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

The course is aimed at equipping students with advanced concepts in wireless network theory and technologies, vital for a successful career in digital economy. Wireless communication is fast growing industry segments today. Many types of wireless networks are now being used for applications such as personal communication, entertainment, rural and urban healthcare, smart home building, inventory control, and surveillance. This course introduces the concepts of wireless networks and mobile computing to give engineering students at the undergraduate/graduate level a solid background in the field. It also looks at the latest research and challenging problems in the field to serve as a reference for advanced-level researchers.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of wireless network.
2. Gain bandwidth management and node localization in wireless networks
3. Describe the message communication in adhoc network and sensor nodes.
4. Discuss the communication optimization and security in wireless communication.

COURSE OUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the fundamentals of wireless communication concepts.	1,2,3, 4, 8, 9 , 12	1
CO2	Make use of bandwidth management concept in wireless networks	1 ,2,3, 5,9,12	2
CO3	Apply the knowledge of routing in wireless network for optimization	1 ,2,3,4 5, 9, 12	2
CO4	Develop an algorithm for energy efficient communication and secure transmission.	1,4,5,9,12	2
CO5	Design a component or a product applying all the relevant standards and with realistic constraints	6,7,9,10	2,3
C06	Design and conduct experiments, as well as to analyze and interpret data	6,7,9,10	3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√		√	
CO3			√	√		
CO4			√	√		
C05			√		√	
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2				2	1			1	3		
CO2	3	2	3		3				1			1		3	
CO3	3	1	2	2	3				1			1		3	
CO4	3			2	3				1			1	3	3	
CO5						2	3		1	2				2	2
CO6						2	3		2	3				3	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT – 1
Introduction: Applications Involving Wireless Communication, Effects of Mobility of Devices, Issues in Cellular Mobile Networks, Issues in Ad Hoc Networks, Issues in Cognitive Radio Networks, Issues in Sensor Networks **Mobility Management in Cellular Networks:** Call Setup in Public Land Mobile Networks, Call Setup in Mobile IP Networks, Handoff Management, Mobility Models
UNIT – 2
Bandwidth Management in Cellular Networks: Introduction, Benchmark Instances, Lower Bounds on Bandwidth, Genetic Algorithm for Channel Assignment, Coalesced CAP, Fast Near-Optimal Channel Assignment **Localization of Nodes in Mobile Networks :** System Model, Preliminaries, Estimation of Location Error, Beacon Nodes Selection Algorithm, Location Region Identification
UNIT – 3
Messae Communication in Ad Hoc Networks: Introduction, Broadcast in Ad Hoc Networks, Transmission Schedule, Slot Assignment based on Location Information, Deterministic Broadcast and Gossiping, Point-to-point Routing in Ad Hoc Networks, Destination-Sequenced Distance Vector Routing (DSDV) Protocol, Dynamic Source Routing (DSR), Ad-hoc On-Demand Distance Vector Routing (AODV), Temporally-Ordered Routing Algorithm (TORA), Zone Routing Protocol (ZRP)
UNIT – 4
Energy-Efficient Communication: Introduction, Some Elegant Physical Layer-Centric Techniques, Redundant Binary Number Encoding with Silent Zero Communication (RBNSiZeComm), Ternary with Silent Symbol (TSS) Communication Protocol, Compression with Null Symbol (CNS) Communication Protocol, Tri-digit Fibonacci Number System (TFNS) Communication Protocol **Security in Wireless Communication:** Introduction, Measures Against Attacks, Hardware Implementation of RC4 for One Byte per Clock

TEXTBOOKS:

1. Koushik Sinha, Sasthi C. Ghosh, Bhabani P. Sinha, "Wireless Networks and Mobile Computing", CRC press, 1st edition 2015.

REFERENCEBOOKS:

1. Savo Glisic ,"Advanced Wireless Networks: Technology and Business Models", Third Edition, John Wiley & Sons, Ltd, 2016.
2. Savo Glisic,"Advanced Wireless Networks: 4G Technologies", John Wiley & Sons, 2006.
3. C. DeMorais and D. P. Agrawal, Ad hoc Networks – Theory and Applications, World Scentific Publishing, New

Jersey (ISBN – 978-981-256-682-9).

4. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks -Architectures and Protocols”, Prentice Hall, 2004.

JOURNALS/MAGAZINES

1. Kim, Taeyoung, et al. "Machine Learning for Advanced Wireless Sensor Networks: A Review." IEEE Sensors Journal (2020).
2. SINGH, UPINDERPAL, et al. "NEW: NEW EVOLUTION IN WIRELESS TECHNOLOGIES.", 2020.
3. Bin, M.A., Shangru, L.I. and Xianzhong, X.I.E., 2020. A Hierarchical Vertical Handover Algorithm Based on Fuzzy Logic in Heterogeneous Wireless Networks. *电子与信息学报*, *42*(3), pp.629-636.
4. https://ieeexplore.ieee.org/document/9116080

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/117/104/117104099/
2. https://www.coursera.org/learn/wireless-communications
3. https://www.coursera.org/learn/iot-wireless-cloud-computing
4. https://www.coursera.org/learn/network-security-communications-sscp

SELF-LEARNINGEXERCISES:

Explore Multi-input multi-output (MIMO) antenna systems

Develop skills to use Simulators for realizing wireless networks

Connectivity support in heterogenous wireless network

Explore network information theory.

Course Title	Compiler Design (PE-III)				Course Type		Theory	
Course Code	B20EJS609	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This Course intends to make students learn the techniques needed for compiler construction and also develops analytical skills. The course is conceptual.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of Object-Oriented programming, Object-Relational Databases and Compilers.
2. Describe how syntax tree can be constructed to check the syntax of the given input.
3. Discuss different types of parsers and syntax directed definition and translation.
4. Demonstrate how code optimization and code generation is done for a given source code.

COURSE OUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the concepts of lexical, syntactic and semantic analysis to parse the given statement.	1,2,3,4,5,11,12	1
CO2	Experiment with the knowledge of different parsers by constructing the top down and SLR parsers.	1,2,3,4,5,11,12	2
CO3	Make use of different types of parsers and syntax directed definition and translation to check the syntax of the given input.	1,2,3,4,5,11,12	1
CO4	Develop code optimization and code generation for a given source code.	1,2,3,4,5,11,12	2,3
CO5	Learn new tools and technologies in the compiler designand apply for suitable application development.	12	2
CO6	Develop solutions in the related fieldComputer Vision and Applications to the complex problems, either individually or as a part of the team	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1			√			
CO2			√	√		
			√			
CO4						√
CO5			√		√	
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1						2	2	3		
CO2	2	2	2	1	1						2	2		3	
CO3	2	2	2	1	1						2	2	3		
CO4	2	2	2	1	1						2	2		3	3
CO5												2		2	
CO6					3				2	2				2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1 **Introduction to Compilers:** Language processors; the structure of a Compiler; **Lexical analysis:** Tokens, Regular expressions, Finite state automata, translating regular expressions into finite state automata;
UNIT-2 **Syntax analysis 1:** Context-free grammars, Derivations and syntax trees, Handling ambiguous grammars, Top-down parsing, Bottom-up parsing – SLR( );

UNIT-3
Syntax Analysis 2: More powerful LR Parsers; **Syntax-directed translation:** Syntax-directed definitions; Evaluation orders for SDDs; Applications of syntax-directed translation; Parser stack implementation of Postfix SDT;
UNIT-4
Code optimization and generation: Basic blocks and Flow graphs; Optimization of basic blocks; **Intermediate code generation:** Variants of syntax trees; Three-address code; Control flow; back patching;

TEXT BOOKS:

1. A. V. Aho, R. Sethi and J. D. Ullman, Compilers – Principles, Techniques, and Tools, Addison-wesley, Pearson Education, 2001.
2. Charles N. Fischer, Richard J. leBlanc, Jr., Crafting a Compiler with C, Pearson Education, 1991.
3. Kenneth C Louden, Compiler Construction Principles & Practice, Cengage Learning, 1997.

REFERENCE BOOKS:

1. A.W. Appel, Modern Compiler Implementation in Java, Cambridge University Press, 2002.
2. IEEE, IEEE Transactions on Computers.
3. Elsevier, Computer Languages, Systems and Structures.
4. Springer, Journal of Logic, Language and Information.
5. ACM, ACM Transactions on Programming Languages and Systems (TOPLAS).

JOURNALS/MAGAZINES

1. https://www.springer.com/gp/book/9783319669656
2. https://ieeexplore.ieee.org/document/101813

SWAYAM/NPTEL/MOOCs:

6. https://nptel.ac.in/courses/106/104/106104123/
7. https://www.mooc-list.com/tags/compilers

SELF-LEARNINGEXERCISES:

More Recent Applications: translating regular expressions into finite state automata; survey of latest compilers for dealing with parallel programming.

Course Title	Advanced Topics in Machine Learning (PE-IV)				Course Type		Theory	
Course Code	B20EKS610	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

The course combines breadth and depth of concepts involved in machine learning, offering advanced concepts on learning, hypothesis, analytical learning, inductive analytical approaches to learning

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Enable students to understand advanced probabilistic concepts in machine learning
2. Explore various models in advanced machine learning.
3. Design model parameters
4. Help the student choose most appropriate model to solve a problem.

COURSE OUTCOMES(COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the advanced concepts in machine learning techniques	1,2,3,4,5,12	1,2
CO2	Examine the problem to determine correct model to apply	1,2,3,4,5,12	1,2
CO3	Estimate parameters of different types of models in advanced machine learning	1,2,3,4,5,12	1,2
CO4	Decide on the best ML approach and model to apply for solving a real world problem.	1,2,3,4,5,12	1,2
CO5	Learn new tools and technologies in the machine learning and apply for suitable application development.	12	2
CO6	Develop solutions in the related field machine learning to the complex problems, either individually or as a part of the team and report	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOME

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√		
CO3		√				
CO4				√		
CO5			√		√	
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3			1	1			3	3	3	
CO2	3	3	3	3	3				1			3	3	3	
CO3	3	2	2	2	3				1			2	3	3	
CO4	3	3	2	3	3				1			3	3	3	
CO5												2		2	
CO6					3				2	2				2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT – 1
Introduction – Machine Learning : what and why – Types of ML, Supervised Learning – Classification , Regression, Unsupervised Learning – discovering clusters, discovering latent factors. Parametric vs non-parametric models, a simple non-parametric classifier – K-nearest neighbors, Curse of dimensionality, Parametric models for classification and regression, linear regression, logistic regression, overfitting, model selection, no free lunch theorem. **A brief review of probability** – Discrete random variables, discrete distributions, Bayes rule. **Bayesian Statistics** - MAP estimation, Bayesian Occam's razor, Priors – Uninformative priors, Jeffreys priors, Robust priors, Mixtures of conjugate priors,

UNIT – 2

Gaussian Models : Introduction – notation, basics, MLE for an MVN, Maximum entropy derivation of the Gaussian, Linear discriminant analysis, two class LDS, Nearest shrunken centroids classifier

Linear Regression – Maximum Likelihood estimation least squares- derivation, robust linear regression, ridge regression – basic idea, connection with PCA, Bayesian Linear Regression – computing posterior, computing posterior predictive, Bayesian linear regression. **Bayesian Logistic Regression** – Laplace approximation.

UNIT – 3

Bayesian Concept Learning – Likelihood, prior, posterior, posterior predictive. Beta binomial model – likelihood, prior, posterior, posterior predictive, Dirichlet multinomial model-likelihood, prior, posterior, posterior predictive.

Gaussian Models – Notation, Basics, Maximum likelihood estimation for a MVN. Gaussian discriminant analysis – quadratic discriminant analysis, linear discriminant analysis, two class LDA, regularized LDA, nearest shrunken centroids classifier. **Advanced Models** -Generalized linear models – basics, Probit regression – ML/MAP estimation using gradient based optimization

UNIT – 4

Multi-task learning – Hierarchical Bayes for multi task learning, application to personalized email spam filtering, Directed Graphical Models (Bayes nets) – Markov and Hidden Markov Models, Medical Diagnosis, Mixture Models – Mixtures of Gaussians, using mixture models for clustering. EM algorithm for GMMS, l1 and l2 regularization, Kernel functions – RBF, kernels for comparing documents, Mercer kernels, linear kernels, Matern kernels, string kernels, string kernels, Pyramid match kernels. Kernel machines, kernel trick, kernelized nearest neighbor classification, kernelized K-medoids clustering, kernelized ridge regression.

TEXTBOOKS:

1. Kevin P. Murphy Machine Learning: A Probabilistic Perspective,2012, The MIT Press.

REFERENCEBOOKS:

1. Tom M. Mitchell, “Machine Learning”, India Edition McGraw Hill Education,2013.
2. Chris Bishop,“Pattern Recognition and Machine Learning” , Springer (India) Private Limited, 2013.
3. Ethem Alpaydin, “Introduction to Machine Learning”, Second edition MIT press, 2010, Chapters 1, 2, 6, 7, 19.
4. Yoshua Bengio and Aaron Courville ,”Deep Learning”,Ian Good fellow, MIT Press book,2016.
5. Richard o. Duda, Peter E. Hart and David G. Stork, “Pattern classification”, John Wiley & Sons Inc., 2001

JOURNALS/MAGAZINES

1. IEEE Transactions on Pattern Analysis and Machine Intelligence
2. Springer machine learning
3. Elsevier Computational Statistics and Data Analysis
4. Wiley- International Journal of Intelligent Systems

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/106/106106198/
2. Advanced Machine Learning Specialization -Coursera

SELF-LEARNINGEXERCISES:

Latent linear models – factor analysis, PCA, Sparse linear models,

Course Title	**Advanced Computer Architecture (PE- IV)**				**Course Type**		**Theory**	
Course Code	**B20EKS611**	**Credits**	**3**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIE

The objective of this course is to make students learn advanced computer architecture. The students learns the different aspects of pipe lining, parallelism using instruction level and data parallelism

COURSE OBJECTIVE (S):

Objectives of this course are to:

5. Explain the fundamentals of quantitative design,analysis and memory design
6. Describe instruction level parallelism and know about ILP
7. Define the different aspects of data parallelism
8. Illustrate the techniques for thread level parallelism
9. Provide a continues learning on design and evolution of chips and computer architecture under optimizations
10. Describe the vision of architectural enhancements and research challenges.

COURSE OUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the fundamentals of quantitative, analysis and memory design.	1,2,3,4,5	1
CO2	Make use of different techniques of instruction level parallelism for real world application.	1,2,3,4,5	1
CO3	Identify the different data parallelism technique for given instruction.	1,2,3,4,5	1
CO4	Apply thread level parallelism in programming effectively.	1,2,3,4,5	2

CO5	Provide an understanding in evaluating architecture development and familycategorization.	3,4,6,11,12	2,3
CO6	Continues Learning objectives with evolving computer architecture design and optimization towards research gaps and challenges	4,5,11	3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3		√				
CO4			√			
CO5				√		
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2								3		
CO2	3	2	3	3	3								3		
CO3	3	3	2	2	2								3		
CO4	3	3	2	3	2									2	
CO5			3	2		3					2	2		1	3
CO6				3	3						3				2

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
Fundamentals of Quantitative Design and Analysis: Introduction, Classes of Computers, Defining Computer Architecture, Trends in Technology, Trends in Power and Energy in Integrated Circuits, Trends in Cost, Dependability, Measuring, Reporting, and Summarizing Performance, Quantitative Principles of Computer Design, Putting It All Together: Performance, Price, and Power **Memory Hierarchy Design:** Introduction, Ten Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: Virtual Memory and Virtual Machines, Crosscutting Issues: The Design of Memory Hierarchies, Putting It All Together
UNIT-2
Instruction-Level Parallelism: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Advanced Branch Prediction, Overcoming Data Hazards with Dynamic Scheduling, Dynamic Scheduling: Examples and the Algorithm, Hardware-Based Speculation, Exploiting ILP Using Multiple Issue and Static Scheduling, Exploiting ILP Using Dynamic Scheduling, Multiple Issue, and Speculation, Advanced Techniques for Instruction Delivery and Speculation, Studies of the Limitations of ILP, Cross-Cutting Issues: ILP Approaches and the Memory System, Multithreading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput, Putting It All Together: The Intel Core i7 and ARM Cortex-A8
UNIT-3
Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Crosscutting Issues, Putting It All Together: Mobile versus Server GPUs and Tesla versus Core i7
UNIT-4
Introduction, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization: The Basics, Models of Memory Consistency: An Introduction, Crosscutting Issues, Putting It All Together: Multicore Processors and Their Performance

TEXT BOOKS:

1. John Hennessy David Patterson, Morgan Kaufmann, Computer Architecture, 5th Edition, A Quantitative Approach, September 2011

2. Kai Hwang, Naresh Jotwan, Advanced Computer Architecture, 3e, Tata McGraw Hill.

3. Dezso Sima, Advanced Computer Architectures: A Design Space Approach,.

REFERENCE BOOKS:

1. Chopra Rajiv, Advanced Computer Architecture, A Practical App.

2. Nicholas Carter , Raj Kamal, Computer Architecture and Organisation: Schaum's Outlines Series.

JOURNALS/MAGAZINES

5. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10208
6. https://www.springer.com/gp/book/97898115813

SWAYAM/NPTEL/MOOCs:

3. https://onlinecourses.nptel.ac.in/noc19_cs62/preview
4. https://www.classcentral.com/course/swayam-advanced-computer-architecture-13884

SELF-LEARNINGEXERCISES:

The concepts of pipelining and the effects of pipelining in programming. The harzards of pipelining is also important topics.

<table>
<tr><td>Course Title</td><td colspan="4">Embedded Systems
(PE-IV)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EKS612</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This course introduces different learning approach for embedded systems. It looks at embedded system as a whole, specifies what it is, what it comprises of what is to be done with it, and how to go about the whole process of designing an embedded system with processor, sensors, memory and I/O. It also focusses on hardware/software codesign, real time operating system concept in realizing embedded system and embedded system development environment with an extension to introducing current trends in industry. Enough care is taken to provide in-depth knowledge in embedded system with a facility to build projects, case studies, etc.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss brief idea about the embedded system components, memory, communication interfaces and other firmware components.
2. Understand the Quality attributes, hardware and Software co-design, Computational models in embedded systems, Unified Modelling languages etc.
3. Understand the firmware system development and firmware development languages.
4. Explore the fundamentals of RTOS, Integrated Development Environment, Simulators and Emulators.
5. Explain trends in embedded system development.

COURSE OUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret various hardware and software components of embedded system	1, 2, 3, 4	2
CO2	Understand the quality attributes, hardware-software co-design in embedded systems.	1, 3, 4	3
CO3	Apply RTOS concepts for embedded system design	2, 3, 4, 5, 6	2
CO4	Evaluate IDE for embedded system and interpret emulator, hardware debugging and boundary scan concepts	4, 5, 6,11	3
CO5	Provide a continues learning approach for analysing embedded system applications and operation standards	5,6,11	2,3
CO6	Validating and understanding the change of technological aspects of embedded system applications and configurationinfrastructure	5,7,11,12	3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				
CO3			√	√		
CO4			√	√	√	
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3										3	
CO2	3		3	3											2
CO3		2	3	3	2	3								2	
CO4				2	2	3					2				3
CO5					3	1					3			2	2
CO6					2		2				3	2			3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT – 1
Introduction to Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components
UNIT – 2
Characteristics and Quality Attributes of Embedded Systems Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language **(Self Study/Case Study)**, Hardware Software Trade-offs **Embedded Firmware Design and Development:** Embedded Firmware Design Approaches, Embedded Firmware Development Languages

UNIT – 3

Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS **(Self Study/Case Study)**

UNIT – 4

The Embedded System Development Environment: The Integrated Development Environment (IDE) **(Self Study/Case Study)**, Types of Files Generated on Cross-compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.

Trends in the Embedded Industry:**(Self Study/Case Study)**, Processor Trends in Embedded Systems, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks

TEXTBOOKS:

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009
2. James K Peckol , "Embedded Systems – A contemporary Design Tool", John Wiely, 2008.

REFERENCEBOOKS:

1. Wayne Wolf, — Computers as Components, Principles of Embedded Computing Systems Design‖, Elsevier, 2 nd Edition, 2009.
2. Dr. K. V. K. K. Prasad, — Embedded / Real-Time Systems: Concepts, Design & Programming‖, dreamtech publishers, 1 st Edition, 2003.
3. Frank Vahid, Tony Givargis, —Embedded System Design‖, John Wiley & Sons, 3 rd Edition, 2006.
4. Lyla B Das, —Embedded Systems‖ , Pearson Education, 1 st Edition, 2012.
5. David E. Simon, —An Embedded Software Primer‖, Addison-Wesley, 1 st Edition, 1999.
6. Michael J. Pont, —Embedded C‖, Pearson Education, 2nd Edition, 2008.

JOURNALS/MAGAZINES

1. https://www.inderscience.com/jhome.php?jcode=ijes
1. http://www.sciencepublishinggroup.com/journal/index?journalid=236
2. https://www.electronicsweekly.com/market-sectors/embedded-systems/
3. https://www.embedded.com/embedded-systems-design-magazine-archive/
4. https://spectrum.ieee.org/computing/embedded-systems

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/mastering-microcontroller-with-peripheral-driver-development/
2. https://www.coursera.org/learn/embedded-software-hardware
3. https://www.coursera.org/specializations/embedded-systems-security
4. https://www.coursera.org/specializations/embedded-systems-security
5. https://nptel.ac.in/courses/108/102/108102045/

Self-LearningExercises/Case Study:

1. Explore various hardware embedded system designs

2. Build projects using IoT and hardware to illustrate embedded system concepts
3. Design complex automation system using embedded programming

Create real time application using ARM processor

Course Title	**Data Mining (OE-II)**				**Course Type**		**Theory**	
Course Code	**B20CI0601**	**Credits**	**3**		**Class**		**VIsemester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	3	3	3	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Data mining is a major area of exploration for knowledge discovery in databases. Data mining is for relatively unstructured data for which more sophisticated techniques are needed. The course aims to cover powerful data mining techniques including clustering, classification and association rules.

COURSE OBJECTIVE (S):

1. Introduce the basics of data mining, data types, similarity and dissimilarity measures
2. Explain association rules and algorithms
3. Describe the classification algorithms for data categorization
4. Illustrate the clustering algorithms for grouping datasets
5. Demonstrate the appropriate data mining techniques for decision-making

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Explain the basics of data mining techniques, data types, identify the similarity and dissimilarity between the datasets and analyze the data sets using the association rules andalgorithms	1,2,4,6,11,12	1,2
CO2	Characterize and discriminate data sets with classificationmethods	1,2,3,4,5,6,7	2
CO3	Employ the clustering methods in real lifeproblems	1,2,3,4,5,6,7	2,3
CO4	Apply the knowledge for data miningapplications	1,2,3,4,5,6,7, 12	2,3
CO5	Learn new tools and technologies in the data miningand apply for suitable application development.	12	1, 2

CO6	Develop solutions in the data mining to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2		√	√	√		
CO3			√	√		
CO4			√		√	
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		1		1					2	1	2	3	
CO2	3	3	2	2	3	2	1						3	3	
CO3	3	2	3	2	3	2	3							3	3
CO4	3	2	3	2	3	1	1					2		3	3
CO5	3		3									2		3	
CO6	3		3											3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1

Introduction: What is Data Mining? Motivating Challenges, The origins of data mining, Data Mining Tasks, Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity, Data Mining Applications, Visualization.
UNIT-2 **Association Analysis**: Basic Concepts and Algorithms, Frequent Itemset Generation, Rule Generation, Compact Representation of Frequent Itemsets, Alternative methods for generating Frequent Itemsets, FP GROWTH Algorithm, Evaluation of Association Patterns .
UNIT-3 **Classification:** Basics, General approach to solve classification problem, Decision Trees, Evaluating the performance of a Classifier, Rule Based Classifiers, Nearest Neighbour Classifiers, Naïve Bayes Classifier
UNIT-4 **Clustering:** overview, K-means**,** agglomerative hierarchical clustering, DBSCAN, Cluster Evaluation, Characteristics of Data, Clusters and Clustering Algorithms, Prototype Based Clustering.

TEXTBOOKS:

1. A Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education,2007.
2. JiaweiHanandMichelineKamber,"DataMiningConceptsandTechniques"SecondEdition,Elsevier, Reprinted2008.

REFERENCE BOOKS:

1. K.P.Soman,ShyamDiwakarandV.Ajay,"InsightintoDataminingTheoryandPractice",Easter Economy Edition, Prentice Hall of India,2006.
2. G.K.Gupta,"IntroductiontoDataMiningwithCaseStudies",EasterEconomyEdition,Prentice Hall of India,2006.

JOURNALS/MAGAZINES:

1. Data Mining and Knowledge Science – Springer.
2. Interscience,The International Journal of DataMining, Modelling and Management-
3. IEEE, IEEE Transactions on Knowledge and Data Engineering.

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. Introduction to Data Mining- Coursera
3. Data Mining Specialization- Coursera

SELF- LEARNING EXERCISES:

Decision Trees, Rule Based Classifiers, Nearest Neighbour Classifiers

Course Title	**MACHINE LEARNING (OE-II)**			**Course Type**	**Theory**
Course Code	**B20CI0602**	**Credits**	**3**	**Class**	**VIsemester**

Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can process through large volumes of data at high speed to make predictions or decisions without human intervention.

COURSE OBJECTIVES (S):

The objectives of this course are to:

1. Explain machine learning and problems relevant to machine learning.
2. Discuss the fundamentals of Decision trees learning and its issues
3. Illustrate neural networks, Bayes classifier and k nearest neighbour for problems appearing in machine learning.
4. Describe statistical analysis of machine learning techniques.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Design the learning system to provide the solution for the given problem.	1,2,3,4,5	1, 2, 3
CO2	Apply Decision Tree technique for Classification problem	1,2,3,4,5	1, 2, 3
CO3	Develop Recognition or Prediction systems using Neural Network/Bayesian Model	1,2,3,4,5	1, 2, 3
CO4	Solve the problem by hypothesis testing using probability and statistics.	1,2,3,4,5	1, 2, 3
CO5	Learn new tools and technologies in the machine learningand apply for suitable application development.	12	1, 2
CO6	Develop solutions in the machine learning to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1						√
CO2			√			
CO3			√			√
CO4				√	√	
CO5			√			
CO6			√	√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2								3	3	3
CO2	2	2	2	3	2								3	3	3
CO3	2	3	2	2	2								3	3	3
CO4	3	2	2	2	2								3	3	3
CO5	3	2	2		2								3		3
CO6	3		2		2								3	3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT:

THEORY

UNIT-1
Introduction: Well posed learning problems, designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.
UNIT-2
Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.
UNIT-3
Artificial NeuralNetworks: Introduction,NeuralNetworkrepresentation, appropriate problems,

Perceptrons, Back propagation algorithm.

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm.

UNIT-4

Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.

Instance Based Learning: Introduction, k-nearest neighbour learning, locally weighted regression, radial basis function, cased-based reasoning.

TEXTBOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition McGraw Hill Education,2013.

REFERENCEBOOKS:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", 2nd edition, springer series in statistics.
2. EthemAlpaydın, "Introduction to machine learning", second edition, MIT press.

JOURNALS/MAGAZINES:

1. Journal of Machine Learning Research,https://www.jmlr.org/
2. https://ieeexplore.ieee.org/document/8070809
3. https://www.ieeesmc.org/technical-activities/cybernetics/machine-learning
4. https://www.engpaper.com/machine-learning-ieee-papers-2019.htm

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/106/106106139/
2. Introduction to Machine Learning, Machine Learning, Deep Learning-Cousera

SELF-LEARNING EXERCISES:

Reinforcement Learning: Introduction, Learning Task, Q Learning

Course Title	Neural Network (OE-II)				Course Type		Theory	
Course Code	B20CIO603	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 week / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces the basic learning models, learning algorithms, and some applications of neural networks. The focus is on to understand and use neural networks for solving different problems related to pattern recognition, function approximation, data visualization, etc.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand mathematical basics of neural networks.
2. Choose appropriate error function and optimization algorithm
3. Enable a student to train a neural network using suitable approach
4. Design real world solutions using Neural networks.

COURSE OUTCOMES (COs)

On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs

CO1	Outline the mathematical concepts behind working of neural networks.	1,2,3,4,5	1
CO2	Illustrate the error functions and optimization algorithms that can be applied to a neural network model	1,2,3,4,5	2
CO3	Demonstrate the training of a neural network model to solve a problem.	1,2,3,4,5	3
CO4	Design a neural network using Tensor Flow to solve a real world problem.	1,2,3,4,5	3
CO5	Learn new tools and technologies in the neural networksand apply for suitable application development.	12	1, 2
CO6	Develop solutions in the neural networks to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	**Bloom's Level**					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						√
CO2			√			√
CO3				√		√
CO4				√	√	√
CO5				√		√
CO6				√	√	√

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	2	1								3		
CO2	3	2	3	1	2									3	
CO3	3	1	2	1	2										3
CO4	3	2	2	2	2										3

CO5	3	2	2	2	2									3	3
CO6	3		2	2	2									3	3

Note:1-Low,2-Medium,3-High\

COURSE CONTENT:

THEORY

UNIT-1
Neural Network Basics – Statistical Pattern Recognition – an example character recognition, classification and regression, pre-processing and feature extractions, polynomial curve fitting, multivariate non-linear functions, decision boundaries, minimizing risk, single layer networks – linear discriminant functions, linear separability, least squares techniques, the perceptron, multi-layer perceptron – feed forward network mappings, threshold units, sigmoidal units, error back propagation, Jacobian Matric, Hessian matrix.
UNIT-2
Learning and Generalization: Error Functions and Parameter Optimization Algorithms –Sum of squares error, Minkowski error, input dependent variance, modelling conditional distributions, estimating posterior probabilities, sum of squares for classification, cross entropy for two classes, entropy. Error Surfaces, Local quadratic approximation, linear output units, optimization in practice, gradient descent, conjugate gradients, Newton's Method, Bias and Variance, Regularization, Training with noise, soft weight sharing, Linear Neurons and Their Limitations, Sigmoid, Tanh, and ReLU Neurons, Softmax Output Layers, Looking Forward
UNIT-3.
Training Feed-Forward Neural Networks: The Fast-Food Problem, Gradient Descent, The Delta Rule and Learning Rates, Gradient Descent with Sigmoidal Neurons, The Back-propagation Algorithm, Stochastic and Mini batch Gradient Descent, Test Sets, Validation Sets, and Over fitting, Preventing Over fitting in

Deep Neural Networks. Back Propagation: The Back propagation Network, The Generalized Delta Rule, Practical Considerations, BPNApplications, The Back propagation Simulator.

UNIT-4

Implementing Neural Networks in Tensor Flow: Definition of Tensor Flow, Installing Tensor Flow, Creating and Manipulating Tensor Flow Variables, Tensor Flow Operations, Placeholder Tensors ,Sessions in Tensor Flow, Navigating Variable Scopes and Sharing Variables, Managing Models over the CPU and GPU, Specifying the Logistic Regression Model in Tensor Flow, Logging and Training the Logistic Regression Model, Leveraging Tensor Board to Visualize Computation Graphs and Learning, Building a Multilayer Model for MNIST in Tensor Flow.

TEXT BOOKS:

1. Christopher M Bishop, "Neural Networks for Pattern Recognition", Clarendon Press, Oxford, 2005.
2. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning, designing next-generationmachine intelligence algorithms", O'Reilly, 1st Edition.

REFERENCE BOOKS:

1. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2003.
2. S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networks using MATLAB 6.0", TATA Mc Graw Hill, 2006
3. Neural Networks Algorithms, Applications, and Programming Techniques - James A. Freeman

JOURNALS/MAGAZINES

1. IEEE Transactions on Neural Networks and learning systems
2. IEEE Transactions on Evolutionary Computation
3. IEEE Transactions on Fuzzy systems
4. Journal of Applied Soft Computing –Elsevier

SWAYAM/NPTEL/MOOCs:

1. www.cs.stir.ac.uk/courses/ITNP4B/lectures/kms/1-Intro.pdf
2. https://www.nptel.ac.in/courses/106/106/106106184

SELF-LEARNING EXERCISES:

Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis. Neural network applications: Process identification, control, fault diagnosis.

Course Title	**IOT AND CLOUD COMPUTING LAB**			Course Type	Practical
Course Code	**B20EK0602**	Credits	1	Class	VI semester

Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

1.Getting started with Arduino IDE, add ESP8266 and ESP32 in the ArduinoIDE. GPIO Interfacing and programming

2.Digital on/off sensor (PIR and IR) Interfacing programming

3.Analog sensors Interfacing (Accelerometer and gyroscope) programming

4.Interfacing and programming of actuators

5.Development of an offline server using http protocol

6.Development of an online server

7.Experimenting with existing cloud platforms

8. Development of Android applications suitable for IOT

9.Exchange information using MQTT protocol

10.Getting started with Raspberry Pi and OS Installation

11.Experimenting with Raspberry Pi using Python

12.Dashboard development using visual programming: NodeRED

13.IoT based mini project

Course Title	BIG DATA ANALYTICS Lab				Course Type		Practical	
Course Code	B20EA0604	Credits	1		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	1	2	2	0	26	50%	50%

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	PART-A		
1	The ages of the couples are to be read and stored in a database called "ages". It is required to classify number of couples belonging to 31..40, 41..50, 51..60 and 61..70. Write a Scala program to read the data from the "ages" and classify the ages of couples as mentioned in the above requirement.	Array	Illustrate, Implement, Apply
2	"DataTube", a data collecting agency stores the last 4 characters in given file in uppercase. Write a Scala program to accomplish the solution for the above requirement.	Strings	Illustrate, Implement, Apply
3	"Avron" manufacturing company has a requirement of comparing the two names of their products lexicographically. Write a Scala program to provide the solution for the above requirement. Note: The two strings are lexicographically equal, if they are of same length and contain the same characters in the same positions.	Lexicography	Illustrate, Implement, Apply
4	"GESE", a gene-sequencing company has a requirement to find the maximum occurring characters in a sequence prior to any other types of analysis. Write a Scala program to provide the solution for the above requirement.	Genesequencing	Illustrate, Implement, Apply
5	"Jesica", a gene-sequencing company has a requirement to check if two given sequences are rotations of each other. (Note: ABCDA and CDAAB are rotations of each other) Write a Scala program to provide solution for the above requirement.	Strings, Functions	Illustrate, Implement, Apply
6	Create a RDD in Scala through external source (text file) offering a Hadoop Input Format. "keywords.txt" file has the following 4 lines given below. Apache Spark Big Data and Analytics using Spark Learning Spark Real time Spark Streaming Machine Learning using Spark	RDD	Illustrate, Implement, Apply

	Spark using Scala Pyspark Spark and Kafka Spark and R Spark SQL Perform the following operations of the RDD created: a) Calculate the length (number of characters) of each line in "keywords.txt" using "map" transformation. b) Count the number of lines in RDD "lines" using "count" action. c) Find the sum of total number of characters in text.txt using "reduce" action		
7	Create a RDD in Scala through external source (text file) offering a Hadoop Input Format. "keywords.txt" file has the following 4 lines given below. Apache Spark Big Data and Analytics using Spark Learning Spark Real time Spark Streaming Machine Learning using Spark Spark using Scala Perform the following operations of the RDD created: a) Calculate frequency of each word in "text.txt" using "flatMap" and "reduceByKey" actions. b) Filter out the words in "text.txt" whose length is more than 5 using "filter" transformation.	RDD	Illustrate, Implement, Apply
8	Create a DataFrame using a csv file "people.csv" having the following content, year, name, country, count 2015,john,us,215 2016,jack,ind,120 2017,james,ind,56 2018,john,cannada,67 2016,james,us,218 and perform the following analytics operations on that a) Create an RDD using people.csv. b) Use the filter(func) transformation to remove the header line.	Dataframe, Filtering Transformation	Illustrate, Implement, Apply
9	Create a DataFrame using a csv file "people.csv" having the following content: year,name,country,count 2015,john,us,215 2016,jack,ind,120 2017,james,ind,56 2018,john,cannada,67 2016,james,us,218	Dataframe, MapReduce	Illustrate, Implement, Apply

	Perform the following analytics operations on that a) Use map(func) and the split() method to split fields by ",". b) Retrieve country, name field using map(func). c) Apply groupByKey to group names by each country.		
10	Write Scala code to count the occurrence of each word in a file shown in a csv file "people.csv" of Q5.	RDD, Dataframe	Illustrate, Implement, Apply, Analyze
11	Create the data (IP Address, URL and Location) as logdata.log with comma delimiters. Perform the following operations: a) Create an RDD from the created file with the column names as specified by using the schema inference through reflection method. b) Create a DataFrame from the created RDD and register it as a global temporary view named LogDetails_Global.	RDD, Dataframe	Illustrate, Implement, Apply, Analyze
12	Create the data (IP Address, URL and Location) as logdata.log with comma delimiters. Perform the following operations: a) Write a SQL query to find the number of unique IP addresses in each location. b) Save the DataFrame created in Question 3 as a json file, using the Spark write method by specifying the json format. c) Run the same SQL query to find the number of unique IP addresses in each location directly on the json file created without creating a DataFrame.	RDD, Dataframe, SQL	Illustrate, Implement, Apply, Analyze
PART-B: Mini-Project Title **Health care: Data set on Heart attack possibility**			

Problem Statement: To analyze the Heart disease data set in order to predict Heart Attack possibility for a patient.

It is required to analyze the Heart disease data set in order to predict Heart Attack possibility for a patient. Download the data set from the link:https://archive.ics.uci.edu/ml/datasets/Heart+Disease
and perform the following:

1. **Import**ing of the data from given link the Data Set
2. **Data Cleaning:** Address the data inconsistencies, such as missing values and any redundant variables.
3. **Data Exploration**: boxplots and qplots, are to be plotted to understand the significance of each predictor variables.
4. **Data Modelling**: Build a Classification model using suitable classification algorithm.
5. **Validate the model**: Efficiency of the data model is to be evaluated by using the testing data set.

About data set:
This database contains 76 attributes. The "target" field refers to the presence of heart disease in the patient. It is integer valued 0 = no/less chance of heart attack and 1 = more chance of heart attack. Data set download Link: https://archive.ics.uci.edu/ml/datasets/Heart+Disease

Attribute Information about patient:
1) age
2) sex
3) chest pain type (4 values)
4) resting blood pressure
5) serum cholestoral in mg/dl
6)fasting blood sugar > 120 mg/dl
7) resting electrocardiographic results (values 0,1,2)
8) maximum heart rate achieved
9) exercise induced angina
10) oldpeak = ST depression induced by exercise relative to rest
11)the slope of the peak exercise ST segment
12) number of major vessels (0-3) colored by flourosopy
13) thal: 0 = normal; 1 = fixed defect; 2 = reversable defect
14) target: 0= less chance of heart attack 1= more chance of heart attack

By studying the dependency of these predictor variables on the response variable, you can predict or forecast sales for the upcoming months.

Course Title	Research Based Mini Project				Course Type		Theory	
Course Code	B20CI0601`	Credits	2		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13weeks/Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	2	4	4	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**2**	**4**	**4**	**0**	**52**	**-**	**100%**

COURSE OVERVIEW:

This course offers "An overview of research methodology including basic concepts employed in quantitative and qualitative research methods. This course introduces problem selection, synopsis writing, ethics, research design skills, research methods, how to carry out literature survey, reading and writing technical paper, thesis writing, introduction atex and beamer and how to design the quality research proposal.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the dimensions and methods of research.
2. Illustrate the design of informed choice from the large number of alternative methods and experimental designs available.
3. Describe the features of a good research proposal.
4. Discuss the skills required for undertaking a research project and preparing a technical paper

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the dimensions and methods of research for solving real world problems.	1,4,7,11,12	2,3
CO2	Identify the appropriate research problem and parameters to carry out the research work.	2,5,6,12	2,3
CO3	Apply different research skills in preparing proposal for research project and technical paper.	6,7,11	2,3
CO4	Create IPR documents using Latex Tool.	3,12	3
Co5	Describe the features of a good research proposal	2,5,6,12	2,3
Co6	Illustrate the design of informed choice from the large number of alternative methods and experimental designs available	6,7,11	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√	√	
CO3			√			
CO4						√
Co5		√				
Co6			√			

COURSE ARTICULATION MATRIX

CO#/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			2			1				1	1	1	2	
CO2		2			1	3						2	2	2	
CO3						2	1				2		2	1	
CO4			2									2			3
Co5		2			1	3						2	2	2	
Co6						2	1				2		2	1	

Note:1-Low,2-Medium,3-High

A Mini Project has to be carried out by the students and the same has to be completed by the end of semester. Students have to spend a minimum of 8 hours per week on the mini project. A Mini Project has to be developed and documented using Latex. The outcome of the mini project should be paper publication/ IPR.

Course Title	INDIAN TRADITION & CULTURE				Course Type		Theory	
Course Code	B20PA0501	Credits	1		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50%**	**50%**

COURSE OBJECTIVE (S):

To provide conceptual knowledge of Indian culture and traditions

1. To introduce students to the science and technological advancements related to Indian culture.
2. To help students understand the Indian spiritual aspects of Indian culture
3. To help learners understand the factors which unite the diverse cultures of India

COURSE OUTCOMES (COs):

1. Gain conceptual understanding of Indian culture and traditions.
2. Describe various ancient theories in treatment of any disease, Appreciate the science and technological advancements in ancient India.
3. Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.
4. Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food and Understand India as a land united by cultural diversity.

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Gain conceptual understanding of Indian culture and traditions.	2,3,4,6,8,12	3
CO2	Describe various ancient theories in treatment of any disease, Appreciate the science and technological advancements in ancient India.	10,11	3
CO3	Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.	11	3
CO4	Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food and Understand India as a land united by cultural diversity	11,12	3
CO5	familiarize learners with various aspects of the culture and heritage of India.	10,11	3
CO6	develop among learners a feeling of love and a sense of belonging towards the nation	11,12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1		√				
CO2		√	√			
CO3		√				
CO4		√				
Co5		√				
Co6				√		

COURSE ARTICULATION MATRIX

CO#/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	1	2		2		3				3
CO2										2	2	
CO3											2	
CO4											2	2
Co5										2	2	
Co6											2	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents

UNIT-1

Indian Tradition

Culture – Indus Valley Civilization and early cultural practices, The Vedic culture, Influence of Buddhism and Jainism on Indian Culture, Influence of Islam and Christianity, Indian Cultural Renaissance of the 19th Century

Religion – Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity

Art – Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, puppetry

Architecture – Engineering and Architecture in Ancient India;Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India

Literature- Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

UNIT-2

Contribution of ancient India to Science and Maths

i. Development of Science in Ancient India- Astronomy, Mathematics, Medicine, Metallurgy.

ii. Scientists of Ancient India:

Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya

Science- Kanad, Varahamihira, Nagarjuna

Medical Sciences (Ayurveda and Yoga)- Susruta, Charaka, Yoga and Patanjali

iii. Science and Scientists in Medieval India- Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.

iv. Scientists in Modern India- Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir Bhabha, Dr, Vikram Ambalal Sarabhai, ,Dr. APJ Abdul Kalam

UNIT-3

Indian Spiritual Aspects

I. Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

ii.Hata Yoga and Pranayama- Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga; Bhakti Yoga – yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

iii. Buddhist, Jaina Spiritualities- Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - Ashtanga Marga

UNIT-4

Unity in Diversity

Commensality and the Significance of Food– Eating Together as Family and as a Society, Food at Rituals; annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World
Celebrating Diverse Festivals – Festival Types: Religious and Seasonal, Religious - Holi, Diwali, Ganesh Chaturthi, Janmashtami, Mahavir Jayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals) - Baisakhi, Pongal, Sankranti
Attire - Indus Valley Civilization, Vedic period, Modern India

TEXT BOOKS:

1. Sundararajan K.R., Hindu Spirituality - Vedas through Vedanta, Cross Road Publications, New York, 1997.
2. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992

REFERENCE BOOKS:

1. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998
3. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.
4. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

JOURNALS/MAGAZINES:

1. Arts and Humanities (miscellaneous)
2. History
3. Language and Linguistics
5. History and Philosophy of Science
6. Literature and Literary Theory

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/109/104/109104102/
2. https://nptel.ac.in/courses/109/103/109103018/

Course Title	**Brain Machine Interface**				**Course Type**		**Theory**	
Course Code	**B20EA0602**	**Credits**	**2**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	1	2	2				

	Tutorial	-	-	-				
	Total	**2**	**3**	**3**	**13**	**26**	**50**	**50**

COURSE OVERVIEW

Brain Machine interface (BMI) technology provides a means of communication that allows individuals with severely impaired movement to communicate with assistive devices using the electroencephalogram (EEG) or other brain signals. The practicality of a BMI has been possible due to advances in multi-disciplinary areas of research related to cognitive neuroscience, brain-imaging techniques and human-computer interfaces.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Gain knowledge on different types of BMI signals from instruments.
2. Gain knowledge on the major components of BMI which makes up the system.
3. Gain expertise on Brain machine interfacing.
4. Discuss BMI applications and strategies.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POS	PSOs
1	Describe different types of BMI signals from instruments	1	1,2
2	Describe different types of brain signals used for feature extraction	1,2	1,2
3	Discuss the major components of BMI which makes up the system	1,5, 12	1,2
4	Explain the applications based on BMI	1,5, 12	1,2
5	Use the toolbox BMILAB	1,5,9, 12	1,2
6	Develop solutions in the brain machine interface to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	1,5,9,12	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2		√				
CO3			√			

CO4				√	√	
CO5						√
CO6			√		√	√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3	3											3	3	
CO3	3				3							3	2	2	
CO4	3				3							3	1	1	
CO5	3				3				2			3	3	3	
CO6	3				3				2			3		3	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY

UNIT-1

Brain computer interface: What is BCI? How do BCI works, Brain computer interface types-Invasive, Partially invasive, Non-invasive, Brain signal for BCI signal-EEG, MEG, fNIRS, fMRI , Non brain signals for BCI

UNIT-2

Interfacing Brain and Machine: Introduction, The Brain and Electrode Placement, Operational Techniques in BCI, Data Acquisition, Pre-processing: A Signal Enhancement Requirement along with Noise Reduction, Feature Extraction, Classification, Post-processing, Validation and Optimization Techniques, Graphical User Interface [GUI], Strategies in BCI Applications, Performance Measures of a BCI System.

UNIT-3

Data Acquisition, Pre-processing: A Signal Enhancement Requirement along with Noise Reduction, Feature Extraction,

UNIT-4

Classification, Post-processing, Validation and Optimization Techniques, Graphical User Interface [GUI], Strategies in BCI Applications, Performance Measures of a BCI System.

Practise:

No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Introduction to EEG	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Set up EEG hardware and experiment • Record from the first subject; recognize good electrode impedance and noisy vs. high-quality data • Learn the basics of Simulink
2.	Biological Artifacts in EEG	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Begin analyzing data in MATLAB • Implement FIR filtering to reduce the effects of biological and nonbiological artifacts on the data • Learn about different neural oscillations and associated cognitive processes
3.	Neurofeedback	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Create a real-time measure of alpha and theta powers in Simulink • Understand mechanisms of neurofeedback
4	P300 Speller	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce the concept of event related potentials and describe various ERP components • Apply a preprogrammed module to record data and to control a brain-controlled on-line speller • Find ERPs to target vs. non-target letters and mark the significant P300 responses

5	Auditory ERP	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce auditory ERP components and the auditory oddball paradigm • Design an event marker to track experimental events • Plot neural response on a scalp map; find spatial location of ERP components
6.	Auditory Steady State Response	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce ASSR and frequency-modulated neural components • Design and program an ASSR experiment • Analyze data in the frequency domain using the fast Fourier transform (FFT)
7	Attentional Modulation of ASSR	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Investigate the effect of attention on ASSR paradigm • Implement online analysis in real-time using Simulink
8	Steady State Visually Evoked Potentials	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce SSVEP and its applications • Analyze data in frequency domain in a visual paradigm
9	Imagined Movement	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Understand the basics of human motor cortex • Apply a preprogrammed module to record data for further processes

	Mini Projects i. Auditory Oddball Paradigm		• Design and program an auditory oddball experiment • Investigate the effect of subject attention and deviant probability on different ERP components • Implement group analysis using shared dataset between groups
	ii. Decoding Imagined Movement		• Calculate common spatial pattern (CSP) filters and project data into CSP space • Train an LDA classifier to decode imagined movement of single trials using CSP • Test classifier with cross-validation

- Design of Robotic Wheelchair Through Brain-Machine Interface
- A Feasibility Study for Developing an Emotional Control System Through BMI
- On board Chess playing using Brain Machine Interface
- Analysis on the effect of Colors on Human emotions and Blood groups using BMI
- Brain Browser using BMI – An application for physically challenged
- A study on the effect of Yoga and Meditation on Human physical system using BMI.
- Learning-enhancer: Optimizing studying habits with BCI. An EEG based software, which learns the user's learning behavior. After a few learning sessions, the software will be able to: 1. Tell the user at what times she is at her peak performance, for better learning session planning, and 2. Tell the user at real time when she should stop learning and rest for a few minutes, to work better afterwards.
- Stay-awake app: Are you falling asleep when you should actually be awake??? (i.e., while driving, in a boring conference meeting, while studying). Develop an application which will monitor your brainwaves, and when it detects that you're falling asleep- will provide real time feedback via earphones or loudspeaker (i.e., loud noise, rhythmic music) to wake you up immediately!!!

- Turner: Aim to reduce bicycle traffic accidents using the power of the mind. Using a headband integrated into a bicycle helmet, we will predict the rider's intention to perform maneuvers- turn left or right- and alert the surrounding traffic by blinking lights in the respective direction. Like a car's turn signal.

- EEG Rubik's Cube: Build a device that will manipulate a Rubik cube using EEG input. Depending on our helmet's capabilities, the control of the device will be more interesting. The basic scenario: The Rubik Cube will be solved only when you are really concentrating at something.

TEXTBOOK:

1. "Brain Computer Interfacing an Introduction", Rajesh P N Rao, Cambridge University Press, 2013, 9780521769419.
2. "Brain-Computer Interfacing for Assistive Robotics", Valbhav Gandhi, Academic Press, 2014. eBook ISBN: 9780128015872.

REFERENCEBOOKS:

1. Brain-Computer Interfaces: Lab Experiments to Real-World Applications, Damien Coyle, 2016, ISBN: 9780128092620.

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/brain-computer-interface/

SELF-LEARNINGEXERCISES:

Color Meditation – Effect of Blue color on Human thought and its side effects
Design of an EEG based Emotion Recognition System –An Application to Music Thera

Detailed Syllabus

Semester-7

Title	Swarm and Bio-Inspired Intelligence (PE-V)				Course Type		Theory	
Course Code	B20EAS701	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

The basics of swarm and bio inspired intelligence are introduced. The course also provides knowledge Bio-inspired algorithms such as ant colony algorithm, bat algorithm (BA), cuckoo search (CS), firefly algorithm (FA), and particle swarm optimization.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Impart the knowledge of swarm and bio inspired intelligence
2. Illustrate the swarm intelligence algorithms
3. Discuss metaheuristic Algorithms
4. Analyze Swarm algorithms

COURSE OUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the fundamentals of Swarm and Bio inspired intelligence	1,2,4,5	1,2
CO2	Analyze the performance of Swarm based Algorithm for Constrained Optimization	1,2,3,4,5	1,2
CO3	Apply Meta heuristic algorithm for Metaheuristic Optimization	1,2,3,4,5	1,2
CO4	Develop a program to solve real world problem using Self-Adaptive Memantic Swarm Optimization Algorithm.	1,2,3,4,5	1,2
CO5	Learn new tools and technologies in the **swarm** and bio-inspired intelligence and apply for suitable application development.	12	2
CO6	Develop solutions in the related field swarm and bio-inspired intelligence to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√		
CO3			√			
CO4			√			√
CO5			√		√	
CO6				√	√	

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2	1								3	3	
CO2	3	2	2	1	1								3	3	
CO3	3	2	2	1	1								3	3	
CO4	3	2	1	1	1								3	3	
CO5												2		2	
CO6					3				2	2				2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
Unit-1
Introduction to swarm and bio inspired Intelligence. Current Issues in Bio-Inspired Computing, Search for the Magic Formulas for Optimization, Characteristics of Metaheuristics, Swarm-Intelligence-Based Algorithms
Unit-2
Analysis of Swarm Intelligence Based Algorithms for Constrained Optimization, Ant bee colony, Cuckoo search, Numerical examples
Unit-3
Metaheuristic Algorithms, Le´vy Flights in Global Optimization, Metaheuristic Algorithms Based on Le´vy Probability Distribution: Is It a Good Idea?
Unit-4
Memetic Self-Adaptive Firefly Algorithm, Swarm Algorithms

TEXT BOOKS:

1. Xin-She Yang, Zhihua Cui, Renbin Xiao, Amir Hossein Gandomi, Mehmet Karamanoglu,"Swarm Intelligence and Bio Inspired Computation", Elsevier, 1st Edition, 2013.
2. Eric Bonabeau, Marco Dorigo, Guy Theraulaz "Swarm Intelligence: From Natural to Artificial Systems", Springer, 19
3. Felix Chan, Manoj Tiwari, "Swarm Intelligence: Focus on Ant and Particle Swarm Optimization", InTech, 2007
4. Veysel Gazi and Kevin M. Passino, "Swarm Stability and Optimization", Springer, 2011

REFERENCE BOOKS:

1. James Kennedy and Russel Eberhart, "Swarm Intelligence", Morgan Kaufmann, 2001.
2. Zbigniew Michalewicz and David Fogel, "How to solve it: Modern Heuristics", Springer, 2001.
3. Marco Dorigo and Thomas Stützle, "Ant Colony Optimization", The MIT Press, 2004.
4. C. Solnon, "Ant Colony Optimization and Constraint Programming", Wiley 2010.
5. Gerhard Weiss, "Multiagent Systems: A modern approach to distributed artificial systems", The MIT Press, 2000.
6. Christian Müller-Schloer, Hartmut Schmeck and Theo Ungerer, "Organic Computing — A Paradigm Shift for Complex Systems", Springer, 2011.

JOURNALS/MAGAZINES

1. https://www.springernature.com/gp/researchers/text-and-data-mining
2. https://www.researchgate.net/publication/220834557_Using_Swarm_Intelligence_Techniques_in_Document_Management_Syste

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ma29/
2. Bioinspiration-Coursera

SELF-LEARNINGEXERCISES:

Comparative study of swarm and bio inspired algorithms

Course Title	Augmented and Virtual Reality (PE-III)				Course Type		Theory	
Course Code	B20EKS702	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	3	3	3	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

This course covers basic concepts of augmented reality and virtual reality. The course also introduces the student to the working of multiple models of input and output interface in VR. The course also helps the student to understand development tools and frameworks in VR. Further, this course helps the student to work on the application of VR in digital entertainment.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the principles and multidisciplinary features of Virtual Reality.
2. Illustrate the multimodal user interaction and perception in Virtual Reality.
3. Demonstrate the use of objects for managing large scale Virtual Reality environment in real time.
4. Discuss the various solutionsusing Virtual Reality system framework and development tools for industry and social relevant applications.

COURSE OUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the components of Augmented Reality and Virtual Reality.	1,10	1
CO2	Apply multimodal user interaction and perception techniques involved in Virtual Reality.	1,2,3,5,10	3
CO3	Develop real world applications using simulation and interactive techniques.	1,2,3,5,10,11	2,3
CO4	Choose the innovative Virtual Reality solutions for industrial and Social relevant applications.	1,10,11	1
CO5	Evaluate current trends of AR and VR media delivery to propose options to potential clients, and discuss the benefits, challenges and misconceptions involved with working in AR and VR.	1,8,12	1,2
CO6	Evaluate various interaction schemes common to AR/VR experiences.	9,12	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4		√		√		
CO5				√	√	
CO6					√	

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3									3			3		
CO2	3	3	3		3					3					3
CO3	3	3	3		3					3	2			3	3
CO4	3									3	2		3		
CO5	2							2					1	2	
CO6	1		2						2					2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
Introduction to Augmented Reality (AR): Definition and Scope, A Brief History of Augmented Reality, Examples, Related Fields, System Structure of Augmented Reality,Key Technology in AR. **Introduction to Virtual Reality (VR):** Fundamental Concept and Components of VR, Primary Features and Present Development on VR.
UNIT-2
Multiple Models of Input and Output Interface in VR: Input – Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus and 3D Scanner. Output – Visual, Auditory, Haptic Devices.
UNIT-3
Environment Modeling in VR: Geometric Modeling, Behavior Simulation, Physically Based Simulation. **Interactive Techniques in VR:** Body Track, Hand Gesture, 3D Manus, Object Grasp.
UNIT-4
Development Tools and Frameworks in VR: Frameworks of Software Development Tools in VR, X3D Standard, Vega, MultiGen, Virtools, Unity. **Application of VR in Digital Entertainment:** VR Technology in Film and TV Production, VR Technology in Physical Exercises and Games, Demonstration of Digital Entertainment by VR.

TEXT BOOKS:

1. Dieter Schmaltzier and Tobias Hollerer. Augmented Reality: Principles and Practice, Addison-Wesley, 2006.
2. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.

REFERENCE BOOKS:

1. Sherman, William R. and Alan B. Craig, Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
2. Fei GAO, Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
3. Guangran LIU, Virtual Reality Technology, Tsinghua Press, Jan. 2011.

JOURNALS/MAGAZINES

1. 1.International Journal of Virtual and Augmented Reality (IJVAR), https://www.igi-global.com/journal/international-journal-virtual-augmented-reality/145080
2. Springer, Virtual Reality, https://www.springer.com/journal/10055

SWAYAM/NPTEL/MOOCs:

1. https://www.mooc-list.com/tags/virtual-reality
2. https://nptel.ac.in/courses/106/106/106106138/

SELF-LEARNINGEXERCISES:

Unity 3D, Manus

Course Title	**System Modeling and Simulation (PE-V)**				**Course Type**		**Theory**	
Course Code	**B20EKS703**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

System modelling is a process of development of a model for a real world operation. Model is built to check the feasibility of implementation of the real world applications. Simulation is the imitation of the operation of a real world system that gives information about the system being investigated. . The system may be electrical, electronic, industrial, and chemical. The activities of the model consist of events, or inputs and outputs, which are activated at certain points in time and in this way affect the overall state of the system.

COURSE OBJECTIVE:

The objectives of this course are to:

1. Explain the concept of simulation along with single channel and multichannel queuing system.
2. Illustrate the working of discrete event system and manual simulation with respect to event scheduling algorithm.
3. Discuss random number generation and variates with different testing techniques.
4. Describe how to model, calibrate, verify and validate a software model along with simulation

COURSE OUTCOMES(COs)

After the completion of the course the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the simulation tools in real world applications.	1,2,3,4,5	1

CO2	Analyse the concept of scheduling with respect to time and events simulation analysis.	1,2,3,4,5	1
CO3	Identify a suitable random variate method for solving given real world problems.	1,2,3,4,5	2,3
CO4	Compare Verification and Validation of simulation models for given real world data.	1,2,3,4,5	1
CO5	Learn new tools and technologies in the system modeling and simulationand apply for suitable application development.	12	2
CO6	Develop solutions in the related fieldsystem modeling and simulation to the complex problems, either individually or as a part of the team	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2				√		
CO3		√				
CO4		√		√		
CO5			√		√	
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	2								3		
CO2	3	2	2	1	2								3		
CO3	3	1	3	2	2									3	3
CO4	3	1	2	2	3								3		

CO5												2		2	
CO6					3				2	2				2	

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1 **Introduction to Simulation:** Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, Discrete Event system simulation, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System.
UNIT-2 **General Principles:** Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling, list processing. **Statistical models in simulation:** Review of terminology and concepts; Useful statistical models, Discrete distribution: Bernoulli distribution, Binomial distribution, Geometric and Poisson distribution. Continuous distribution: Uniform distribution, Exponential distribution and normal distribution.
UNIT-3 **Random Numbers:** Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test. **Random Variate Generation:** Inverse Transform Technique- Exponential, Uniform distributions, direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique.
UNIT-4 **Analysis of Simulation Data** **Input Modelling**: Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis. **Verification and Validation of Model**: Model Building, Verification, Calibration and Validation of Models.

TEXT BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, Discrete-Event System Simulation,Pearson Education, 4th Edition, 2007.
2. Lawrence M. Leemis, Stephen K. Park,Discrete – Event Simulation: A First Course Pearson Education/ Prentice-Hall India, 2006.

REFERENCE BOOKS:

1. Geoffrey Gordon, System Simulation, Prentice Hall publication, 2nd Edition, 1991
2. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition.
3. Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, 2004

JOURNALS/MAGAZINES

1. https://ieeexplore.ieee.org/document/5679170
2. https://link.springer.com/book/10.1007/978-4-431-49022-7

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/107/112107214/
2. Modelling and Simulation-Coursera

SELF-LEARNINGEXERCISES:

Types of simulations with respect to output analysis;Output analysis for terminating simulations; Output analysis for steady-state simulations.

<table>
<tr><td>Course Title</td><td colspan="4">Python for Data Science (OE-III)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20CIO701</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course covers fundamentals of Python programming, data preprocessing, sampling methods, Data Visualization techniques, it involves developing a methods to analyzing data effectively to extract useful information and statistical method used in statistical decision using experimental data.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of python programming
2. Discuss the data science and issues of Data science.
3. Describe the methods and programming tips of handling large data
4. Summarize the fundamentals of statistics and various Data Visualization techniques

COURSE OUTCOMES (COS)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the concepts of python programming to develop simple applications.	1-5,8,9,10	1,2
CO2	Make use of the concepts of data science for solving real world problem.	1-5,8,9,11	1,2
CO3	Identify the techniques which are suitable to handle large volumes of data for distributed data storage.	1-5,7,9,10,11	1,2
CO4	Analyze the results obtained using various visualization techniques on given data.	1- 5,8,10,11,12	3
CO5	Apply python code to analyse the data science methods.	1-12	3
CO6	Develop data science application using python coding	1-12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3		√				
CO4			√	√		
CO5			√		√	
CO6				√		√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	0	0	3	3	2	0	0	3	3	0
CO2	2	2	1	2	2	0	0	3	3	0	2	0	3	3	0
CO3	2	2	2	1	2	0	3	0	3	3	2	0	3	3	0
CO4	2	2	1	2	2	0	0	3	0	3	2	3	0	0	3
CO5	3	2	3	3	3	3	3	3	3	3	3	3	0	0	3
CO6	3	3	2	2	2	3	3	3	3	3	2	3	0	0	3

Note:1-Low,2-Medium,3-High

COURSE CONTENTS:

THEORY

UNIT- 1

Introduction to concepts of OOPs: Objects and Classes, Data Abstraction, Encapsulation, Polymorphism and Inheritance. Difference between OOP and POP. Python IDEs.

Your First Python Program: Diving in; Declaring Functions; Optional and Named Arguments, Writing Readable Code, Documentation Strings, the import Search Path, Everything Is an Object, What's an Object? Indenting Code, Exceptions, Catching Import Errors, Unbound Variables.

Native Data types: Booleans, Numbers, Coercing integers to Floats and Vice Versa, Numbers in a Boolean Context, Lists, Tuples, Sets, and Dictionaries.

Comprehensions: Working with Files and Dictionaries, List Comprehensions, Dictionary Comprehensions, Set Comprehensions.

UNIT- 2

Introduction to Data Science: Definition: Big Data and Data Science Hype, Why Data Science, Getting Past the Hype, Current Landscape, Who is Data Scientist? Data Science Process Overview, Defining goals, Retrieving data, Data preparation, Data exploration, Data modeling, Presentation.

UNIT -3
Handling large data on a single computer: The problems you face when handling large data, General techniques for handling large volumes of data, General programming tips for dealing with large data sets, Case study 1: Predicting malicious URLs, Case study 2: Building a recommender system inside a database. First Steps in Big data: Distributing data storage and processing with Frameworks, Case study: Assessing risk when loaning money.
UNIT- 4
Statistics: Introduction, Types of Statistics. Data Visualization and Interpretation: Histogram, Bar Charts, Scatter Plots, Good vs. Bad Visualization. **Sampling distributions**: Point estimation - estimators, minimum variance unbiased estimation, maximum likelihood estimation, method of moments, consistency; Interval estimation.

TEXT BOOKS:

1. Mark Pilgrim, "Dive into Python 3", Apress Special Edition, Second Edition, 20l5.
2. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications Co., 1st edition, 2016.
3. Travis E. Oliphant, "Guide to NumPy", Trelgol publishers,2006.
4. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann, 2011.
5. William Navidi, "Statistics for Engineers and Scientists", McGraw Hill Education, India, 3rd Edition, 2013.

REFERENCE BOOKS:

1. Mark Lutz, "Learning Python", Oreilly.2003.
2. John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle & Associates, 2009.
2. Michael Dawson, "Python Programming for the Absolute Beginners", 3rd Edition, CENAGE Learning, 2011.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Person Education, 2007.
4. K.P. Soman, Shyam Diwakar and V. Ajay ", Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2016.

JOURNALS/MAGAZINES

1. https://datascience.codata.org
2. https://www.springer.com/journal/41060
3. https://ieeexplore.ieee.org/document/8757088
4. https://www.ijcseonline.org/pub_paper/57-IJCSE-03229.pdf

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs33/preview
2. Python for Data Science, AI & Development -Coursera

Self-Learning Exercises:

Data Science using R, Creating own datasets, functions and packages in R and using packages in R

Course Title	Deep Learning (OE III)				Course Type		Theory	
Course Code	B20CIO702	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW:

This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. Deep learning is behind many recent advances in AI, including Siri's speech recognition, Facebook's tag suggestions and self-driving cars.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts of Deep Learning.
2. Describe supervised and unsupervised learning.
3. Demonstrate the use of a deep learning neural network in a real-world application.
4. Illustrate the use of deep learning techniques in neural networks and natural language processing

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of mathematics to solve problems based on deep learning concepts.	1-10	1,2
CO2	Make use of suitable machine learning algorithms on real world problems (classification, clustering).	1,-11	1,2

CO3	Utilize deep learning neural network model on real time applications.	1-10	1,3
CO4	Develop Recommender systems applications using CNN concepts of NLP.	1-12	1
CO5	Analyse real world problems	1-12	3
CO6	Create a solution to solve real world problems	1-12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2			√			
CO3			√			
CO4						√
CO5				√	√	
CO6				√	√	√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	2	3	3	2	3	0	0	3	3	0
CO2	2	3	1	2	1	3	3	2	2	2	3	0	3	3	0
CO3	1	3	1	2	2	3	2	1	2	3	0	0	3	0	3
CO4	1	1	3	2	1	3	2	3	2	3	33	2	3	0	0
CO5	2	3	2	3	3	3	3	3	3	2	3	2	0	0	3

CO6	3	2	3	3	3	3	2	3	2	3	3	2	0	0	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

Contents
UNIT-1
Machine Learning Basics: Linear Algebra-Scalors, Vectors, Matrices and Tensors, Eigen Decomposition, SVD, PCA Probability and Information Theory-Probability Distribution, Conditional Probability, Chain Rule of Conditional Probability, Bayes' Rule.
UNIT-2
Numerical Computation: Overflow, Underflow, Gradient Based Optimization, Constrained Optimization, Linear Least Squares, Machine Learning Basics- Learning Algorithms, Overfitting and Underfitting, Maximum Likelihood Estimation, Supervised and Unsupervised Learning Algorithms, Building Machine Learning Algorithm, Challenges Motivating Deep Learning.
UNIT-3
Deep Networks: Modern Practices-Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architectural Design, Back-Propagation Algorithm.
UNIT-4
Convolutional Networks: Recurrent Neural Networks, Applications- Natural Language Processing, Recommender Systems.

TEXTBOOKS:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning" First edition, An MIT Press book in preparation, 2015.

REFERENCE BOOKS:

1. Duda, R.O., Hart, P.E., and Stork, D.G. "Pattern Classification", Wiley-Inder science. 2nd Edition. 2001.
2. Theodoridis, S. and Koutroumb as, K.," Pattern Recognition", Edition 4. Academic Press, 2008.
3. Russell, S. and Norvig, N.," Artificial Intelligence: A Modern Approach", Prentice Hall Series in Artificial Intelligence. 2003.

JOURNALS/MAGAZINES:

1. Springer Journal of Machine Learning, https://www.springer.com/journal/10994
2. http://ieeexplore.ieee.org/document/8297269/

SWAYAM/NPTEL/MOOCs:

1. https://www.my-mooc.com/en/categorie/deep-learning
2. https://nptel.ac.in/courses/106/105/106105215/

SELF-LEARNINGEXERCISES:

Linear factor Models, Structured probabilistic Models, Monte-Carlo Methods, Deep generative Models.

course Title	Summer Internship/Global Certification				Course Type		Theory	
Course Code	B20CI0701	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	3	6	6	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**6**	**6**	-	**78**	-	**100**

COURSE OVERVIEW:

This course covers student's knowledge with industry.

COURSE OBJECTIVES:

Objectives of this course are to:

1. Learn industry knowledge
2. Get certificate of emerging technologies

Course Out comes (Cos):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Study emerging technologies	1 to 5, 7,810,11,12,	1
CO2	Analyze real time problems	1 to 5, 7,8,9,11,12	2
CO3	Design and develop the for the solution	1 to 5, 7,8,9,11,12	2, 3
CO4	Make use of emerging models for real world applications.	1 to 5, 8,9,10,11	3
CO5	Apply new Techniques for real time applications	1-12	3
CO6	Develop an algorithm using latest technology to an applications	1-12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2		√	√			
		√	√			
CO4		√				
CO5			√		√	
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	3	2	0	2	3	2	3	0	0
CO2	3	3	2	1	3	0	3	2	3	0	2	3	0	3	0
CO3	3	3	3	2	2	0	3	2	3	0	2	3	0	3	3
CO4	3	3	3	1	1	0	0	3	3	2	3	0	0	0	3
CO5	3	2	3	3	3	2	2	3	2	3	2	3	0	0	3
CO6	3	2	3	3	2	2	3	2	3	2	3	2	0	0	3

Note:1-Low,2-Medium,3-High

JOURNALS/MAGAZINES

1. https://www.springer.com/journal/500
2. https://www.journals.elsevier.com/
3. Https://IEEE.org

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/105/106105173

SELF LEARNING

Linear Algebra, probability and Information Theory, Genetic Algorithms.

Course Title	Project Phase-1				Course Type		Theory	
Course Code	B20CI0702	Credits	4		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	4	8	8	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**4**	**8**	**8**	**-**	**104**	**-**	**100**

COURSE OVERVIEW:

This course covers student's innovation in current trends.

COURSE OBJECTIVES:

Objectives of this course are to:

1. Learn current trends
2. Expose their knowledge with innovation methods to develop new technology

Course Outcomes (Cos):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Study emerging technologies	1 to 5, 7,810,11,12,	1
CO2	Analyze real time problems	1 to 5, 7,8,9,11,12	2
CO3	Design and develop the for the solution	1 to 5, 7,8,9,11,12	2, 3
CO4	Make use of emerging models for real world applications.	1 to 5, 8,9,10,11	3
CO5	Apply new Techniques for real time applications	1-12	3
CO6	Develop an algorithm using latest technology to an applications	1-12	3

BLOOM'S LEVEL

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2		√	√			
		√	√			
CO4		√				
CO5			√		√	
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	3	2	0	2	3	2	3	0	0
CO2	3	3	2	1	3	0	3	2	3	0	2	3	0	3	0
CO3	3	3	3	2	2	0	3	2	3	0	2	3	0	3	3
CO4	3	3	3	1	1	0	0	3	3	2	3	0	0	0	3
CO5	3	2	3	3	3	2	2	3	2	3	2	3	0	0	3
CO6	3	2	3	3	2	2	3	2	3	2	3	2	0	0	3

Note:1-Low,2-Medium,3-High

JOURNALS/MAGAZINES

1. https://www.springer.com/journal/500
2. https://www.journals.elsevier.com/
3. Https://IEEE.org

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/105/106105173

SELF LEARNING

Linear Algebra, probability and Information Theory, Genetic Algorithms

Detailed Syllabus
Semester 8

Course Title	Capstone - Project Phase-II				Course Type		Theory	
Course Code	B20CI0801	Credits	8		Class		VIII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	8	16	16	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**8**	**16**	**16**	**-**	**208**	**-**	**100**

COURSE OVERVIEW:

This course covers student's innovation in current trends.

COURSE OBJECTIVES:

Objectives of this course are to:

1. Learn current trends
2. Expose their knowledge with innovation methods to develop new technology

Course Outcomes (Cos):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Study emerging technologies	1 to 5,7,810,11,12,	1
CO2	Analyze real time problems	1 to 5, 7,8,9,11,12	2
CO3	Design and develop the for the solution	1 to 5, 7,8,9,11,12	2, 3
CO4	Make use of emerging models for real world applications.	1 to 5, 8,9,10,11	3
CO5	Apply new Techniques for real time applications	1-12	3
CO6	Develop an algorithm using latest technology to an applications	1-12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2		√	√			
CO3		√	√			
CO4		√				
CO5			√		√	
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	3	2	0	2	3	2	3	0	0
CO2	3	3	2	1	3	0	3	2	3	0	2	3	0	3	0
CO3	3	3	3	2	2	0	3	2	3	0	2	3	0	3	3
CO4	3	3	3	1	1	0	0	3	3	2	3	0	0	0	3
CO5	3	2	3	3	3	2	2	3	2	3	2	3	0	0	3
CO6	3	2	3	3	2	2	3	2	3	2	3	2	0	0	3

Note:1-Low,2-Medium,3-High

JOURNALS/MAGAZINES

1 https://www.springer.com/journal/500

2 https://www.journals.elsevier.com/

3 Https://IEEE.org

SWAYAM/NPTEL/MOOCs:

1. 1 https://nptel.ac.in/courses/106/105/106105173

Self Learning

Linear Algebra, probability and Information Theory, Genetic Algorithms

Course Title	IoT Programming(OE-IV)				Course Type		Theory	
Course Code	B20CIO801	Credits	3		Class		VIII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

The course covers the importance of IoT in society, the current components of typical IoT devices and trends for the future. IoT design considerations, constraints and interfacing between the physical world and your device will also be covered. This course will get to know how to make design trade-offs between hardware and software. It also covers key components of networking to ensure that students understand how to connect their device to the Internet.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain basics of Arduino program.
2. Illustrate sample programs to interface sensors to aurdino board storead, process and analyze data.
3. Demonstrate WebApp stored and stored at a from sensors, and to monitor and control IoT devices.
4. Discuss IoT programming to develop larger smart products useful for the society.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Develop programs to interface sensors to Aurdino board stored, process and analyze data.	1-6,8-10	3
CO2	Analyse the performance of Communication Protocols used in real time IoT Projects.	1-6,8,9	1
CO3	Make use of different IoT Patterns to develop the real-world applications.	1-6,9,11	2
CO4	Identify the IoT security requirements to solve the given real world problem.	1-6, 8,10,11,12	1
CO5	Analyze Real world IoT applications	1-12	3
CO6	Develop an real time application in IoT environment	1-12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				√		√
CO2				√		
CO3			√			√
CO4		√	√			
CO5				√	√	
CO6					√	√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	0	3	2	3	0	0	0	0	3
CO2	2	3	3	2	2	3	0	3	2	0	0	0	3	0	0
CO3	3	3	2	2	3	3	0	0	3	3	2	3	3	0	0
CO4	3	3	3	3	3	2	0	3	0	3	3	3	3	0	0
CO5	3	2	3	3	2	3	3	2	2	1	2	3	0	0	3
CO6	2	3	3	3	2	3	2	3	2	3	3	3	0	0	3

Note:1-Low,2-Medium,3-High

COURSE CONTENTS:

THEORY:

UNIT- 1

Building Blocks: Arduino Basics, Hardware Requirements, Software Requirements: Toolbar, Status Window, Serial Monitor Window; Arduino Programming Language Reference Internet Connectivity: Arduino Uno Wired Connectivity (Ethernet), Hardware Required, Software Required Circuit, Code (Arduino), Final Product; Arduino Uno Wireless Connectivity(Wi-Fi), Hardware Required, Software Required, Circuit, Code (Arduino), Final Product

Communication Protocols: HTTP: Code (Arduino), Final Product; MQTT: Intrusion Detection System, Remote Lighting Control, Code (Arduino), Final Product

UNIT -2

Complex Flows: Node-RED: Hardware Required, Software Required, Circuit, Node-RED Flow, Code (Arduino), External Libraries, Internet Connectivity (Wireless),Read Sensor Data, Data Publish, Standard Functions and the Final Product.

IoT Patterns: Real-time Clients: Hardware Required, Software Required, Circuit, Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions, Code (Android): Project Setup, Screen Layout, Screen Logic, MQTT Client and the Final Product.

IoT Patterns: Remote Control: Hardware Required, Software Required, Circuit, Code (Android): Project Setup, Screen Layout, Screen Logic; MQTT Client, Code(Arduino):External Libraries, Internet Connectivity(Wireless),Data Subscribe, Control Lights, Standard Functions and the Final Product.

UNIT- 3

IoT Patterns: On-Demand Clients: Hardware Required, Software Required, Circuit, Database Table(MySQL), Code(PHP): Database Connection, Receive and Store Sensor Data, Get the Parking Spot Count; Code(Arduino): External Libraries, Internet Connectivity(Wireless), Read Sensor Data; Code(iOS): Project Setup, Screen Layout, Screen Logic and the Final Product.

IoT Patterns: Web Apps: Hardware Required, Software Required, Circuit, Database Table (MySQL),Code(PHP): Database Connection, Receive and Store Sensor Data, Dashboard; Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions and the Final Product.

IoT Patterns: Location Aware: Hardware Required, Software Required, Circuit, Database Table(MySQL),Code(PHP):Database Connection, Receive and Store Sensor Data, Map; Code (Arduino):External Libraries, Get GPS Coordinates, Data Publish, Standard Functions and the Final Product.

UNIT-4

IoT Patterns: **Machine to Human:** Hardware Required, Software Required, Circuit, Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions, Effektif Workflow: Process Creation, Process Configurations; Node-RED Flow and the Final Product.

IoT Patterns: Machine to Machine: Light Sensor Device, Code (Arduino): Lighting Control Device, Code (Arduino) and the Final Product

IoT Platforms: Hardware Required, Software Required, Circuit, Xively Setup, Zapier Setup, Xively Trigger, Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions and the Final Product.

Security Requirements in IoT Architecture: Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things - Security Requirements in IoT.

Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities - Secrecy and Secret-Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption - Attack & Fault trees.

Self-learning component: Explore any one of the boards like Raspberry Pi, Intel Galileo, Beagle Bone Black, Dragon Board, UDOO DUAL/QUAD, ARM Boards, DIY Development boards for IoT prototyping (C.H.I.P, Mediatek Linkit One, Particle Photon, Tessel, Adafruit Flora, LightBlue Bean, Udoo Neo, Intel Edison).

TEXT BOOKS:

1. Adeel Javed, "Building Arduino Projects for the Internet of Things: Experiments with Real- World Applications",Apress,2015.
2. Brian Russell, Drew Van Duren, "Practical Internet of Things Security" (Kindle Edition),2016

REFERENCE BOOKS:

1. 1.Agus Kurniawan, "Smart Internet of Things Projects",Packt Publishing, 2016.
2. 2.IEEE Internet of Things Journal.

3. Elsevier Journal of Internet of Things.

JOURNALS/MAGAZINES:

1 IEEE Internet of Things Journal.
2. Elsevier Journal of Internet of Things.

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. An Introduction to Programming the Internet of Things (IOT) Specialization -Coursera

Self-Learning Exercises:

Explore any one of the boards like Raspberry Pi, Intel Galileo, Beagle Bone Black, Dragon Board, UDOO DUAL/QUAD, ARM Boards, DIY Development boards for IoT prototyping (C.H.I.P, MediatekLinkit One, Particle Photon, Tessel, Adafruit Flora, LightBlue Bean, Udoo Neo, Intel Edison)

<table>
<tr><td>Course Title</td><td colspan="4">Reinforcement Learning (OE-IV)</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20CIO802</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VIII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50</td><td>50</td></tr>
</table>

Course Overview:

This course covers fundamental principles and techniques in deep and reinforcement learning. Topics include convolutional neural networks, recurrent and recursive neural networks, back propagation algorithms, regularization and optimization techniques for training such networks, dynamic programming, Monte Carlo, and temporal difference, and function approximation reinforcement learning algorithms, and applications of deep and reinforcement learning.

Course Objectives:

The objectives of this course are to:

3. Describe back propagation algorithms to train deep neural networks and apply regularization techniques.
4. Explain optimization techniques to train deep neural networks and convolutional neural networks.
5. Discuss recurrent neural networks to analyze basic deep learning algorithms for speech recognition, face recognition, object recognition and NLP.
6. Demonstrate reinforcement learning algorithms for real time applications

Course Outcomes:

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the concepts of Deep Feed forward Networks to train deep neural networks.	1- 6, 8,10	1
CO2	Utilize optimization techniques in deep neural networks and convolutional neural networks for real world application.	1-5, 7,9,10 ,12	1
CO3	Develop recurrent neural networks algorithm for analysis of NLP applications.	1-6,9,10,12	1
CO4	Solve real world complex problems using reinforcement learning algorithms.	1-6, 8,9,10	1
CO5	Apply learning algorithm in various real world problems	1-12	3
CO6	Create a algorithm for solving real world problems	1-12	3

BLOOM'S LEVELOF THECOURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3				√		√
CO4			√			
CO5			√	√		
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	2	0	3	0	3	0	0	3	0	0
CO2	1	2	1	1	1	0	3	0	3	2	0	2	3	0	0

CO3	3	2	1	2	2	1	0	3	2	3	0	1	3	0	0
CO4	2	1	3	2	2	1	0	3	2	3	0	0	3	0	0
CO5	3	3	3	2	2	3	2	3	2	3	2	3	0	0	3
CO6	2	3	3	3	2	3	2	3	3	2	3	3	0	0	3

Note:1-Low,2-Medium,3-High

COURSE CONTENTS:

THEORY

Unit-1
Deep Networks: Deep Feed forward Networks: Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms. Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multitask Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier.
Unit-2
Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms. Convolutional Networks: The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuro scientific Basis for Convolutional Networks.
Unit-3
Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence, Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing.

Unit-4

The Reinforcement Learning Problem: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope. Multi-arm Bandits :An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Non stationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search, **Finite Markov Decision Processes** : The Agent–Environment Interface , Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Function, Optimality and Approximation, Dynamic Programming: Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration.

TEXT BOOKS:

1. Ian Good fellow, Yoshua Bengio, and Aaron Courville Deep Learning, MIT Press, 2016
2. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction" Second Edition, the MIT Press,2015.

REFERENCE BOOKS:

1 1 Abhishek Nandy, Manisha Biswas, Reinforcement Learning: With Open AI, Tensor Flow and
2 Keras Using Python, Apress,2017.
3 Eugene Charniak, Introduction to Deep Learning, The MIT Press, 2018.

JOURNALS/MAGAZINES:

1 https://ieeexplore.ieee.org/document/6025669
2 https://ieeexplore.ieee.org/document/7301554
3 https://www.jair.org/index.php/jair/article/view/10166
4 http://www.ijstr.org/final-print/mar2020/A-Study-Of-Reinforcement-Learning-Applications-Its-Algorithms.pdf

SWAYAM/NPTEL/MOOCs:

1 https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs27/
2 Reinforcement Learning, Practical Reinforcement Learning-Coursera

SELF-LEARNING EXERCISES:

Implement and apply Monte Carlo reinforcement learning algorithms, implement and apply temporal-difference reinforcement learning algorithms.

Registrar
REVA University
Bengaluru - 560 064

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF MECHANICAL ENGINEERING

B. Tech

in

Mechanical Engineering

HAND BOOK

2021-25

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
www.reva.edu.in

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF MECHANICAL ENGINEERING

HANDBOOK

B. Tech. in Mechanical Engineering

2020 Scheme

Applicable for 2021-25 Batch

Rukmini Knowledge Park,

Kattigenahalli, Yelahanka, Bangalore - 560 064

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Rukmini Educational
Charitable Trust

www.reva.edu.in

Registrar
REVA University
Bengaluru - 560 064

B

Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."

- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from

various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. M. Dhanamjaya
Vice-Chancellor, REVA University

Director's Message

With great pleasure, I welcome you to the School of Mechanical Engineering at REVA University. The School offers Undergraduate programs in Mechanical Engineering and Mechatronics Engineering leading to B. Tech. Degree, in addition to Master's Program leading to M. Tech. Degree in Machine Design. More than 1500 students representing various parts of India as well a few students from overseas study at our School. The School has more than 60 well qualified and experienced faculty members. The School has modern teaching, learning, innovation and research facilities, in addition to excellent facilities for recreation and sports. Students are encouraged to live on campus to have better campus experience and our hostel facilities are second to none.

We understand that the students come to university for learning and the School focuses on enhancing the efficiency of learning of students and also achieving the learning outcomes to pursue careers in modern day industries. To improve efficiency of learning the School has successfully adopted modern day pedagogical methods like project based learning, problem based learning, blended learning, flipped class rooms, experiential learning and created digital resources for students to access and experience. The faculty members of the School continuously upgrade their pedagogical methods and knowledge to be in par with the best in the Country. Our students are very successful in developing and demonstrating technologically advanced projects during their final year. The Curriculum Caters to and has relevance to Local, Regional, National, Global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to Professional ethics, Gender, Human Values, Environment & Sustainability.

The Curriculum Caters to and has relevance to Local, Regional, National, Global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to Professional ethics, Gender, Human Values, Environment & Sustainability.

Our masters and PhD Scholars work on scientifically and technologically advanced topics in mechanical design, engineering analysis, manufacturing of mechanical and mechatronic systems and publish their research findings in international journals of repute.

The Curriculum Caters to and has relevance to Local, Regional, National, Global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to Professional ethics, Gender, Human Values, Environment & Sustainability.

The School has created an excellent ambience conducive for innovation, creativity and interaction. Faculty mentors and senior students instill confidence in the junior students and motivate them to achieve higher goals. The students are given support for their industry internship, placements, study abroad, industry projects and interaction with industry mentors.

I welcome you to our School and I am sure your learning experience at our school will be an enjoying and memorable one.

Dr. K.S. Narayanaswamy
Director

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 13,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands-on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit

System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fluid Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety

of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor& Dean, and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc., to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO,

Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defense Dr. Sathish Reddy, Scientific Advisor, Ministry of Defense, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVOTSAVA conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga class's every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

ABOUT SCHOOL OF MECHANICAL ENGINEERING

Mechanical Engineering is one of the oldest and classical branches of engineering which drives the development and economy of the country .The school of Mechanical Engineering in REVA University has a rich blend of experienced, energetic and dedicated faculty with highest qualification in the specialization of thermal, design, manufacturing and management streams. The school is having well-furnished class rooms and well equipped laboratories with modern software tools to meet academic and industry requirements. The research Centre with modern equipment's and testing facility is also available to cater research activities in the field of materials and bio-fuels. The school is conducting extracurricular and co-curricular activities to develop additional skills, knowledge and confidence through University Industry Interaction Cell and various student clubs and student chapters with the support of industries. Industry persons are invited to give technical talks on latest technologies and students are deputed for internship in industries and universities in India and Abroad. The school is having MOU with reputed industries and universities in India and abroad for internship, research and twinning program or higher studies which will give more exposure of our students to outside world. Many students have done internship in reputed institutions like IISc, ISRO, DRDO, HAL, Rail Wheel factory, Volvo and many more. Every semester school is organizing industry visits to reputed institutions to learn various aspects of industry. The school is having clubs and chapters which are MARS, ISHRAE Student Chapter, Foundry man Society, Fluid Power Society, Solar Society, Tribology society, Robotics club, SAE club and Aryan Racing Team through which cultural events, training programs, invited talks, industry visits and placement activities are conducting. School is encouraging the students to participate in national and international level competitions like solar car design, Electric vehicle design, Formula car design, ATV design, Go-Cart design and quiz competition through this student can learn additional skills like design, team management, time management and financial aspects. Additional training programs are conducting in the field of automobile, robotics, and manufacturing to impart skills with industry relevant. The School is organizing workshops, seminars, conferences and competitions in national and international level for the students, faculty and research scholars to enhance their skills and research trends. The school offers B.Tech in Mechanical Engineering, B.Tech in Mechatronics Engineering, M.Tech in Machine design and PhD program. The curriculum of both UG and PG is designed to meet the needs of the society and industry for present and future. It also meets the requirements of higher studies in India and abroad and also for the requirement of competitive exams. In overall, school will support and make our students more disciplined, good human being and more responsible persons of the society.

Vision

"Aspires to be recognized globally for outstanding value based education in mechanical and allied areas and research leading to well-qualified engineers, who are innovative, entrepreneurial, successful in their career and committed to the development of the country."

Mission

- To impart quality education to the students and enhance their skills to make them globally competitive engineers in mechanical and allied areas.
- To promote multidisciplinary study, cutting edge research and expand the frontiers of engineers' profession in mechanical and allied areas.
- To create state-of-art facilities with advanced technology for providing students and faculty with opportunities for innovation, application and dissemination of knowledge.
- To prepare for critical uncertainties ahead for mechanical engineering and allied areas and to face the challenges through clean, green and healthy solution.
- To collaborate with industries, institutions and such other agencies nationally and internationally to undertake exchange programs, research, consultancy and to facilitate students and faculty with greater opportunities for individual and societal growth.

ADVISORY BOARD

Sl. No.	Details of Members
1	**Dr. N. V. Ravikumar,** Associate Professor, Department of Metallurgy & Materials Engineering, IIT Madras, Chennai.
2	**Mr. K. N. Narsimha Murthy** Chairman, Fluid Air Systems, Bengaluru. Hon. Treasurer, Karnataka Small Scale Industries Association (KSSIA)
3	**Prof. M. V. Krishna Murthy** Former Professor, Dept. Mechanical Engineering, IIT Madras, Chennai, Former Director, VIT, Vellore.
4	**Mr. Praveen Kumar Jinde,** Scientist, NAL, Bengaluru.
5	**Dr. K Ramachandra** Former Director, GTRE, Bangalore CEO, NP-MICAV's National Design Research Forum The Institute of Engineers, Bengaluru.
6	**Prof. E. Abhilash** Dept. Mechanical Engineering, King Khalid University Abha, Kingdom of Saudi Arabia.

Programme Overview

Mechanical Engineering is a discipline of engineering that applies the principles of physics and materials science for design, analysis, prototyping, manufacturing, and maintenance of mechanical systems. Mechanical engineering deals with inter conversion of thermal and mechanical power and the design, production, and operation of machines and tools. It is one of the oldest and broadest engineering disciplines.

The mechanical engineering field requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, and structural analysis. Mechanical engineers use these core principles along with tools like computer-aided engineering and product lifecycle management to design and analyze manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices and more.

Mechanical Engineering science emerged in the 19th century as a result of developments in the field of physics. The field has continually evolved to incorporate advancements in technology. Mechanical engineers today are pursuing developments in fields such as composites, mechatronics and micro and nano technology. Mechanical Engineering overlaps with aerospace engineering, civil engineering, electrical engineering, petroleum engineering and chemical engineering to varying amounts.

There is tremendous scope for mechanical engineers in automobile engineering, cement industry, steel, power sector, hydraulics, manufacturing plants, drilling and mining industry, petroleum, aeronautical, biotechnology and many more. Nowadays they are also increasingly needed in the environmental and bio-medical fields. There are exciting times ahead for mechanical engineers as transport technologies like hyper loop, electric vehicles, flying cars, drone technologies, intelligent system like robots and additive manufacturing including 3D printing are gaining importance.

A beginner in Mechanical Engineering can opt for various job openings such as: Design Engineer, CAE Analyst, Shop Floor Engineer, Production Planning, Quality Assurance, Maintenance Engineer, Safety Engineer, Production Supervisor/Engineer, R&D Trainee etc.

The School of Mechanical Engineering at REVA UNIVERSITY offers B. Tech., Mechanical Engineering–an undergraduate programme to create motivated, innovative, creative and thinking graduates to fill the roles of Mechanical Engineers who can conceptualize, design, analyse, develop and produce Mechanical Systems to meet the modern day requirements.

The B. Tech., in Mechanical Engineering curriculum developed by the faculty at the School of Mechanical Engineering, is outcome based and it comprises required theoretical concepts and practical skills in the

domain. By undergoing this programme, students develop critical, innovative, creative thinking and problem solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in interdisciplinary topics and attitudinal skills to enhance their scope. The above mentioned features of the programme, advanced teaching and learning resources, and experience of the faculty members with their strong connections with manufacturing sector makes this programme unique.

Program Educational Objectives (PEO's)

The After few years of graduation, the graduates of B.Tech Mechanical Engineering will:

- **PEO-1:** Exhibit skills as a member of a team in national and international organizations with highest ethics through lifelong learning.
- **PEO-2:** Pursue higher education through continuous learning with effective communication skills.
- **PEO-3:** Start own enterprise and provide solutions in mechanical engineering and allied areas.

Program Outcomes (POs)

On successful completion of the program, the graduates of B.Tech Mechanical Engineering will be able to:

- **PO-1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, to solve mechanical engineering problems.
- **PO-2: Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- **PO-3: Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO-4: Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems
- **PO-5: Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- **PO-6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO-7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- **PO-8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- **PO-9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **PO-10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO-11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- **PO-12: Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

On successful completion of the program, the graduates of B.Tech Mechanical Engineering will be able to:

- **PSO-1:** Apply mechanical engineering knowledge and skills in Design, Manufacturing, Thermal and Industrial Engineering to obtain realistic outcomes.

- **PSO-2:** Identify, formulate, analyze and solve problems in Mechanical Engineering and allied domains.

- **PSO-3:** Conduct investigations in Mechanical Engineering and allied areas to provide optimal and sustainable solutions.

REVA University Academic Regulations

B. Tech., (4 years) Degree Programs

(Applicable for the programs offered from 2020-21)

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

These Regulations shall be called **"REVA University Academic Regulations – B. Tech., Degree Program 2020-21 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following B. Tech., Degree programs of REVA University offered during 2019-20

B Tech in:

Bioelectronics Engineering
Civil Engineering
Computer Science and Engineering
Computer Science and Information Technology
Computer Science and Systems Engineering
Computer Science and Engineering (AI and ML)
Electrical and Electronics Engineering
Electrical and Computer Engineering
Electronics and Communication Engineering
Electronics and Computer Engineering
Information Science and Engineering
Mechanical Engineering
Mechatronics Engineering

3. Duration and Medium of Instructions:

Duration: The duration of the B Tech degree program shall be FOUR years comprising of **EIGHT** Semesters. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B. Tech degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

The medium of instruction shall be English.

4. Definitions:

Course: "Course" means a subject, either theory or practical or both, listed under a programme; Example: "Fluid Mechanics" in B Tech Civil Engineering program, Engineering Thermodynamics in B. Tech., Mechanical program are examples of courses to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely:

L	**Lecture**
T	**Tutorial**
P	**Practice**

Where:

L stands for **Lecture** session consisting of classroom instruction.
T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.
P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

Classification of Courses

Courses offered are classified as: Core Courses, Open Elective Courses, Project work/Dissertation

Core Course: A course which should compulsorily be studied by a candidate choosing a particular program of study

Foundation Course: The foundation Course is a mandatory course which should be completed successfully as a part of graduate degree program irrespective of the programof study

Hard Core Course (HC) simply core course: The **Hard Core Course** is a Core Course in themain branch of study and related branch(es) of study, if any, that the candidates have tocomplete compulsorily

Soft Core Course (SC) (also known as Professional Elective Course)

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study

Open Elective Course (OE):

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course**

Project Work / Dissertation:

Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems. The project will be conducted in two phases, phase-I (7th Semester), Consists of literature survey, problem identification, formulation and methodology. In Phase-II (8th Semester) student should complete the project work by designing or creating an innovative process or development of product as an outcome. A project work carrying **TWO**, **FOUR or SIX** credits is called Minor Project work / Dissertation. A project work of **SIX, EIGHT, or TEN,** credits is called Major Project work / Dissertation. **A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned. But the Major Project shall be Hard Core.**

"Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma Degree or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to B Tech Program of 4 years (8 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B Tech)	4 Years (8 Semesters)	Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry, Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together.
2	Bachelor of Technology (B Tech)	Lateral entry to second year	A. Passed Diploma examination from an AICTE approved Institution with at least 45% marks (40% in case of candidates belonging to SC/ST category) in appropriate branch of Engineering / Technology. B. Passed B. Sc Degree from a recognized University as defined by UGC, with at least 45% marks (40% in case of candidates belonging to SC/ST category) and passed XII standard with mathematics as a subject. C. Provided that in case of students belonging to B. Sc. Stream, shall clear the subjects of Engineering Graphics / Engineering Drawing and Engineering Mechanics of the first year Engineering program along with the second year subjects. D. Provided further that, the students belonging to B. Sc. Stream shall be considered only after filling the seats in this category with students belonging to the Diploma stream. E. Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized University as defined by UGC, shall also be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first year class in case the vacancies at lateral entry are exhausted. However the

Sl. No.	Program	Duration	Eligibility
			admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above.
	Bachelor of Technology (B Tech)	Lateral entry to fourth year (final year)	Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester in the concerned branch of study, provided he/she fulfils the University requirements.
4	B. Tech. in Bioelectronics		Pass in PUC / 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry / Biotechnology / Biology / Computer Science / Electronics / Technical Vocational subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC / ST category) in the above subjects taken together of any board recognized by the respective State Government / Central Government / Union Territories or any other qualification recognized as equivalent there to.

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, such as AICTE, UGC from time to time.

6. Courses of Study and Credits

Each course of study is assigned with certain credit value

Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for final examination, evaluation and announcement of results

The credit hours defined as below:

In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching-learning process.

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.
The following table describes credit pattern

Table -2: Credit Pattern					
Lectures (L)	**Tutorials (T)**	**Practice (P)**	**Credits (L:T:P)**	**Total Credits**	**Total Contact Hours**
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4
2	0	0	2:0:0	2	2

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course

7. Different C**ourses of Study**:
Different C**ourses of Study** are labeled as follows:

a. Core Course (CC)
b. Foundation Course (FC)

c. Hard Core Course (HC)

d. Soft Core Course (SC)
e. Open Elective Course (OE)

f. Project Work / Dissertation:
g. A project work carrying **TWO, FOUR or SIX** credits is called Minor Project work / Dissertation. A project work of **EIGHT, TEN, TWELVE or SIXTEEN** credits is called Major Project work / Dissertation. A Project work may be a hard core or a Soft Core as decided by the BoS / concerned.

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

A candidate has to earn 160 credits for successful completion of B Tech degree with the distribution of credits for different courses as given in table below:

Course Type	**Credits (Range)**
	For B Tech Degree (8 Semesters)
Foundation Core Course	A minimum of 06 but not exceeding 12
Hard Core Course	A minimum of 118 but not exceeding 121
Soft Core Course	A minimum of 15 but not exceeding 21

Open Elective	A minimum of 04 but not exceeding 12

The concerned BOS based on the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work,field work, self-study elective, as **Foundation Course (FC), Hard Core (HC) or Soft Core (SC), Open Elective (OE).**

Every course including project work, practical work, field work, self-study elective should be entitledas **Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE)** or **Core Course** (**CC**) by the BoS concerned. However, following shall be the **Foundation Courses** with credits mentioned against them, common to all branches of study.

Sl. No.	**Course Title**	**Number of Credits**
Foundation Courses		
1	English for Technical Communication / Communicative Skills	2-3
2	Environmental Studies / Environmental Sciences	2
3	Indian Constitution and Professional Ethics	2
4	MOOC / Internship /Soft Skill Training	6-15

The concerned BOS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

A candidate can enrol for a maximum of 28 credits and a minimum of 19 credits per Semester. However he / she may not successfully earn a maximum of 28 credits per semester. This maximum of 28 credits does not include the credits of courses carried forward by a candidate.

Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 160 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B Tech Degree program**.**

Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B Tech Degree program.

The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the candidate contains the courses studied and grades earned.

9 Assessment and Evaluation

The Scheme of Assessment will have two parts, namely;

i. Internal Assessment (IA); and
ii. Semester End Examination (SEE)

Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of UG Engineering programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

The 50 marks of internal assessment shall comprise of:

Internal Test	**30 marks**
Assignments / Seminars / Model Making / Integrated Lab / Project Based Learning / Quizzes etc.	**20 marks**

There shall be **two Internal Tests** conducted as per the schedule announced below. **The Students' shall attend both the Tests compulsorily.**

- 1st test is conducted for 15 marks during **6th week** of the Semester;
- 2nd test is conducted for 15 marks during **12th week** of the of the Semester;

The coverage of syllabus for the said tests shall be as under:

- Question paper of the **1st test should be based on first 40 %of the total syllabus**;
- Question paper of the **2nd test should be based on second 40 %of the total syllabus**;
- An assignment must be designed to cover the last **20% of the Syllabus**

There shall be one Assignment / Project Based Learning / Field Visit / Quiz test carrying 20 marks covering the last 20% of the Syllabus

The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

A test paper is set for a maximum of 30 marks to be answered in 1 hour duration. A test paper can have 4 main questions. Each main question is set for 10 marks. The main question can have 2-3 sub questions all totalling 10 marks. Students are required to answer any three main questions. Each question is set using Bloom's verbs. The questions must be set to assess the course outcomes described in the course document even with the choice is given in question

The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by the Question Paper Scrutiny Committee to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

The evaluation of the answer scripts shall be done by the internal teachers who have taughtthe course and set the test paper.

Assignment/seminar/Project based learning/simulation based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarise the answer from web or any other resources. An assignment / Quiz can be set for a maximum of 20. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self-study.

Internal assessment marks must be decided well before the commencement of Semester End examinations

Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18th and 19th week of the semester and the entire course syllabus must be covered while setting the question paper.

Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can havea 3-4 sub questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

There shall be three sets of question papers for the semester end examination of which oneset along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of Examiners particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

There shall also be an **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. The Examination Review Committee shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

The report provided by the Examination Review Committee shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

University may decide to use available modern technologies for writing the tests and SEE bythe students instead of traditional pen and paper

Any deviations required to the above guidelines can be made with the written consent ofthe Vice Chancellor

Online courses may be offered as per UGC norms.

For online course assessment guidelines would be as follows:

1. If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA University norms.
2. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain at the discretion of the School.

The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy,Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

Utilization of one or two credit online courses would be:

4 week online course – 1 credit

8 week online course / MOOC – 2 credits

12 week online course / MOOC – 3 credits

Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	**Type of Assessment**	**when**	**Syllabus Covered**	**Max Marks**	**Reduced to**	**Date by which the process must be completed**
1	Test-1	During 6th week	First 40%	30	15	7th week
2	Test -2	During 12th Week	Second 40%	30	15	13th Week
3	Assignment / Quiz	15th Week	Last 20%	20	20	16th Week
4	SEE	18/19th Week	100%	100	50	20th Week

10 Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

The 50 marks meant for Internal Assessment (IA) of the performance in carrying out practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	**50 marks**

The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

i	Conducting of semester end practical examination	30 marks

ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

The duration for semester-end practical examination shall be decided by the concerned School Board.

For MOOC and Online Courses assessment shall be decided by the BOS of the School.

For > 3 credit courses

i	IA-I	25 marks
ii	IA-2	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	50 marks
	Total	**100 marks**

For 1 & 2 credit courses

i	IA	25 marks
ii	Semester end examination by the concern school board (demo, test, viva voice etc.)	25 marks
	Total	**50 marks**

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

12. Requirements to Pass a Course:

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 , SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) which is compulsory.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below:

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P= [IA + SEE]) secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

a. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA).

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e. : **SGPA (Si) = ∑(Ci x Gi) / ∑Ci** where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
Course 7	3	O	10	3X10=30
	19			159

Thus, **SGPA = 159 ÷ 19 = 8.37**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
Course 7	2	B+	7	2X7=21

Course 8	2	O	10	2X10=20
	24			175

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

Course	**Credit**	**Grade Letter**	**Grade Point**	**Credit Point (Credit x Grade point)**
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			**199**

Thus**, SGPA = 199 ÷ 24 = 8.29**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (160) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = ∑(Ci x Si) / ∑Ci**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Illustration:

CGPA after Final Semester

Semester (ith)	**No. of Credits (Ci)**	**SGPA (Si)**	**Credits x SGPA (Ci X Si)**
1	19	6.83	19 x 6.83 = 129.77
2	21	7.29	21 x 7.29 = 153.09
3	22	8.11	22 x 8.11 = 178.42
4	22	7.40	22 x 7.40 = 162.80
5	22	8.29	22 x 8.29 = 182.38
6	22	8.58	22 x 8.58 = 188.76
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**160**		**1288.36**

Thus, **CGPA** = $\frac{19x6.83+21x7.29+22x8.11+22x7.40+22x8.29+22x8.58+22x9.12+10x9.25}{160}$ = 8.05

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.05 x 10=80.5

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index)	Letter Grade	Performance	FGP
	G			Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. Provisional Grade Card: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average (SGPA).**

b. Final Grade Card: Upon successful completion of B Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

All students must attend every lecture, tutorial and practical classes.

In case a student is on approved leave of absence (e g:- representing the University in sports, gamesor athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

16. Absence during Internal Test:

In case a student has been absent from an internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), he/she can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. He/she can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the Grievance committee is final.

18. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances.

For every program there will be one grievance committee. The composition of the grievance committee is as follows:-

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

19. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

20. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

21. Provision to Carry Forward the Failed Subjects / Courses:

The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of succeeding year(s) of study till 8th semester. And he / she shall appear for Semester End examination of failed courses of previous semesters concurrently with odd semester end examinations and / or even semester end examinations of current year of study.

Case 1: A student who has failed in a maximum of 4 courses in 1st and 2nd semester together shall move to the 3rd semester of the succeeding year.
Case 2: A student who has failed in a maximum of 4 courses from semester 1 to 4 together shall move to the 5th semester of the succeeding year.
Case 3: A students who has failed in a maximum of 4 courses from semester 1 to 6 together shall move to the 7th semester of the succeeding year.

22. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

b. The answer scripts (in whatever form) for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

23. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

24. All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

B.Tech in Mechanical Engineering

Curriculum Structure for B. Tech Mechanical Engineering Program

SEMESTER-1 (Cycle-1)

Sl. No	Course Code	Title of the Course	HC/FC/ SC / OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours / Week
					L	T	P	Total	
1	B20AS0103	Differential Equations and Linear Algebra	FC	PUC/ Equivalent	3	0	0	3	3
2	B20AS0107	Physics for Engineers	FC	PUC/ Equivalent	3	0	1	4	5
3	B20CS0101	Introduction to Data Science	HC	PUC/ Equivalent	2	0	1	3	4
4	B20ER0101	Introduction to Engineering Mechanics	HC	PUC/ Equivalent	3	0	0	3	3
	Practical /Term Work / Practice Sessions/Online /MOOC								
5	B20ME0104	Entrepreneurship	HC	PUC/ Equivalent	1	0	0	1	1
6	B20EC0101	IoT and Applications	HC	PUC/ Equivalent	1	0	1	2	3
7	B20ME0101	Computer Aided Engineering Drawing	HC	PUC/ Equivalent	2	0	1	3	4
				TOTAL	**15**	**0**	**4**	**6**	**23**
				TOTAL SEMESTER CREDITS				**19**	
				TOTAL CUMULATIVE CREDITS				**19**	
				TOTAL CONTACT HOURS				**23**	

SEMESTER-2 (Cycle-2)

Sl. No	Course Code	Title of the Course	HC/FC/SC/ OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours/ Week
					L	T	P	Total	
1	B20AS0205	Vector Calculus and Partial Differential Equations	FC	B20AS0103	3	1	0	4	4
2	B20AS0201	Applied Chemistry	FC	-	3	0	0	3	3
3	B20CI0101	Introduction to Python programming	HC	-	2	0	1	3	4
4	B20EE0101	Basic Electrical and Electronics Engineering	HC	-	3	0	1	4	5
5	B20ER0201	Elements of Mechanical Engineering	HC	-	3	0	1	4	5
	Practical /Term Work / Practice Sessions/Online /MOOC								
6	B20AS0109	Biology for Engineers	FC	-	1	0	0	1	1
7	B20ME0102	Design Thinking	HC	-	1	0	1	2	3
				TOTAL	**16**	**0**	**5**	**21**	**25**
				TOTAL SEMESTER CREDITS				**21**	
				TOTAL CUMULATIVE CREDITS				**40**	
				TOTAL CONTACT HOURS				**25**	

SEMESTER-3 (Cycle-1)

Sl. No	Course Code	Title of the Course	HC/FC/ SC/OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours/ Week
					L	T	P	Total	
1	B20AS0304	Laplace Transforms and Fourier Series	FC	B20AS0205	3	0	0	3	3
2	B20ER0301	Engineering Thermodynamics	HC		3	1	0	4	5
3	B20ER0302	Material Science	HC		3	0	0	3	3
4	B20ER0303	Manufacturing Science	HC		3	0	0	3	3
5	B20ER0304	Mechanics of Materials	HC		3	0	0	3	3
Practical /Term Work / Practice Sessions/Online /MOOC									
6	B20ER0305	Manufacturing Technology Lab	HC		0	0	1	1	2
7	B20ER0306	Material Testing Lab	HC		0	0	1	1	2
8	B20AH0301	Communication Skill	FC		2	0	0	2	2
9	B20LS0301	Indian constitution and Professional Ethics	FC		2	0	0	2	2
10	B20AHM301	Advanced Kannada	MC		0	0	0	0	2
	B20AHM302	Basics of Kannada	MC		0	0	0	0	2
TOTAL					**19**	**1**	**2**	**22**	**27**
TOTAL SEMESTER CREDITS								**22**	
TOTAL CUMULATIVE CREDITS								**62**	
TOTAL CONTACT HOURS								**27**	

SEMESTER-4 (Cycle-2)

Sl. No	Course Code	Title of the Course	HC/FC/SC/ OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours/ Week
					L	T	P	Total	
1	B20AS0403	Probability and Sampling Theory	FC	B20AS0304	3	0	0	3	3
2	B20ER0401	Mechanical Measurements and Metrology	HC		2	0	1	3	4
3	B20ER0402	Machining Process	HC		3	0	0	3	3
4	B20ER0403	Kinematics and Dynamics of Machines	HC		3	0	0	3	3
Practical /Term Work / Practice Sessions/Online /MOOC									
5	B20ER0404	Computer Aided Machine Drawing	HC	B20ME0101	1	0	2	3	5
6	B20ER0405	MATLAB for Mechanical Engineers	HC		0	0	1	1	2
7	B20ER0406	Machine Shop	HC		0	0	1	1	2
8	B20ER0407	Mechanical Systems Analysis Lab	HC		0	0	1	1	2
9	B20MG0301	Management Science	HC		2	0	0	2	2
10	B20AS0303	Environmental Science	FC		2	0	0	2	2
11	B20AHM401	Universal Human Values	MC		0	0	0	0	2
				TOTAL	**16**	**0**	**6**	**22**	**30**
								TOTAL SEMESTER CREDITS	**22**
								TOTAL CUMULATIVE CREDITS	**84**
								TOTAL CONTACT HOURS	**30**

SEMESTER-5

Sl. No	Course Code	Title of the Course	HC/ FC/SC/ OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours / Week
					L	T	P	Total	
1	B20ER0501	Design of Machine Elements	HC		3	1	0	4	5
2	B20ER0502	Fluid Mechanics and Machines	HC		2	1	0	3	4
3	B20ER0503	Thermal Engineering Systems	HC		4	0	0	4	4
Professional Elective-1									
4	B20ERS511	Smart Materials	SC	B20ER0302	3	0	0	3	3
	B20ERS512	Experimental Stress Analysis	SC		3	0	0	3	3
	B20ERS513	Energy Technology	SC		3	0	0	3	3
	B20ERS514	Automotive Engineering	SC		3	0	0	3	3
	B20ERS515	Statistical Quality Control	SC		3	0	0	3	3
Open Elective-1 for other school students									
5	B20MEO501	Smart Materials	OE		3	0	0	3	3
Practical /Term Work / Practice Sessions/Online /MOOC									
6	B20ER0504	Flow Analysis Using Ansys Fluent	HC		1	0	1	2	3
7	B20ER0505	Fluid Machines Lab	HC		0	0	1	1	2
8	B20ER0506	Heat Engine Lab	HC		0	0	1	1	2
9	B20PA0501	Indian Tradition and Culture	FC		1	0	0	1	1
				TOTAL	**17**	**2**	**3**	**22**	**27**
								TOTAL SEMESTER CREDITS	**22**
								TOTAL CUMULATIVE CREDITS	**106**
								TOTAL CONTACT HOURS	**27**

SEMESTER-6

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours/ Week
					L	T	P	Total	
1	B20ER0601	Heat Transfer	HC	B20ER0301	2	1	0	3	4
2	B20ER0602	Finite Element Methods	HC	B20ER0304	2	1	0	3	4
3	B20ER0603	Design of Transmission Elements	HC	B20ER0501	3	0	0	3	3
Professional Elective-2									
4	B20ERS611	Product Design by Additive Manufacturing	SC		3	0	0	3	3
	B20ERS612	Design for Manufacturing and Assembly	SC		3	0	0	3	3
	B20ERS613	Turbomachines	SC	B20ER0502	3	0	0	3	3
	B20ERS614	Electric and Hybrid Vehicles	SC		3	0	0	3	3
	B20ERS615	Production and Operations Management	SC	B20ERS515	3	0	0	3	3
Professional Elective-3									
5	B20ERS621	Automation in Manufacturing	SC		3	0	0	3	3
	B20ERS622	Robotic Systems Kinematics	SC		3	0	0	3	3
	B20ERS623	Refrigeration and Air Conditioning	SC		3	0	0	3	3
	B20ERS624	Aircraft Fundamentals	SC		3	0	0	3	3
	B20ERS625	Industrial Engineering	SC		3	0	0	3	3
Open Elective-2 for other school students									
6	B20MEO601	Energy Technology	OE		3	0	0	3	3
Practical /Term Work / Practice Sessions/Online /MOOC									
7	B20ER0604	Heat Transfer Lab	HC		0	0	1	1	2
8	B20ER0605	Computer Aided Engineering Analysis Lab	HC		0	0	1	1	2
9	B20ER0606	Technical Documentation	FC		1	0	0	1	1
10	B20ER0607	Research Based Mini Project	HC		0	0	1	1	3
				TOTAL	**17**	**2**	**3**	**22**	**28**
				TOTAL SEMESTER CREDITS				**22**	
				TOTAL CUMULATIVE CREDITS				**128**	
				TOTAL CONTACT HOURS				**28**	

SEMESTER-7

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours/ Week
					L	T	P	Total	
1	B20ER0701	Vibrations and Noise Engineering	HC		2	1	0	3	4
2	B20ER0702	CAD/CAM/CIM	HC		3	0	0	3	3
3	B20ER0703	Mechatronics and Control Systems	HC		3	0	0	3	3
4	B20ER0704	Engineering Economics and Financial Management	HC		3	0	0	3	3
Professional Elective-4									
5	B20ERS711	IoT in Manufacturing	SC		3	0	0	3	3
	B20ERS712	Robotic Systems Dynamics and Control	SC	B20ERS622	3	0	0	3	3
	B20ERS713	Computational Fluid Dynamics	SC		3	0	0	3	3
	B20ERS714	Micro Electro Mechanical Systems	SC		3	0	0	3	3
	B20ERS715	Total Quality Management and Six Sigma	SC	B20ERS615	3	0	0	3	3
Professional Elective-5									
6	B20ERS721	Fluid Power Engineering	SC		3	0	0	3	3
	B20ERS722	Tribology	SC		3	0	0	3	3
	B20ERS723	Solar Energy Systems	SC		3	0	0	3	3
	B20ERS724	Autonomous Vehicles	SC		3	0	0	3	3
	B20ERS725	Operation Research	SC		3	0	0	3	3
	B20ERS726	Internship	SC		0	0	3	3	3
Open Elective-3 for other school students									
7	B20MEO701	Electric and Hybrid Vehicles	OE		3	0	0	3	3
Practical /Term Work / Practice Sessions/Online /MOOC									
8	B20ER0705	Design Lab	HC		0	0	1	1	2
9	B20ER0706	Computer Integrated Manufacturing Lab	HC		0	0	1	1	2
				TOTAL	**20**	**1**	**2**	**23**	**26**
								TOTAL SEMESTER CREDITS	**23**
								TOTAL CUMULATIVE CREDITS	**151**
								TOTAL CONTACT HOURS	**26**

SEMESTER-8

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Pre requisite	Credit Pattern & Credit Value				Contact Hours/ Week
					L	T	P	Total	
Open Elective-4 for other school students									
1	B20MEO801	Total Quality Management and Six Sigma	OE		3	0	0	3	3
Practical /Term Work / Practice Sessions/Online /MOOC									
2	B20ER0801	Major Project	HC		0	0	6	6	18
				TOTAL	**3**	**0**	**6**	**9**	**21**
								TOTAL SEMESTER CREDITS	**9**
								TOTAL CUMULATIVE CREDITS	**160**
								TOTAL CONTACT HOURS	**21**

List of Professional Electives

Sl. No	Course Code	Title of the Course
1	B20ERS511	Smart Materials
2	B20ERS512	Experimental Stress Analysis
3	B20ERS513	Energy Technology
4	B20ERS514	Automotive Engineering
5	B20ERS515	Statistical Quality Control
6	B20ERS611	Product Design by Additive Manufacturing
7	B20ERS612	Design for Manufacturing and Assembly
8	B20ERS613	Turbomachines
9	B20ERS614	Electric and Hybrid Vehicles
10	B20ERS615	Production and Operations Management
11	B20ERS621	Automation in Manufacturing
12	B20ERS622	Robotic Systems Kinematics
13	B20ERS623	Refrigeration and Air Conditioning
14	B20ERS624	Aircraft Fundamentals
15	B20ERS625	Industrial Engineering
16	B20ERS711	IoT in Manufacturing
17	B20ERS712	Robotic Systems Dynamics and Control
18	B20ERS713	Computational Fluid Dynamics
19	B20ERS714	Micro Electro Mechanical Systems
20	B20ERS715	Total Quality Management and Six Sigma
21	B20ERS721	Fluid Power Engineering
22	B20ERS722	Tribology
23	B20ERS723	Solar Energy Systems
24	B20ERS724	Autonomous Vehicles
25	B20ERS725	Operation Research

List of Open Elective Courses

Sl.No	Course Code	Semester	Open Elective Course Name	Offered by	Offered to School
1	B20CEO501	5	BUILDING MATERIALS AND CONSTRUCTION	CE	All Engineering
2	B20CEO601	6	BUILDING PLANNING AND BYE LAWS	CE	All Engineering
3	B20CEO701	7	DISASTER PREPAREDNESS, PLANNING AND MANAGEMENT	CE	All Engineering
4	B20CEO801	8	ROAD SAFETY AND MANAGEMENT	CE	All Engineering
5	B20CIO501	5	INTRODUCTION TO AI	CI	Mech, Civil, ECE, EEE
6	B20CIO502	5	OOPS WITH C++	CI	Mech, Civil, ECE, EEE
7	B20CIO503	5	WEB TECHNOLOGY	CI	Mech, Civil, ECE, EEE
8	B20CIO601	6	DATA MINING	CI	Mech, Civil, ECE, EEE
9	B20CIO602	6	MACHINE LEARNING	CI	Mech, Civil, ECE, EEE
10	B20CIO603	6	NEURAL NETWORKS	CI	Mech, Civil, ECE, EEE
11	B20CIO701	7	DEEP LEARNING	CI	Mech, Civil, ECE ,EEE
12	B20CIO702	7	PYTHON FOR DATA SCIENCE	CI	Mech, Civil, ECE, EEE
13	B20CIO801	8	IOT PROGRAMMING	CI	Mech, Civil, ECE, EEE
14	B20CIO802	8	REINFORCEMENT LEARNING	CI	Mech, Civil, ECE, EEE
15	B20CSO501	5	DATABASE MANAGEMENT SYSTEMS	CS	All Engineering
16	B20CSO601	6	DATA STRUCTURES	CS	All Engineering
17	B20CSO701	7	JAVA PROGRAMMING	CS	All Engineering
18	B20CSO801	8	R PROGRAMMING LANGUAGE	CS	All Engineering
19	B20ECO501	5	SENSORS AND INSTRUMENTATION	EC	All Engineering
20	B20ECO601	6	MICROPROCESSORS AND MICROCONTROLLERS	EC	All Engineering
21	B20ECO801	7	AUTOMOTIVE ELECTRONICS	EC	All Engineering
22	B20ECO802	8	ROBOTICS AND AUTOMATION	EC	All Engineering
23	B20EEO501	5	ENERGY CONSERVATION	EE	All Engineering
24	B20EEO601	6	ELECTRICAL SAFETY AND REGULATIONS	EE	All Engineering
25	B20EEO801	7	RENEWABLE ENERGY SYSTEM	EE	All Engineering
26	B20EEO802	8	TROUBLE SHOOTING OF COMMON ELECTRICAL APPLIANCES	EE	All Engineering
27	B20MDO501	5	BIOPYTHON	MD	All Engineering
28	B20MDO601	6	BIOSENSORS AND BIOELECTRONICS	MD	All Engineering
29	B20MDO701	7	COGNITIVE NEUROSCIENCE	MD	All Engineering
30	B20MDO801	8	CYBER SECURITY AND FORENSICS	MD	All Engineering
31	B20MEO501	5	SMART MATERIALS	ME	All Engineering
32	B20MEO601	6	ENERGY TECHNOLOGY	ME	All Engineering
33	B20MEO701	7	ELECTRIC AND HYBRID VEHICLES	ME	All Engineering
34	B20MEO801	8	TOTAL QUALITY MANAGEMENT AND SIX SIGMA	ME	All Engineering

Detailed Syllabus
Semester - 1

Course Title	Differential Equations and Linear Algebra				Course Type		FC	
Course Code	B20AS0103	Credits	3		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW

This course is introduction to applied mathematics, which is useful for Mechanical engineering students. This course covers identifying and methods of solving differential equation of first and higher order along with applications to engineering problems. Most importantly learn linear algebra topics like linear transformation, solving linear system of equations and determining Eigen values and Eigen vectors.

COURSE OBJECTIVES

1. To impart the Knowledge of first order ordinary differential equations and its applications in the field of engineering.
2. To impart the Knowledge of higher order linear differential equations and its applications in the field of engineering.
3. To study different methods to solve consistent system of algebraic equations.
4. To study Eigen values and Eigen vectors using numerical method, diagonalization and canonical forms.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Solve first order ordinary differential equations and its application using different methods.	1,2	1
CO2	Solve Non-Homogeneous Linear Differential Equations with constant coefficients using direct method and the method of variation of parameters	1,2	1
CO3	Solve Non-Homogeneous Linear Differential Equations with variable coefficients	1,2	1
CO4	Compute the solution of system of equations by various methods	1,2	1
CO5	Compute the Eigen values and Eigen vectors of square matrix and to diagonalize the square matrices.	1,2	1
CO6	Apply the linear transformation and canonical form of matrix in Mechanical Engineering	1,2	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓	✓			
CO2	✓	✓	✓			
CO3	✓	✓	✓			
CO4	✓	✓	✓			
CO5	✓	✓	✓			
CO6	✓	✓	✓			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											3		
CO2	3	1											3		
CO3	3	1											3		
C04	3	2											2		
CO5	3	2											2		
C06	3	2											3		
Average	**3.0**	**1.5**											**2.7**		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit – 1

Differential equations of First order and first degree:

(Recap: Variable separable, Homogenous and Linear equations) Bernoulli's equation, Exact Differential Equations, Equation reducible to exact [IF for the case of $\frac{1}{M}(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x})$ ***and*** $\frac{1}{N}(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x})$ ***only***].Orthogonal trajectories (both Cartesian and polar form), Engineering applications.

Unit – 2

Linear differential equations:

Linear differential equations with constant coefficients: inverse differential operator method and method of variation of parameters. Linear differential equations with variable coefficients: Solution of Cauchy's and Legendre's linear differential equations, engineering applications.

Unit – 3

Linear Algebra:

Rank of Matrix by elementary transformations, Linear System of Equations, Conditions of Existence and Uniqueness of Solutions. Solution of linear system of equations by Gauss Elimination, Gauss –Jordan and Gauss-Seidel method, Engineering applications.

Unit – 4

Matrix theory:

Eigen Values and Eigen Vectors, Rayleigh's power method to find the largest Eigen value and the corresponding Eigen vector. Linear transformation, diagonalization of a square matrix. Reduction of Quadratic form to Canonical form, engineering applications.

TEXT BOOKS

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015

REFERENCE BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013
2. P.V. O'Neil, "Advanced Engineering Mathematics", Thomson Mathematical Methods by Potter & Goldberg; Publisher: PHI.

JOURNALS / MAGAZINES

1. https://www.journals.elsevier.com/journal-of-differential-equations
2. https://www.journals.elsevier.com/linear-algebra-and-its-applications

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/111/106/111106051/
2. https://nptel.ac.in/courses/111/104/111104031/
3. https://www.coursera.org/learn/differential-equations-engineers

Course Title	Physics for Engineers				Course Type		FC	
Course Code	B20AS0107	Credits	4		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**4**	**5**	**5**	**40**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Fundamental Physics is very important and necessary basic subject for all branches of engineering students. It provides the fundamental knowledge of basic principles of Physics which is required for basic foundation in engineering education irrespective of branch. This course introduces the basic concepts of Physics and its applications to Mechanical Engineering courses by emphasizing the concepts underlying four units .1 Lasers and optical fibers , 2.Quantum effects like blackbody radiations ,photoelectric effect , electromagnetic radiations 3.Quantum mechanics and its applications ,4.Theories of solids to explain electrical properties of materials(Conductors, semiconductors, insulators and superconductors) etc.. This subject has basic laws expressions and theories which helps to increase the scientific knowledge to analyze upcoming technologies. The course also consists of real time and numerical examples which makes subject interesting and attractive.

COURSE OBJECTIVES

This course enables graduating students

1. To understand the basic concepts and principles of Physics to analyze practical engineering problems and apply its solutions effectively and efficiently.
2. To gain the knowledge of different physical phenomena, quantum/wave mechanics and materials science.
3. To understand design issues, practical oriented skills and problem solving challenges.

COURSEOUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Explain the working, principle and applications CO_2 and semiconductor lasers and characteristics of lasers	1, 9, 10	2,3
CO2	Summarize principles and distinguish different types of optical fibers	1, 2, 9, 10	2,3
CO3	Analyze quantum effects like blackbody radiations , photoelectric effect , and polarization of electromagnetic radiations	1, 2, 9, 10	2, 3
C04	Interpret laws of quantum mechanics and applications of schrodinger wave equations	1, 2	2, 3
CO5	Compare theories of solids to apply Conductors, semiconductors and dielectrics in the varies fields	1, 2, 9, 10	2, 3
C06	Demonstrate the experiments to characterize the semiconductor, laser, optical fiber, transistors, photodiode and capacitor.	1, 2, 9, 10	2, 3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓	✓	✓		
CO2	✓	✓	✓	✓		
CO3	✓	✓	✓	✓		
C04	✓	✓	✓	✓		
CO5			✓	✓		
C06	✓	✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3								3	3				1	1
CO2	3	2							3	3				1	1
CO3	3	2							3	3				1	1
C04	3	2												1	1
CO5	3	1							3	3				1	1
C06	3	1							3	3				1	1
Average	**3.0**	**1.6**							**3.0**	**3.0**				**1.0**	**1.0**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Lasers: Lasers Interaction between radiation and matter, Expression for energy density at thermal equilibrium in terms of Einstein's coefficients. Characteristics of laser light, Conditions for laser operation, Requisites of laser system, Construction and working of Carbon Dioxide (CO_2) laser, semiconductor laser and Applications of laser.

Optical fibers: Construction and light propagation mechanism in optical fibers, Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Types of optical fibers, Attenuation and reasons for attenuation, optical fiber communication using block diagram, Advantages and limitations. Working of LED and Photodiode.

Unit-2

Electromagnetic Waves: Wave equation in differential form in free space. Plane electromagnetic waves in vacuum, their transverse nature. Polarization of electromagnetic waves (qualitatively)

Quantum Physics: Black body radiation spectrum, Stefan's law of radiation, Plank's quantum theory of radiation, verification of Weins law and Rayleigh Jeans law, using planks law. Wave Particle dualism, deBroglie hypothesis, Matter waves, Photoelectric effect, Compton Effect (qualitative).

Unit-3

Quantum Mechanics: Heisenberg's uncertainty principle, and its applications (nonexistence of electron inside the nucleus). Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation - Particle in one dimensional infinite potential well with numerical examples.

Unit-4

Electron Theory of Metals: Classical free electron theory and its failures. Quantum Free electron theory and its success, density of states, Fermi-Dirac statistics (qualitative), Fermi factor, Fermi level, Fermi energy.

Physics of Semiconductor: Band structure – types of semiconductors-mention the expression for concentration of electrons and Holes in intrinsic semiconductors, Expression for electrical Conductivity of semiconductors in terms of energy gap and temperature. (Derivation)

Dielectric materials: polar and non-polar dielectrics, types of polarizations. Internal fields in a one dimensional solid dielectric (Derivation), Applications and Numerical problems.

Superconductivity and properties of superconductors.

PRACTICE:

Sl. No.	Title of the Experiment
1.	Variation of Resistivity of intrinsic Semi-conductor crystal using four probe method

Sl. No.	Title of the Experiment
2.	Determination Value of Planck's constant by using light emitting diode
3.	Attenuation and propagation characteristics of optical fiber cable.
4.	Determination of numerical aperture of a given optical fiber.
5.	To find the laser parameters–wavelength and divergence of laser light by diffraction method.
6.	Photo Diode Characteristics (Study of I–V characteristics in reverse bias and variation of photocurrent as a function of reverse voltage and intensity
7.	Dielectric constant of a capacitor by charging and discharging of a capacitor
8.	Determination of particle size using laser.
9.	Band gap of intrinsic Semi-conductor
10.	Verification of Stefan's law of radiation by electrical method

TEXT BOOKS

1. M.N. Avadhanulu and P.G. Kshirsagar , "A Text book of Engineering Physics", S. Chand & Company Ltd, New Delhi, 10th revised Ed,.
2. Gaur and Gupta, "Engineering Physics", Dhanpat Rai Publications, 2017.

REFERENCE BOOKS

1. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill Edu Pvt Ltd- New Delhi, 6th Edition, 2006
2. M K Verma, "Introduction to Mechanics", University Press (India) Pvt Ltd, Hyderabad, 2nd Edition, 2009.
3. B laud, "Lasers and Non Linear Optics", New Age International Publishers, 3rd Edition, 2011
4. S O Pillai, "Solid State Physics", New Age International Publishers, 8th Edition, 2018.

Course Title	**Introduction to Data Science**				**Course Type**		**Hard Core**	
Course Code	**B20CS0101**	**Credits**	**3**		**Class**		**I Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	**0**	**0**				
	Total	**3**	**4**	**4**	**26**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: Set Theory, Probability theory, Tools for data science, ML algorithms and demonstration of experiments by using MS-Excel/ Python/R.

COURSE OBJECTIVES

The objectives of this course are to:

1. Explain the fundamental concepts of Excel.
2. Illustrate the use of basic concepts of Data Science in the real world applications.
3. Demonstrate the use of SQL commands in real world applications.
4. Discuss the functional components of Data Science for real world applications

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Make use of the basic concepts of Data Science in developing the real world applications.	1 to 5, 8 to 10	1, 2, 3

CO2	Apply the SQL commands in developing the real-world applications.	1 to 5, 8 to 10	1, 2, 3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1 to 5, 8 to 10	1, 2, 3
CO4	Create the real world AI based solutions using different machine learning algorithms.	1 to 5, 8 to 10	1, 2, 3
CO5	Illustrate modeling Error in Linear Regression	1 to 5, 8 to 10	1, 2, 3
C06	Demonstrate applications of data science.	1 to 5, 8 to 10	1, 2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1			✓			
CO2			✓			
CO3			✓	✓		
CO4			✓	✓	✓	✓
CO5		✓				
C06			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2			1	3	3			3	3	3
CO2	2	2	2	2	2			1	3	3			3	3	3
CO3	3	3	2	2	2			1	3	3			3	3	3
CO4	3	3	3	2	2			1	3	3			3	3	3
CO5	3	3	3	2	2			1	3	3			3	3	3
CO6	3	3	3	2	2			1	3	3			3	3	3
Average	**2.8**	**2.8**	**2.5**	**2.0**	**2.0**			**1.0**	**3.0**	**3.0**			**3.0**	**3.0**	**3.0**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to Microsoft Excel: Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Filters, Grouping. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.

UNIT – 2

Introduction to Data Science: What is Data Science? Probability theory, bayes theorem, bayes probability; Cartesian plane, equations of lines, graphs; exponents**.**

Introduction to SQL: Creation, insertion, deletion, retrieval of Tables by experimental demonstrations. Import SQL Database Data into Excel

UNIT – 3

Data Science Components: Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Description of linear regression and Logistic

Regression. Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression.

UNIT – 4

Data visualization using scatter plots, charts, graphs, histograms and maps: Statistical Analysis: Descriptive statistics- Mean, Standard Deviation for Continuous Data, Frequency, and Percentage for Categorical Data. Applications of Data Science, Data science life cycle, Applications of data science with demonstration of experiments either by using Microsoft Excel.

PRACTICE:

<table>
<tr><th>Sl.No</th><th>Title of the Experiment</th><th>Tools and Techniques</th><th>Expected Skill/Ability</th></tr>
<tr><td>1</td><td>The height (in cm) of a group of fathers and sons are given below, Find the lines of regression and estimate the height of son when the height of father is 164 cm.
<table>
<tr><td>Plot the graph. Hgt of Fathers</td><td>158</td><td>166</td><td>163</td><td>165</td><td>167</td><td>170</td><td>167</td><td>172</td><td>177</td><td>181</td></tr>
<tr><td>Hgt of Sons</td><td>13</td><td>18</td><td>167</td><td>170</td><td>160</td><td>180</td><td>170</td><td>173</td><td>172</td><td>173</td></tr>
</table></td><td>MS Excel</td><td>Create and perform operations on Excel data set by applying Linear regression</td></tr>
<tr><td>2</td><td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES, perform the following:
i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trend line feature).
iv) Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
v) Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
</table>

<table>
<tr>
<td>3.</td>
<td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.

i) Plot a scatter diagram.
ii) Determine the regression equation (hint: use MS Excel's Add Trend line feature).
iii) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
iv) Compute the coefficient of determination and the coefficient of correlation</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>4.</td>
<td>Apply multiple linear regression to predict the stock index price which is a dependent variable of a fictitious economy based on two independent / input variables interest rate and unemployment rate.

<table>
<tr><th>year</th><th>month</th><th>interest rate</th><th>unemployment rate</th><th>stock index price</th></tr>
<tr><td>2020</td><td>10</td><td>2.75</td><td>5.3</td><td>1464</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>5.</td>
<td>Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10, 00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for a loan availed of Rs.10, 00,000 during 3 years.

<table>
<tr><th>Sl No.</th><th>A</th><th>B</th></tr>
<tr><td>1</td><td>Principal</td><td>Rs.10,00,000</td></tr>
<tr><td>2</td><td>Annual interest rate</td><td>5.20%</td></tr>
<tr><td>3</td><td>Year of the loan</td><td>3</td></tr>
<tr><td>4</td><td>Starting payment number</td><td>1</td></tr>
<tr><td>5</td><td>Ending payment number</td><td>36</td></tr>
<tr><td>6</td><td>Total interest paid during period</td><td>?</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Create Excel data and perform EMI estimator</td>
</tr>
<tr>
<td>6.</td>
<td>Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO, should not be NULL.</td>
<td>SQL</td>
<td>Creating Tables</td>
</tr>
</table>

<table>
<tr><td>7.</td><td>Create the customer database of a big Market with CUSTOMER_ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_CODE. Store at least twenty customer's details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.</td><td>SQL</td><td>Creating and retrieving Tables</td></tr>
<tr><td>8.</td><td>Apply linear regression to find the weather (temperature) of a city with the amount of rain in centimeters. Create your own database with following details.<table><tr><th>CITY</th><th>Temperature in Centigrade</th><th>Rain in Centimeters</th></tr><tr><td></td><td></td><td></td></tr></table></td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>9.</td><td>Use the linear regression technique to compare the age of humans with the amount of sleep in hours.<table><tr><th>Name</th><th>Age in Years</th><th>Sleep in hours</th></tr></table>Create your own database with above details.</td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>10.</td><td>Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/ recorded in the matches. Assume your own database.</td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>11.</td><td>Design the ER diagram and create schema of the REVA library management system.</td><td>Entity Relatio</td><td>Entity Relationship</td></tr>
<tr><td>12.</td><td>Design the ER diagram and create schema for Hospital Management system.</td><td>Entity Relatio</td><td>Schema design</td></tr>
</table>

TEXT BOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.
2. Ramakrishnan and Gehrke, "Database Management systems", McGraw Hill Publications, 3rd Edition 2003.
3. Mastering Data Analysis in Excel - https://www.coursera.org/learn/analytics-excel.
4. Kenneth N. Berk, Carey, "Data Analysis with Microsoft Excel", S. Chand & Company, 2004.

REFERENCE BOOKS

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Edition, 2013.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th Edition, 2013.
3. Seymour Lipschutz, John J. Schiller, "Schaum's Outline of Introduction to Probability and Statistics", McGraw Hill Professional, 1998.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
2. https://www.springer.com/journal/41060
3. International Journal on Data Science and Analytics
4. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253
5. IEEE Magazine on Big data and Analytics

SWAYAM/NPTEL/MOOCs

1. Excel Skills for Business: Essentials, Macquarie University (https://www.coursera.org/learn/excel-essentials)
2. SQL for Data Science, University of California, Davis (https://www.coursera.org/learn/sql-for-data-science)
3. Data Science Math Skills, Duke University (https://www.coursera.org/learn/datasciencemathskills)
4. https://www.edx.org/course/subject/data-science
5. https://onlinecourses.nptel.ac.in/noc19_cs60/preview

SELF-LEARNING EXERCISES

1. Relational database management system.
2. Advanced MS-Excel

Course Title	Introduction to Engineering Mechanics				Course Type		Hard Core	
Course Code	B20ER0101	Credits	3		Class		I semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The primary purpose of the study of Introduction to Engineering Mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering. This capacity requires more than a mere knowledge of the physical and mathematical principles of mechanics; also required is the ability to visualize physical configurations in terms of real materials, actual constraints ,and the practical limitations which govern the behavior of machines and structures. One of the primary objectives in a mechanics course is to help the student develop this ability to visualize, which is so vital to problem formulation.

COURSE OBJECTIVES

This course enables graduating students to identify, analyze, formulate, and solve engineering problems by applying principles of engineering, Mathematics and Physics.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Determine the Resultant force and moment for a given system of forces.	1	1
CO2	Analyses and apply the knowledge of centroid, and moment of inertia for composite plane figures.	1,2	1,2
CO3	Apply knowledge of support reaction to find reaction forces and equilibrium condition for different beams.	1,2	1.2
CO4	Analyze planer and spatial to determine the forces in the member of trusses.	1,2	1.2
CO5	Evaluate the friction forces required to hold a system in static equilibrium	1,2	1,2
CO6	Determine the properties of a system or its loads for which a system will be in a condition of impending motion.	1,2	1.2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO5 CO6	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		✓				
CO2			✓	✓		
CO3			✓			
CO4				✓		
CO5			✓			
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											1		
CO2	3	3											1	3	
CO3	3	3											1	3	
CO4	3	1											1	3	
CO5	3	3											1	3	
CO6	3	1											1	3	
Average	**3.0**	**2.2**											**1.0**	**3.0**	**2.3**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Engineering Mechanics, Idealization of bodies, Basics concepts, fundamental principles, system of units.

Concurrent forces in a plane: Concept of force, vector, Parallelogram law of forces, Moment of force, Moment of couple, simple problems on force and couple, Composition of forces by method of resolution, Numerical Problems

Unit-2

Non-Concurrent forces in a plane: Varignon's principle moments, resultants of non-concurrent force system, Numerical problems, Equilibrium of Concurrent forces in a plane Types of forces acing on the body, free body diagram, Equation of Equilibrium, Lami's theorem, equilibrium of connected bodies, Numerical problems. **Equilibrium of Non Concurrent forces in a plane:** Equilibrium equation and Numerical Problems.

Unit-3

Centroid: Centre of gravity, center of gravity of a body, concept of centroid, centroid of two dimensional body, Determination of centroid or center of Gravity – integration method. Centroid of a composite plane figure.

Moment of Inertia: Moment of inertia of plane figure, polar moment of Inertia, radius of gyration, theorems of moment of Inertia, finding moment of inertia for standard sections.

Unit-4

Supporting Reaction: Types of support, Types of Beams, Types of loading, finding support reactions.

Introduction to Simples trusses: Types of Frames and its applications, Assumptions, Nature of forces in members. Numerical on pin joint stresses only

Friction: Introduction, law of friction, block resting on horizontal and inclined plane, Application of wedge and ladder, Rope and pulley systems.

TEXT BOOK

1. Ferdinand P. Beer, E. Russell Johnston, Jr. David F. Mazurek, Phillip J. Cornwell, with the collaboration of Brian P. Self, "Vector Mechanics for Engineers static and Dynamics", Tata McGraw Hill, 12th Edition.

REFERENCE BOOKS

1. Shames. I. H, and Krishna Mohana Rao.G, "Engineering Mechanics (Statics and Dynamics)", Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2006.
2. Hibbeler. R.C., "Engineering Mechanics: Statics & Dynamics", Pearson Education (US), 14th Edition, 2015.

JOURNALS/MAGAZINES

1. https://ascelibrary.org/journal/jenmdt
2. https://www.scimagojr.com/journalsearch.php?q=22062&tip=sid

SWAYAM/NPTEL/MOOCs

1. https://swayam.gov.in/explorer?searchText=Engineering%20mechanics
2. https://nptel.ac.in/downloads/111104026/
3. https://www.coursera.org/learn/engineering-mechanic

Course Title	Entrepreneurship				Course Type		Hard Core	
Course Code	B20ME0104	Credits	3		Class		I semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	-	-	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This introductory course is designed to introduce you to the foundational concepts of entrepreneurship, including the definition of entrepreneurship, the profile of the entrepreneur, the role of venture creation in society. The course also provides a bird's eye view on the steps to start a venture, financing, marketing as well as support by various institutions towards entrepreneurship.

COURSE OBJECTIVES

1. To understand the basic terms, concepts in Entrepreneurship Development
2. To analyze and apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Define the keywords and concepts used in entrepreneurship development	1	
CO2	Describe the characteristics and types of an entrepreneur	1,6	
CO3	Explain the new generations of an entrepreneurship and skills of an entrepreneur	1,2,6,7,10,12	1,3
CO4	Differentiate between the industrial park and special economic zone	1,2,7	1,3
CO5	Classify the tender process and exemptions from income tax.	1,2,5,8,10-12	1,3
CO6	Choose the suitable government agencies to support his/her idea to become an entrepreneur	1-4,6-12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√					
CO2	√					
CO3		√				
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1														
CO2	1					1							2		2
CO3	1	1				2	1			1		2	2		2
CO4	1	1					2						2		2
CO5	2	2			1			3		3	3	1	2		2
CO6	1	3	3	1		3	3	3	1	3	3	2	2		2
Average	**1.2**	**1.8**	**3.0**	**1.0**	**1.0**	**2.0**	**2.0**	**3.0**	**1.0**	**2.3**	**3.0**	**1.7**	**2.0**		**2.0**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Entrepreneurship: Evolution of term 'Entrepreneurship', Factors influencing entrepreneurship', Psychological factors, Social factors, Economic factors, Environmental factors. Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc., Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving.

Unit-2

Institutional Support for Entrepreneurship: Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) license, Environmental Clearance, National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs

TEXT BOOKS

1. K. Ramachandran, "Entrepreneurship Development", Tata Mc. Graw Hill, 2008
2. Sangeeta Sharma, "Entrepreneurship Development" PHI Publications, 2016

REFERENCE BOOKS

1. Baringer and Ireland, "Entrepreneurship", Pearson, 11th Edition, 2020.
2. P. Narayana Reddy, "Entrepreneurship – Text and Cases, Cengage Learning India", 1st Edition, 2010
3. Corporate Entrepreneurship: Building the Entrepreneurial Organization" by Paul Burns published by Palgrave Macmillan.
4. Drucker F Peter: "Innovation and Entrepreneurship", 1985.Heinemann, London.
5. Doanld F Kuratko & Richard M Hodgeth, "Entrepreneurship in the New Millennium", India Edition - South-Western, Cengage Learning

JOURNALS/MAGAZINES

1. International Small Business Journal: https://journals.sagepub.com/home/isb
2. Journal of Development Entrepreneurship: https://www.worldscientific.com/worldscinet/jde

SWAYAM/NPTEL/MOOCs

1. Entrepreneurship: https://nptel.ac.in/courses/110/106/110106141/

Course Title	**IoT and Applications**				**Course Type**		**Hard Core**	
Course Code	**B20EC0101**	**Credits**	**2**		**Class**		**I Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**2**	**3**	**3**	**13**	**26**	**50 %**	**50 %**

COURSE OVERVIEW:

The Internet of Things (IoT) expands access to the world-wide web from computers, smart phones, and other typical devices to create a vast network of appliances, toys, apparel, and other goods that are capable of connecting to the Internet. This introductory course focuses on IoT architecture, its domains and communication protocols. The course is supported with hands on sessions that incorporates different types sensors interfaced with IoT board to build IoT projects to solve real time problems. The case study of deployment of IoT in various applications are provided.

COURSE OBJECTIVES

The objectives of this course are to:

1. Explain the architecture of Internet of Things.

2. Inculcate knowledge of IoT devices, Sensors and Communication Protocols in various application domains.
3. Gain expertise in interface of various sensors to IoT Boards.
4. Discuss the various applications of IoT.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the architecture of IoT eco-system	1	1,2
CO2	Identify IoT devices, architecture, sensors and Communication protocols	1	1,2
CO3	Demonstrate the interface of sensors to IoT board	1,5, 12	1,2
CO4	Realize various Applications of IoT through case studies	1,5, 12	1,2
CO5	Develop simple IoT projects and modules	1,5,9, 12	1,2
CO6	Identify technologies used to develop IoT based applications	1, 5, 9,10,11,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2		√				
CO3			√			
CO4				√	√	
CO5				√	√	√
CO6				√	√	√

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3												3	3	
CO3	3				3							3	2	2	
CO4	3				3							3	1	1	
CO5	3				3				2			3	3	3	
CO6	3				3				2	2	2	3			
Average	**3.0**				**3.0**				**2.0**	**2.0**	**2.0**	**3.0**	**2.4**	**2.4**	**2.5**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit – 1

IoT Basics: Introduction to IoT, How does Internet of Things Works, Features of IoT, Advantages and Disadvantages of IoT, Embedded Devices in IoT, IoT eco-system

IoT Architecture and IoT Devices: Components of IoT architecture, Stages of IoT solution architecture, Smart Objects, IoT Devices.

Unit – 2

IoT boards in Market: Arduino, Arduino UNO, ESP8266, Raspberry Pi

IoT Platform: Amazon Web Services (AWS) IoT platform, Microsoft Azure IoT platform, Google Cloud Platform IoT, IBM Watson IoT platform, Thing Work IoT platform

Technologies Used in IoT: Bluetooth, Wi-Fi, Li-Fi, RFID, Cellular, Z-Wave

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
		Part-A	
1.	Introduction to IoT Board a. Arduino UNO b. Arduino Nano c. Node MCU d. Ethernet Shield	Hardware	• Identifications of various parts of Arduino and Node MCU boards • Study of Ethernet shield and connection to the board
2.	Working with Arduino IDE (Integrated Development Environment)	Open source Arduino IDE	• Download specified software • Modify code as per the application
3.	a) Demonstration of Multimeter usage b) Demonstration of Breadboard connection for Voltage, Ground, series and parallel connections c) Exercise to read the value of resistor using Colour code chart	Multimeter Breadboard Resistor packs	• Measurement of voltage at various points in IoT boards • Choose the value of Resistor for an application
4.	Reading photo resistor sensor value connected to Arduino Board	Arduino UNO Arduino IDE LDR , Multimeter, Resistor	• Interface of photo sensor to IoT board for light measurement applications
5.	Reading temperature sensor value connected to Arduino Board	Arduino UNO , Arduino IDE, Temperature sensor, Multimeter	• Interface of Temperature sensor to IoT board for temperature measurement application
6.	Reading motion detector sensor value connected to IoT board	Arduino UNO , Arduino IDE, pyro-dielectric sensor, Multimeter	• Interface of Motion detector sensor to IoT board for motion detection.
7	Reading distance measurement using Ultrasonic sensor Connected to IoT board	Arduino UNO, Arduino IDE, Ultrasonic sensor, Multimeter.	• Interface of Motion detector sensor to IoT board for motion detection
8	Interface relay to IoT board	Arduino UNO , Arduino IDE, relay Multimeter	Interface relay to IoT board for Switching applications
9	Connect Wifi-ESP8266 to Arduino UNO board, Send and receive data through smart phone.	Arduino UNO ESP8266, Arduino IDE Smart phone	Connect IoT board to Wifi network
		Part-B (Case Study projects)	
Automated lighting system IoT and Cloud Server Based Wearable Health Sensor's Monitoring System intelligent Traffic system Motor Controlling with Android App A Smart System connecting E-Health Sensor's and the Cloud IoT based Garbage Management System ,	**S**mart Parking Smart healthcare IoT - Industrial Internet of Things Monitoring Of Sensor's Data on Android App Integrated Smart Health Care Monitoring System Smart E-Agriculture	Smart water management IoT for smart cities Remote Patient Monitoring ,E Agriculture Monitoring on Webpage Air Pollution & Water Quality Monitoring System An IoT Based Patient Monitoring System using Raspberry Pi	

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
IoT based submersible motor pumps on/off IoT Based Electronic Door Opener, IoT Based Garbage Monitoring Building Automation System Using GRPS IoT, Implementation of Industrial Data Acquisition, management and Guiding using IoT Distance based Accident Avoidance System using CAN protocol & Tracking through IoT , Swachh Bharat Waste Collection Management System using IOT		Monitoring Using Internet Of Things Smart Home Automation using IOT Monitoring of Highway Hybrid Parameter & Controlling Highway Light Through IoT IoT Based Smart Agriculture Monitoring System IoT Based Agriculture Crop - Field Monitoring System and Irrigation Automation Multiple Garbage Box Monitoring & Collection system IoT Based Garbage Monitoring System	,Underground Cable Fault Detection Over Internet Of Things (Iot) Google Map IoT Air & Water Quality Monitoring System,IoT Based Automatic Vehicle Accident Detection and Rescue System Patient Health Status Observing Based On IoT and Email Alert IoT Based Vehicle Accident Detection and Tracking System on google map webpage Data Logger System for weather monitoring using WSN ,Smart intelligent security system for women
PART C (Mini Project)			
1	Arduino Controlled Light intensity: design and build a simple , effective circuit called Auto Intensity Control of Street Lights using Arduino	ArduinoUNO,DS3231 RTC Module, LDR 16×2 LCD Display ,LED,10KΩ Potentiometer,10KΩ Resistor, Push Button, Connecting Wires, Breadboard	Design and Implementation of IoT project to solve Engineering Problems.
2	Thermometer: build an LCD thermometer with an Arduino UNO and a LM35/36 analog temperature sensor.	Arduino Uno, Temperature Sensor, LCD display, Breadboard and Connecting wires	Design and Implementation of IoT project for Engineering applications.
3	Motion activated light lamp: build an automated project that It switches on and off when there's motion.	Arduino Uno, PIR Motion sensor, breadboard, connecting wires, LED generic.	Design and Implementation of IoT project for Engineering applications
4	Touchless motion sensor trash can: build touchless motion sensor trash can	Arduino UNO, Ultra sonic sensor, Micro servo motor, Breadboard, Connecting wires	Design and Implementation of IoT project for Engineering applications

TEXT BOOK

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On- Approach " Second edition 2014, ISBN: 978

0996025515.

REFERENCE BOOK

1. Raj Kamal," Internet of Things: Architecture & design Principle", McGraw Hill Education, 2017.

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/learn/iot
2. https://www.coursera.org/learn/interface-with-arduino

SELF-LEARNING EXERCISES:

1. Create Arduino project hub

Course Title	Computer Aided Engineering Drawing				Course Type		Hard Core	
Course Code	B20ME0101	Credits	3		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	-	-				
	Total	**3**	**4**	**4**	**26**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Engineering Graphics or drawing is known as language of engineers. All phases of engineering process require the conversion of new ideas and design concepts into the basic line language of graphics. There are many areas such as civil, mechanical, electrical, architectural, computer, electronics and industrial applications where knowledge and skills of the drawing play major roles in the design and development of new products or construction. This course emphasizes on projection of point, line, surfaces and solids. It also provides knowledge about representing the object in terms of 3d view and also development of the object.

COURSE OBJECTIVES

1. To introduce the students to various concepts like dimensioning, conventions and standards of engineering drawings in order to become professionally efficient
2. To enable students to learn about the software tool to prepare engineering drawings
3. To teach the students about the concepts and principles of orthographic projections, development of lateral surfaces and isometric projection of simple solids
4. To communicate the concept/idea with others through the language of technical drawing and sketching.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Draw orthographic projection of point, line manually and also by using CAD software.	1,2,5,10	1
CO2	Draw orthographic projection of plane surfaces manually and also by using CAD software.	1,2,5, 10	1
CO3	Draw orthographic projection of simple solids manually and also by using CAD software.	1,2,5, 10	1
CO4	Draw sectional views of prisms, pyramids, cone and cylinder manually and also by using CAD software.	1,2,5, 10	1
CO5	Draw the development of lateral surfaces of the solids manually and also by using CAD software.	1,2, 3,5,10	1
CO6	Create isometric view of the solids manually and also by using CAD software.	1,2,3,5,10	1

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			2					3			3		
CO2	3	2			2					3			3		
CO3	3	2			2					3			3		
CO4	3	2			2					3			3		
CO5	3	2	2		2					3			3		
CO6	3	1	2		2					3			3		
Average	**3**	**1.6**	**2**		**2**					**3**			**3**		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Introduction – Geometrical constructions, engineering drawing standards, Introduction to CAD Software. Orthographic projection of points in first and third Quadrant only. Orthographic projection of straight lines inclined to both horizontal and vertical planes. Orthographic projection of regular plane surfaces when the surface is inclined to both HP and VP.

Unit-2

Orthographic projection of regular solids like prisms, pyramids cone and cylinder when the axis is inclined to both HP and VP.

Unit-3

Sections of solids – Drawing sectional views and true shape of section, Development of surfaces- Parallel line method for prisms and cylinders, Radial line method for pyramids and cones.

Unit-4

Isometric projections of simple and combined solids.

PRACTICE:

Sl. No	Practice	Tools and Techniques	Expected Skill /Ability
1.	Use of solid edge software and familiarization of tools	Solid Edge Software	Use of commands to draw the drawings
2.	Draw the projection of point locating in first and third quadrant	Solid Edge Software	Analyzing and software skill
3.	Draw the projection of lines locating in first quadrant	Solid Edge Software	Draw the views of the line and software skill
4.	Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	Interpretation and software skill

Sl. No	Practice	Tools and Techniques	Expected Skill /Ability
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
9	Draw the projection of section of solids in simple position	Solid Edge Software	Analyzing and Software Skill
10	Develop the lateral surface of prisms and cylinder	Solid Edge Software	Creative and Software Skill
11	Develop the lateral surface of pyramids and cone	Solid Edge Software	Creative and Software Skill
12	Draw the isometric projection of simple plane surface and simple solids	Solid Edge Software	Analyzing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analyzing and software skill

TEXT BOOKS

1. K S Narayanswamy and Mahesh L, "Engineering Drawing", WILEY Publishers, 2017, ISBN: 978-81-265-7004-1.
2. K. R. Gopala Krishna, "Engineering Graphics", Subhas Publications, 2012.
3. Bhatt N.D., Panchal V.M. & Ingle P.R, "Engineering Drawing", Charotar Publishing House, 2014.

REFERENCE BOOKS

1. Luzadder and Duff, "Fundamental of Engineering Drawing", Printice Hall of India Pvt. Ltd. 11th Edition, 2001.
2. Shah, M.B. and Rana B.C., "Engineering Drawing and Computer Graphics", Pearson Education, 2008.

SWAYAM/NPTEL/MOOCS

1. https://nptel.ac.in/courses/112/103/112103019/
2. https://www.udemy.com/course/ed/

SEMESTER-2

Course Title	Vector Calculus and Partial Differential Equations				Course Type		FC	
Course Code	B20AS0205	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	1	1	1				
	Total	**4**	**4**	**4**	**52**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course is an essential one for civil and mechanical engineering students. This course covers the concept of vector differentiation to understand the flow problems. Further students are able to understand identifying partial differential equations and methods of solving them.

COURSE OBJECTIVES

1 To impart the knowledge of partial differentiation, multiple integrals and beta gamma functions.
2. To impart the knowledge of vector calculus in the field of engineering.
3. To study about vector integration and curvilinear coordinate system.
4. To study various methods to solve partial differential equations.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Study the concept of partial differentiation and its application in engineering.	1,2	1
CO2	Solve double and triple integrals over a region and improper integrals using Beta and Gamma function.	1,2	1
CO3	Analyze vector functions and vector differential operators.	1,2	1
CO4	Evaluate line integrals, surface, and volume integrals and to study curvilinear coordinate systems.	1,2	1
CO5	Evaluate the solution of homogeneous and non- homogeneous partial differential equations.	1,2	1
CO6	Study various methods to solve partial differential equations having one or more independent variables	1,2	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓	✓		✓	
CO2	✓	✓	✓		✓	
CO3	✓	✓	✓		✓	
CO4	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	
CO6	✓	✓	✓		✓	

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											3	
CO2	3	1											3	

CO3	3	1											3	
CO4	3	2											2	
CO5	3	2											2	
CO6	3	2											3	
Average	**3.0**	**1.5**											**2.7**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Partial Derivatives and Multiple Integrals: Functions of several variables – Partial derivatives, Homogeneous Functions – Euler's theorem, Jacobians. Multiple Integrals – Double integrals – Change of order and change of variables. Triple integrals Illustrative examples for change of order and change of variables. Gamma and Beta functions with simple examples. Engineering applications.

Unit –2

Vector Calculus: Differentiation of Vectors, Curves in space, Velocity and Acceleration, Tangential and normal acceleration, Relative velocity and acceleration, Scalar and vector point functions- Vector operator del. Del applied to scalar point functions – Gradient, Del applied to Vector point function – Divergence and Curl. Engineering applications.

Unit -3

Vector integration: Line integral – Circulation – work, Surface integral – Flux, Green's Theorem in the Plane, Stokes Theorem, Volume Integral, Divergence Theorem, Green's Theorem, Irrotational and Solenoidal Fields, Orthogonal Curvilinear Coordinates. Engineering Applications.

Unit -4

Partial Differential Equations: Formation of partial differential equations, solutions of non-homogeneous PDE by direct integration, Solutions of homogeneous PDE involving derivatives with respect to one independent variable, solution of Lagrange's Linear PDE, Solutions of PDE by product method, Engineering Applications.

TEXT BOOKS

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.

REFERENCE BOOKS

1. P.V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning, 7th Edition, 2012.
2. Potter and Goldberg, "Mathematical Methods", Printice Hall of India Pvt. Ltd.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/partial-differential-equations-in-applied-mathematics/
2. https://www.elsevier.com/books/vector-calculus/cox/978-0-08-057295-6

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/learn/calculus-and-optimization-for-machine-learning
2. https://www.coursera.org/learn/vector-calculus-engineers.
3. https://www.coursera.org/learn/differential-equations-engineers

Course Title	**Applied Chemistry**				**Course Type**		**FC**	
Course Code	**B20AS0201**	**Credits**	**3**		**Class**		**II semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Applied chemistry covers very relevant topics compatible with Civil engineering students and make them aware of importance of various aspects of basic science in engineering. The subject of applied chemistry covers area of water technology, corrosion phenomenon, which is widely an interdisciplinary subject of discussion. Further the course

focus on the corrosion phenomenon, and various methods to control it. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge of corrosion in higher semester. The present applied chemistry course further enlightens on the energy conversion and storage devices, which have become very attractive field of research in engineering stream. The subject deals with various engineering materials, their properties and applications in the field of engineering.

COURSE OBJECTIVES

The Applied chemistry course is designed to fulfill the following objective;

1. To impart knowledge about the significance of water chemistry and various methods of water treatment.
2. To provide information on electrochemical concepts of corrosion science and engineering.
3. Highlights on energy storage devices and other renewable energy sources and their applications.
4. Introduction to engineering materials, properties and their applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the properties of water and various methods employed in water treatment.	1	1
CO2	Analyse the metal stability (corrosion resistance) under different environmental conditions.	1,2	1
CO3	Identify and compare the materials best suited materials for construction of Battery, fuel cells and Photovoltaic Cell.	1,2	1
CO4	Demonstrate common use of metals and alloys, ceramics, polymers, their composition, properties and engineering applications.	1,2	1
CO5	Explore the modern materials and their composites for technological applications	1,2	1
CO6	Suggest advanced materials for electrochemical energy storage, conversion, and environmental remedies.	1,2	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓		✓		
CO3		✓				
CO4		✓				
CO5		✓				
CO6		✓				

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3												1	
CO2	2	1											1	
CO3	1	1											1	
CO4	2	1											1	
CO5	2	1											1	
CO6	1	1											1	
Average	**1.8**	**1.0**											**1.0**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Water Technology: Sources of water, Impurities of water, Hardness & its determination (EDTA method), Boiler Troubles & their removal, water softening methods -Lime soda, Zeolite & Ion exchange, Desalination of water — Electro dialysis & Reverse osmosis method, Chemical analysis of water

Unit-2

Corrosion: Definition, Examples, Types, Theory of corrosion, Dry corrosion (Direct chemical Attack), Wet corrosion (electrochemical attack), Mechanism of wet corrosion, Factors affecting corrosion, Corrosion Control methods, protective coatings — Metallic & organic type.

Unit-3

Energy devices: Batteries & types, fuel cell, super capacitors, photo voltaic cell.

Unit-4

Materials: Metals & Alloys: Classification and properties of iron, Steel, Nickel, Chromium, Tungsten & alloys.
Modern Materials: Classification, properties, and compositions: polymers, biomaterials, glass, cement, ceramics, composite materials, Nano materials, thin films, liquid crystals.

TEXT BOOKS

1. R.V.Gadag and Nithyanandashetty, "Engineering Chemistry", Ik International Publishing house.
2. S.S. Dara, "Text Book of Engineering Chemistry", S. Chand & Co.

REFERENCE BOOKS

1. P.W. Atkins, "Physical Chemistry", Oxford Publisher, 5thedition.
2. Callister W.D., "Materials Science and Engineering", John Wiley & Sons.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/water-science-and-technology
2. https://iwaponline.com/wst
3. https://www.scitechnol.com/nanomaterials-molecular-nanotechnology.php
4. https://www.journals.elsevier.com/journal-of-energy-storage

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/105/105/105105201/
2. https://nptel.ac.in/courses/112/108/112108150/

<table>
<tr><td>Course Title</td><td colspan="3">Introduction to Python Programming</td><td colspan="2">Course Type</td><td colspan="2">Hard Core</td></tr>
<tr><td>Course Code</td><td>B20CI0101</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>26</td><td>26</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

Python is a Programming Language that can be treated in a procedural way, an object-orientated way or a functional way. It can be used on a server to create web applications, create workflows, connect to database systems, read and modify files, handle big data and perform complex mathematics. It can implement object oriented features and exception handling, It can parse the strings using regular expressions. It can be used for implementing the machine learning algorithms to develop solutions for interdisciplinary problems apart from any general problems leading to automation.

COURSE OBJECTIVES

The objectives of this course are to:

1. Explain the fundamentals of python programming language constructs and their applications.
2. Inculcate knowledge of parsing of regular expressions and their usage in various application domains.
3. Gain expertise in Object oriented programming and NumPy package.
4. Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Make use of fundamentals of python programming to solve real world problems.	1,2,3 ,9, 10	1
CO2	Develop solutions for text processing and other application domains by making use of regular expressions.	1,2,3, 9, 10	2
CO3	Apply features of object oriented and NumPy package to develop computationally intensive applications to analyze and interpret the data.	1,2,3,4	2-3
CO4	Create data science solutions with the help of files, Pandas and Data Visualization.	1-4,5	1,2, 3
CO5	Develop sustainable solutions/projects for the needs of society, organizations and other sectors.	7,11, 9, 10	1,2,3
CO6	Recognize the need and engage in learning new libraries and tools in python.	12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√	√		
CO4			√	√	√	√
CO5						√
CO6		√				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3						3	3			3		
CO2	3	2	3						3	3		1		3	
CO3	3	1	2	1										3	2
CO4	3	2	3	2	2								3	3	2
CO5							3		3	3	2		3	3	2
CO6												2			2
Average	**3.0**	**1.5**	**2.8**	**1.5**	**2.0**		**3.0**		**3.0**	**3.0**	**2.0**	**1.5**	**3.0**	**3.0**	**2.0**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Introduction to Computer Fundamentals: Computer Components, accessories, specifications of computers and external devices. Flowchart symbols and guidelines, types and advantages, Algorithm design.

Python Fundamentals: Introduction to Python: History, Applications, Your First Python Program, Constants, Variables, Naming conventions, simple data types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions. Introduction to GitHub and applications.

Unit-2

Strings: Unicode, Formatting Strings, Format Specifiers, other Common String Methods, Slicing a String.

Regular Expressions: Case Study: Street Addresses, Case Study: Roman Numerals, Checking for Thousands, Checking for Hundreds, Using the {n, m} Syntax, Checking for Tens and Ones.

Unit-3

Object Oriented Programming: Defining Classes, The init () Method, Instantiating Classes, OOP features: Abstraction. Encapsulation, Single Inheritance, Polymorphism.

Files: Reading from Text Files, Writing to text files, Reading and Writing the Binary Files.

Unit-4

Numpy: Introduction to numpy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output.

Pandas and Data Visualization: Introduction, Series and Data Frames in pandas and Data Visualization.

PRACTICE:

Sl.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on list.
	b). "TUPLE1" and "TUPLE2" are two tuples that contain "N" values of different data types read using the user defined function "READ" with the help of input() function. Elements of "TUPLE1" and "TUPLE2" are to be read one at a time and the "larger" value among them should be placed into "TUPLE3". Display all tuples.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on Tuples.
2.	a).SET1 and SET2 are two sets that contain unique integers. SET3 is to be created by taking the union or intersection of SET1 and SET2 using the user defined function Operation (). Perform either union or intersection by reading choice from user. Do not use built in functions union () and intersection () and also the operators "|" and "&".	Windows/Linux OS, IDE, Jupyter	Create and perform Union and Intersection, Operations on Sets.
	b).The Dictionary "DICT1" contains N Elements and each element in dictionary has the operator as the KEY and operand's as VALUES. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.
3.	a).A substring "Substr" between index1 and index2 is to be extracted from the given input string "Str1", which is read using input (). Display the substring "Substr" using a user defined function if available in string "Str1",	Windows/Linux OS, IDE, Jupyter	String operations.

Sl.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. i) Convert all the strings to uppercase and display ii) Split the words of a string using space as the separation character and display.		
4.	a).Consider the text file, "Std.txt", with the details of students like SRN, NAME, SEMESTER, SECTION AND AVG_MARKS. Read the file, "Std.txt" and display the details of all the students of 4th Semester "A" Section who have scored more than 75%.	Windows/Linux OS, IDE, Jupyter	File Handling.
	b).Consider the text file "Emp.txt", with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: i) TOTAL_DEDUCTIONS= (LIC+PF) ii) GROSS_SALARY= BASIC_SALARY+ DA iii) NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of "Emp.txt" and display the details of each employee.		File Handling.
5.	a). A "CAR" has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for "CAR" to store the above attributes and perform the following operations: i) Get the details of "CAR" object from user and store into Array of objects ii) Display the details of "CAR" object based on "COMPANY", "MODEL" and "PRICE".	Windows/Linux OS, IDE, Jupyter	Classes and objects usage.
	b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for "Airlilne" with the above attributes and perform the following operations: i) Get the details of "Airline" object from user and store into Array of objects ii) List details of all the passengers who travelled From "Bengaluru to London". iii) List details of all the passengers who travelled From "Chicago to Beijing" on 10th of Feb, 2020.		

Sl.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
6.	a). "Arr_1" is an integer array of size M x N. Size and content of the array is to be read using input () by using the user defined function READ_DATA (). It is required to display the i) Diagonal elements of "Arr_1" ii) Elements of m^{th} row (row no should be entered by user)	Windows/Linux OS, IDE, Jupyter	NumPy arrays usability.
	b).The dictionary "DICT1" contains the pass percentage of each semester of B. Tech in CSE, where, " Semester" acts as the key and "Pass Percentage" acts as the value. A Python Pandas data frame is required to be created using the dictionary "DICT1" and display it using a user defined function.		Pandas Series usability.
	Part-B (Mini Project: Library Management System)		
1.	Develop a program to create the class "USER" with the attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add_ user (), delete user (), edit user (), search user () should be part of the class. Instantiate "User" class with 10 objects. Read the attributes of each "User" object using input () and store them in the file "User_File.txt".	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes of user and store them in a file.
2	Develop a program to get the name of the "User" object whose details are to be deleted. Read the "User_File.txt" and delete the "User" object if found. Display the contents of "User_File.txt" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes and delete the object.
3	Develop a program to get the name of the "User" object whose details are to be edited (modified). Edit the details of the user object in the file "User_File.txt" and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
4	Develop a program to create the class "BOOK" with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add book(), delete book(), edit book() and search book(). Instantiate "Book" class with 10 objects. Read the attributes of each "BOOK" object using input () and store them in the file "Book_File.txt".	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes of user and store them in a file.
5	Develop a program to get the name of the "BOOK" object whose details are to be deleted. Read the "Book_File.txt" and delete the "BOOK" object whose details match with the data entered. Display the contents of "Book_File.txt" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes and delete the object.
6	Develop a program to get the name of the "BOOK" object whose details are to be edited (modified). Edit the details of the "Book" object in the file "Book_File.txt" and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.

Sl.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
7	Develop a program to create the class "TRANSACTION" with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue book(), return book() and search book(). Instantiate "Transaction" class with 10 objects. Read the attributes of each "Transaction" object using input () and store them in the file "TransactionFile.txt". Develop a program to issue the book as requested by the user. Update the attributes in	Windows/Linux OS, IDE, Jupyter	Create class and perform string operations.
8	Develop a program to return the book. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in "TransactionFile.txt" and display the contents after modification. Compute the fine amount to be paid if return date is not same as due date. If both return date and due date are same and put zero in fine amount.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operation.
9	Develop a program to search for a book using its "author". Display the message "available" if search is successful otherwise display the message "not available".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
10	Develop a program to get a list of users by referring to "User_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
11	Develop a program to get List of Books in stock by referring to "Book_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
12	Develop a program to get List of Books Issued by referring to "User File", "Book File" and "Transaction File".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and
13	Develop a project by integrating User, Books, Transaction and Reports Modules.	Windows/Linux OS, IDE, Jupyter	Module integration and project development.

TEXT BOOKS

1. Mark Pilgrim, "Dive into Python 3", Apress Special Edition, 2nd Edition, 20l5.
2. Travis E. Oliphant, "Guide to NumPy", Trelgol Publishers, 2006.

REFERENCE BOOKS

1. A B Choudhary, "Flowchart and Algorithms Basics", Mercury Learning and Information, 2020
2. Mark Lutz, "Learning Python", Oreilly, 2003.
3. John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle & Associates. 2004.
4. Michael Dawson, "Python Programming for the Absolute Beginners", CENAGE Learning, 3rd Edition.
5. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2nd Edition.
6. Steve Holden and David Beazley, "Python Web Programming", New Riders Publishers, 2002.
7. Kent D. Lee, "Python Programming Fundamentals", Springer, 2nd Edition.
8. John V. Guttag, "Introduction to Computation and Programming using Python", MIT Press, 2016.

9. https://www.tutorialspoint.com/computer_fundamentals/computer_fundamentals_tutorial.pdf

JOURNALS/MAGAZINES

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/1742-6596/423/1/012027
4. https://ieeexplore.ieee.org/document/4160250

SWAYAM / NPTEL / MOOCs

1. Coursera – Python for everybody, University of Michigan
2. Coursera – Python Basics, University of Michigan
3. https://nptel.ac.in/courses/106/106/106106182/
4. https://www.edx.org/learn/python

<table>
<tr><td>Course Title</td><td colspan="4">Basic Electrical and Electronics Engineering</td><td colspan="2">Course Type</td><td colspan="2">Hard Core</td></tr>
<tr><td>Course Code</td><td>B20EE0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td>Theory Hours</td><td>Practical Hours</td><td>IA</td><td>SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td><td rowspan="2">39</td><td rowspan="2">26</td><td rowspan="2">50 %</td><td rowspan="2">50 %</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>4</td></tr>
</table>

COURSE OVERVIEW

Basic Electrical & Electronics Engineering covers basic concepts of electrical engineering and electromagnetism. This course introduces the student to the working AC and DC Machines. It also helps the student to understand the basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes in rectifiers, filter circuits. Further, it has a self-learning component on BJT's.

COURSE OBJECTIVES

1. Explain the basics of electrical and electronics engineering terminologies.
2. Distinguish the single and three phase systems.
3. Illustrate the different building blocks in digital electronics using logic gates and explain simple logic functions using basic universal gates.
4. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
5. To build a broad concept for hands on experience in various types of electrical apparatus, tools and instrumentation with electrical safety norms.
6. To analyze the schematics for making electrical connection and to interpret experimental data for various electrical appliances.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Summarize the basics of electrical engineering terminology and the usage.	1,2	1
CO2	Analyze the concepts and applications of DC & AC Machines.	1,2	1
CO3	Apply the concept of domestic wiring, importance of safety and sensing devices	1,2,10	1
CO4	Analyze the different building blocks in digital electronics using logic gates and applications of diode in rectifiers, filter circuits and wave shaping. .	1,2	1
CO5	Interpret, Identify and use appropriate electrical tools for electrical connections and to repair electrical equipment's	1,2,9,10	1,2
CO6	Compare experimental results with theoretical analysis and the ability to critically evaluate the performance of electrical appliances.	1,2,9,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2				√		
CO3			√			
CO4				√		
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											1	
CO2	1	1											1	
CO3	2	2								2			1	
CO4	3	1											1	
CO5	2	2							3	1			3	3
CO6	2	2							3	1			3	3
Average	**2.0**	**1.5**							**3.0**	**1.3**			**1.7**	**3.0**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Resistive, Inductive, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations, Network Theorems (Superposition, Thevenin's & Norton's) Generation of an alternating Emf–average and rms values of alternating quantity–representation of alternating quantities by phasors–single phase series and parallel circuits (simple problems), three phase systems and power calculations.

Unit-2

DC-Machines: Construction and Principle of operation of DC Machines–Emf & Speed equations-types–applications. AC-Machines: Principle of operation of single phase transformers–Emf equation–losses– efficiency and regulation-Construction and working principle of induction motors–Slip–torque characteristics–applications-Construction and Principle of operation of alternators applications.

Unit-3

Instruments: Basic Principle of indicating instruments–PMMC&MI instruments. Tariff, Protective Devices and Sensors: Tariff schemes, basic concepts of domestic wiring and types, Earthing, protective fuses, MCB, sensors: pressure sensors, strain gage, proximity sensors, displacement sensors, Rotatory encoder and ultrasonic sensors and civil engineering applications.

Unit-4

Diodes: Introduction, Physical operation of p-n junction diodes, Characteristics of p-n junction diodes, Zener diode, Rectifier circuits (half-wave, full-wave, bridge and peak rectifiers),Light emitting diodes.

Digital Electronic Principles: Introduction, Binary digits, Logic levels and Digital waveforms, Introduction to basic logic operation, Number system, Decimal numbers, Binary numbers, Decimal-to-Binary conversion, Simple binary arithmetic.

PRACTICE:

Sl. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	**Electrical Safety Training.** a) To Study the importance of Earthing during accidental shorting of line wire and the body of b) To conduct experiment and to know the Importance and mechanism of FUSE c) To study the Importance and mechanism of MCB.	Trainer kit Ohms Law Fall of resistance	Importance & applications of Earthing, Fuse & MCB
2.	Home Electrical Wiring Demonstration. a) To study & verify the connection procedure for fluorescent lamp wiring. b) To study the connection of Fan with switch and regulator.	Fluorescent Lamp wiring Panel Fan with switch and regulator Kit	Connection & Trouble shooting of Fluorescent lamp wiring & Fan with switch and regulator
3.	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring	Two-way switch or staircase wiring Kit	Connection, Working & application of Two-way switch
4.	Behaviour of current and voltage in series and parallel circuits. a) To study and verify the behaviour of current and voltage in series circuit. b) To study and verify the behaviour of current and voltage in parallel circuit.	Series and parallel circuits Kit	Connection & behaviour of current & voltage in series , parallel circuit
5.	Polarity test on single phase transformer. a) To determine the additive polarity of a single-phase transformer. b) To determine the subtractive polarity of a single-phase transformer.	Transformer Kit	Polarities of single phase transformer
6.	Determination of VI characteristics of Zener Diode	VI characteristics of Zener Diode kit	VI characteristics of Zener Diode
7.	Determination of VI characteristics of Silicon Diode	VI characteristics of Silicon Diode kit	VI characteristics of Silicon Diode
8.	Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Rectifier kit	Determine the efficiency, Voltage regulation, ripple factor of rectifiers
9.	Determine the Characteristics of BJT in Common Emitter Configuration	Characteristics of BJT in Common Emitter Configuration	Input & Output Characteristics of BJT
10.	Determine the Characteristics of JFET in Common Source Configuration	Characteristics of JFET in Common Source	Input & Output Characteristics of JFET
11.	Realization of Universal gates using basic logic gates.	Trainer kit	Universal gates will be realized using basic gates

TEXT BOOKS

1. Nagrath I.J. and D. P. Kothari, "Basic Electrical Engineering", Tata McGraw Hill, 3rd Edition 2009.

2. Hayt and Kimberly, “Engineering Circuit Analysis”, Tata McGraw Hill, 8th Edition, 2013.
3. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.
5. Hughes, E., “Electrical Technology”, Pearson, 2005.
6. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
7. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.

REFERENCE BOOKS

1. Theodore Wildi, “Electrical Machines, Drives and Power”, Pearson Prentice Hall, 5th Edition, 2007.
2. Hughes, “Electrical Technology”, Addison Wesley Longman Limited, 9th Edition, 2005.

JOURNALS/MAGAZINES

1. International Journal of Electrical Power and Energy Systems (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)
2. Journal of Electrical Engineering (https://link.springer.com/journal/202)

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/108/108/108108076/

Course Title	Elements of Mechanical Engineering				Course Type		Hard Core	
Course Code	B20ER0201	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Elements of Mechanical Engineering is a basic course of Mechanical Engineering discipline. It focuses on overall view of mechanical engineering area’s like thermal, design and manufacturing streams. The course is designed to understand basic concept like formation of steam and compute the steam properties like specific volume, enthalpy, and internal energy using steam tables. The students are introduced to internal combustion engines, turbines (water, steam and gas) and refrigeration-air conditioning system. The students will be imparted to calculate BP, IP, mechanical efficiency of IC engines. The students are exposed to the machine elements like springs, belt drives and gear drives. Acquainted with different machine tools like lathe, drilling machines and CNC machines. The students will be exposed to joining processes like Soldering, Brazing and Welding and various power transmission systems. Students are introduced to the engineering materials and modern manufacturing Technology like 3D printing technology.

COURSE OBJECTIVES

1. To develop the basic knowledge on heat & work, steam formation, working principle of boilers, turbines, IC engines and refrigeration - air conditioning systems
2. To incorporate the concept of different types of machine elements like springs, belt drives & chain drives
3. To give exposure in the field of engineering materials and manufacturing processes
4. To incorporate the concepts of modern manufacturing processes like CNC, 3D printing technology and its applications

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the concepts of heat & work, steam formation, properties, working principle of boilers, turbines, and IC engines.	1,2,3,9,10	1,2
CO2	Explain the working principle of refrigeration and air conditioning systems	1,2	1,2
CO3	Discuss the application of machine elements.	1,2	1,2

CO4	Calculate the speed ratio of belt drives and Gear Drives.	1,2,3 9,10	1,2
CO5	Compare the different kinds of machine tools and select the suitable machine tool for processing the materials and different metal joining process for the different applications	1,2, 3, 9,10	1,2
CO6	Classify the engineering materials and discuss the concept of casting, CNC and 3D printing technology	1,2, 9,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4			√			
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1						3	3			1	2	
CO2	3	2											1	2	
CO3	3	2											1	2	
CO4	3	2	3						3	3			2	1	
CO5	3	2	1		1				3	3			2	1	
CO6	3	2							2	2			3	1	
Average	**3.0**	**2.0**	**1.7**		**1.0**				**2.8**	**2.8**			**1.7**	**1.5**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Introduction to Energy Systems: Concept of heat and work, Steam formation, Types of steam, Steam properties. Introduction to boilers, working of Babcock and Wilcox boiler.

Unit-2

Prime Movers: Types and working principle of turbines and IC Engines.

Introduction to Refrigeration and Air Conditioning: Working principle of refrigeration system, working of domestic refrigerator and window air conditioner

Unit-3

Machine Elements: Types and applications of springs, belt drives, gear drives and chain drives, Numerical on belt drives and gear drives.

Unit-4

Materials and Manufacturing Processes: Introduction to engineering materials and classifications, casting, Machine Tools- lathe & drilling machine, metal joining process-welding, brazing and soldering, modern manufacturing technology-CNC machines and 3D printing.

PRACTICE

Sl. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Dismantling and Assembly of 2-Wheeler (2–stroke) Engine	2-Stroke Engine	Hands on Experience
2.	Identification of parts of an engine of Toyota Innova and Toyota Fortuner	Toyota Engine	Hands on Experience
3.	Calculation of Speed ratio of belt, chain and gear drives		Thinking Skill
4.	Study of Power train of Bicycle, 2-Wheeler and 4-Wheeler	Engines	Hands on Experience
5	Study of Fitting tools and preparation of fitting models(2 Models)	Fitting tools	Hands on experience
6	Study of sheet metal tools and development of pen stand and funnel	Sheet metal tools and soldering tools	Creative Thinking
7	Hands on training on basic welding joints	Welding tools	Hands on experience
8	Preparations of welding models like 3-Legged table, 4-legged table, Name boards, Window frame etc.	Welding tools	Creative Thinking & team work

TEXT BOOKS

1. K.R. Gopal Krishna, “Elements of Mechanical Engineering”, Subhash Publishers, 12th Edition, 2012.
2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, 2000.

REFERENCE BOOKS

1. SKH Chowdhary, AKH Chowdhary and Nirjhar Roy, “The Elements of Workshop Technology - Vol I & II”, Media Promotors and publisher, 11th edition, 2001.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. International Journal of Refrigeration.

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Course Title	Biology for Engineers				Course Type		FC	
Course Code	B20AS0109	Credits	1		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**1**	**1**	**13**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Understanding biological systems, principles and concepts in order to create usable, tangible, economically viable product or process has become need of the hour. Hence irrespective of the parent engineering discipline, knowledge and expertise from pure and applied sciences is necessary to create product or process related to healthcare, agriculture, environmental issues and many more. Any engineer will have a high probability of using biology related skills and concepts to create products and processes beneficial to the mankind and as well for the sustainable environmental friendly approach. For example, the knowledge can be used to create medical devices, diagnostic equipment’s, bioreactor designing, agriculture related equipment/instruments or anything related to surface science, fluid mechanism and polymer science. This course is designed to lay foundation in the field of Cell biology,

Molecular biology and Genetics, so that anyone who is interested can design better product/process to enhance the overall quality of life.

COURSE OBJECTIVES

1. To inculcate the basic concepts of biology from engineering perspective among students
2. To understand the interplay between biology and engineering disciplines
3. To conceptualize the engineering design/process/product for life science challenges

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Understand and explain the concepts regarding origin and evolution of life.	1, 7	
CO2	Demonstrate the structure and functions of various biomolecules in living system.	1	
CO3	Comprehend the organization of cell structure in prokaryotes and eukaryotes.	1	
CO4	Describe the process of cell division involving mitosis and meiosis	1	
CO5	Predict the inheritance pattern of genes from parents to offspring	1	
CO6	Apply the principles of Biology either for the process/product development from the engineering perspective.	1,6, 7	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√	√			
CO3	√	√	√			
CO4	√	√				
CO5	√	√				
CO6	√	√	√			

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						1								
CO2	3														
CO3	3														
CO4	3														
CO5	3														
CO6	3					1	2								
Average	**3**					**1**	**1.5**								

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Biology, Evolution and Origin of Life, Biomolecules-Lipids, Biomolecules: Carbohydrates, Water, Biomolecules: Amino acids, Proteins, Biomolecules: Enzymes, Biomolecules: Nucleotides

Unit-2

Cell structure and function – Prokaryotes, Cell structure and function – Eukaryotes, Cell cycle-Mitosis and Meiosis, Mendelian genetics: Mendelian inheritance, Genetic diseases and Mendelian inheritance, Central Dogma – Replication, Transcription and Translation.

TEXT BOOKS

1. G.K. Suraishkumar, "Biology for Engineers", Oxford University Press, 2019

2. Biology for Engineers, As per AICTE curriculum, Wiley publication,
3. Dr.Sohini Singh and Dr.Tanu Allen, "Biology for Engineers", Vayu Education of India.

REFERENCE BOOKS

1. P.S.Verma and V.K. Agarwal, "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", S. Chand & Company Ltd., 2018
2. Handbook of Genetics, Sambamurthy, Friends Publisher, 2010.

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ge31/preview
2. Coursera: Biology everywhere

Course Title	Design Thinking				Course Type		Hard Core	
Course Code	B20ME0102	Credits	2		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**2**	**3**	**3**	**13**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Today, innovation is everyone's business. At every level, in every kind of organization, design thinking provides the tools that one needs to become an innovative thinker and uncover creative opportunities. For example, companies like Procter, Gamble and GE have incorporated Design Thinking into their strategy and marketing. The course draws on methods from engineering and design, and combines them with ideas from the arts, tools from the social sciences, and insights from the business world.

In this course, students start in the field, where they discover the needs of the target audience. They then iterate ideas on teams to develop a range of promising possible solutions, create rough prototypes to take back out into the field, and learn to test with real people in the target audience.

COURSE OBJECTIVES

1. To impart knowledge on design thinking process for understanding designs.
2. To provide design skills to analyze design thinking issues and apply the tools and techniques of design.
3. To inculcate attitude to solve societal problems using design thinking tools.

COURSE OUTCOMES (CO'S)

On successful completion of this course; the student shall be able to:

CO	Course Outcomes	POs	PSOs
CO1	Identify the problems that fall under the purview of human centered design process for creative problem solving.	1,2, 9,10,12	2
CO2	Develop empathy maps to visualize user needs and to get insights of the problem.	1,2,9,10,12	2
CO3	Define the problem from user's perception.	1,2, 9,10,12	1,2
CO4	Apply Ideation techniques to ideate innovative ideas for the problem	1,2,9,10,12	1,2
CO5	Develop simple prototypes for problems using feasible idea.	1,3, 5,9,10,12	1, 2
CO6	Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.	1,4,8,9,10,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					

CO2			✓			
CO3	✓					
CO4			✓			
CO5						✓
CO6					✓	

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2							2	2		2	3	2	
CO2	1	3							2	3		2		2	
CO3	1	2							3	2		3	1	2	
CO4	1	2							3	2		2	1	2	
CO5	2		3		2				3	3		2	2	3	
CO6	2			2				1	3	2		2	2	3	
Average	**1.7**	**2.3**	**3.0**	**2.0**	**2.0**			**1.0**	**2.7**	**2.3**		**2.2**	**1.8**	**2.3**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Design Thinking Process:

Types of the thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking. Problem Exploration, Case Studies from Embrace-Stanford Innovation Challenge, IDEO, GE Healthcare, The Good Kitchen- Denmark Program etc., identifying the target users for the problem selected, Survey on existing solutions for the problem identified.

Empathizing: Powerful Visualizing tool – a method to connect to the user, Creating Empathy maps – Case studies.

Unit-2

Defining the problems:

POV statements from User perspective. Idea generation: Methods to spark the innovative ideas – Brainstorming, Mind map, Story board, Provocation etc.

What is a prototype? - Prototyping as a mind-set, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping- Minimum Viable prototype

Prototyping for digital products: What's unique for digital, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users.

PRACTICE:

Sl. No	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Identifying the problem that can be solved using Design Thinking approach	Observation and survey	Develop identifying human centered problems
2	Build the empathy maps for simple problems like single user	Visualization	Develop ability to understand other's emotions
3	Build the detailed empathy maps for problem identified in the teams formed	Visualization	Develop ability to understand other's emotions
4	Presentation by student teams	PPT	Develop ability to express their views
5	Obtain the insights into user's problems and make PoV statement	Understanding	Develop making problem statements from user perception
6	Presentation by student teams	PPT	Develop ability to express their views

Sl. No	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
7	Carry out Brain storming between the groups and generate as many as ideas possible	Ideation tools	Develop innovative mind set
8	Prototype for best 3 ideas selected	Sketching, simple model making etc.	Develop prototyping techniques
9	Presentation by student teams	PPT	Develop ability to express their plan
10	Test the developed prototype with set of identified users	Google forms , cold calls, social media etc.	Develop understanding of various testing methods
11	Pitching final solution	PPT	Develop ability to express their views

TEXT BOOKS

1. Gavin Ambrose and Paul Harris, "Basics Design-Design Thinking", AVA Publishers, 2010
2. Kathryn McElroy, "Prototyping for Designers: Developing the best Digital and Physical Products", O'Reilly, 2017.

REFERENCE BOOKS

1. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking – New Product Essentials from PDMA", Wiley, 2015.
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", John Wiley & Sons, 2012.

JOURNALS/MAGAZINES/ADDITIONAL SOURCES

1. Leonard, D., and Rayport, J. F. 1997. Spark Innovation through Empathic Design. In Harvard Business Review, November-December 1997, 102-113.
2. https://www.ideo.com
3. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
4. https://www.ibm.com/design/thinking/page/toolkit
5. https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we
6. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking
7. https://youtu.be/M66ZU2PCIcM
8. https://thisisdesignthinking.net/2017/07/innogy_energy_ecarsharing/

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/109/104/109104109/
2. https://nptel.ac.in/courses/11010612

3rd Semester

Course Title	Laplace Transforms and Fourier Series				Course Type		FC	
Course Code	B20AS0304	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number ofClasses Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0			IA	SEE
	Tutorial	0	0	0	Theory	Practical		
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

In this course students will study the Laplace Transforms, inverse Laplace Transforms, Fourier series, Fourier transforms and Numerical Methods. The purpose of this course is to provide students with skills and knowledge required to perform mathematical procedures and processes for solution of engineering problems. This course is widely used in all streams of Engineering particularly in the field of Mechanical Engineering.

COURSE OBJECTIVES

1. To impart the Knowledge of Laplace transforms and its applications in the field of engineering.
2. To impart the Knowledge of Inverse Laplace transforms and its applications in the field of engineering.
3. To study and understand the application approach of the concepts of Fourier series and transforms.
4. To study and understand the application approach of the concepts of Numerical methods.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of Laplace transformation technique to convert physical function form from the time domain to the frequency domain.	1,2,3	1
CO2	Study the periodic function, unit step function and unit impulse function by using Laplace transform.	1,2	1
CO3	Compute Inverse Laplace transform and apply them to ODEs arising in engineering	1,2	1
C04	Find the Fourier series and half range series expansion of different functions in different intervals	1,2	1
CO5	Find the Fourier & inverse Fourier transforms of different functions and apply this knowledge in solving different Mechanical engineering problems.	1,2	1
C06	Apply the numerical methods to solve various engineering problems.	1,2	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√	√		√	
CO2	√	√	√		√	
CO3	√	√	√		√	
CO4	√	√	√		√	
CO5	√	√	√		√	
CO6	√	√	√		√	

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1										2		

CO2	3	2											2		
CO3	3	2											3		
CO4	3	2											2		
CO5	3	2											2		
CO6	3	3											3		
Average	**3.0**	**2.3**	**1.0**										**2.3**		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY

Unit-1

Laplace Transforms: Definition, transforms of elementary functions, Properties-transform of e^{at} f(t) , t^n f(t) and f(t)/t. Laplace transform of derivatives, integrals, periodic functions, unit step function and unit impulse function.

Unit-2

Inverse Laplace Transforms: Inverse Laplace Transforms, Inverse Laplace transform of standard functions, convolution theorem (without proof), Solution of linear differential equations using Laplace Transforms.
Applications: Applications of Laplace transforms to Mechanical engineering problems.

Unit- 3

Fourier Series: Periodic functions, Dirichlet's condition, Fourier series of periodic functions with period 2π and with arbitrary period $2l$. Fourier series of even and odd functions. Half range Fourier series, practical harmonic analysis-Illustrative examples from engineering field.
Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Applications to Mechanical engineering problems.

Unit - 4

Numerical Methods: Numerical solution of algebraic and transcendental equations by Regula- Falsi Method and Newton-Raphson method.
Finite Differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation formula and inverse interpolation formula (all formulae without proof)-Problems.

TEXT BOOKS
1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 48th edition.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1stedition.

REFERENCE BOOKS
1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 13th edition.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition.

Course Title	**Engineering Thermodynamics**				**Course Type**		**Hard Core**	
Course Code	**B20ER0301**	**Credits**	**4**		**Class**		**III Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	1	1	1				
	Total	**4**	**4**	**4**	**52**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The primary purpose of the course Engineering Thermodynamics is to provide the students with knowledge about fundamentals of thermodynamics which includes thermodynamic systems and processes. Thermodynamic laws with application and expose to various thermodynamic cycles. Understand the properties of the gases and pure

substances to analyze the processes. Further the course exposé the students to working of the devices like compressors and refrigeration systems.

COURSE OBJECTIVES

1. To enable the students to understand the basic concepts of thermodynamics.
2. To acquire the knowledge about first and second law of thermodynamics to analyse the practical applications.
3. To gain the concepts about ideal gases, real gases and pre substances to solve numerical on practical applications.
4. To identify and analyse performance of thermal devices like compressors, steam turbines, refrigerators and air conditioners.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply fundamental concepts of thermodynamics to identify systems to solve numerical on temperature measurements.	1,2	1,2
CO2	Analyze the systems using first and second law of thermodynamics and to solve numerical on practical applications.	1,2	1,2
CO3	Solve the numerical on thermodynamic processes by applying the concept of ideal gases, real gases and pure substances.	1,2,6	1.2,3
CO4	Analyze the thermodynamic cycles involved in systems.	1,2	1,2,3
CO5	Solve numerical on single stage reciprocating air Compressor.	1,2	1,2,3
CO6	Apply the concept of refrigeration and psychometric process to solve numerical	1,2,6	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2			√	√		
CO3			√	√		
CO4			√	√		
CO5		√	√			
CO6		√	√			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3	3	
CO2	3	3											3	3	
CO3	3	3				1							3	3	1
CO4	3	3											3	3	1
CO5	3	3											3	3	1
CO6	3	3				1							3	3	1
Average	**3**	**3**				**1**							**3**	**3**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Thermodynamic systems and processes: Types, state, system, process and cycle. Thermal equilibrium, Zeroth law of thermodynamics and thermodynamic temperature scales. Work and heat: Thermodynamic definition, displacement work for various thermodynamic processes.

First Law of Thermodynamics: first law for a closed system undergoing cyclic and non-cyclic process, first law applied for open system- steady flow engineering devices

Unit-2

Second Law of Thermodynamics: Direct and reversed heat engine, Thermal efficiency, COP, Kelvin-Planck and Clausius statements, Equivalence of Kelvin-Planck and Clausius statements, entropy-definition and TdS relations.

Ideal Gases and Pure Substances: Ideal gases: Definition, gas constant, perfect and semi perfect gases, Evaluation of heat, work, and change in internal energy, enthalpy and entropy for various quasi-static processes.

Pure substance: Properties of pure substance, phase transformation, saturated and superheated steam, dryness fraction, properties of dry, wet and superheated steam, Mollier diagram

Unit-3

Gas Power Cycles: Air-standard Otto, Diesel, dual and Brayton cycles,

Reciprocating compressor: Single stage and multi stage compression, volumetric efficiency, saving in work, optimum intermediate pressure, inter-cooling: perfect and imperfect, minimum work for compression.

Unit-4

Vapour Power Cycle: Thermodynamic analysis of simple Rankine cycle, methods to improve cycle performance, Regeneration (open feed water) and reheating.

Refrigeration Cycle: Vapour compression refrigeration system; description, analysis, refrigerating effect. Capacity, power required, units of refrigeration, COP, Refrigerants and their desirable properties, Vapour absorption refrigeration system. Properties of moist air, psychrometric chart, basic psychrometric processes

CASE STUDIES

1. Applications related to temperature measurements, first and second law of thermodynamics
2. Performance evaluation of reciprocating air compressor by using MAT Lab software.
3. Performance evaluation of vapor compression refrigeration system by using MAT lab software.

TEXT BOOKS

1. P. K. Nag, "Basic and Applied Thermodynamics", Tata McGraw Hill, 6th Edition, 2018.
2. R. K. Rajput, "Thermal Engineering", Lakshmi Publications, New Delhi, India, 18th Edition, 2011.

REFERENCE BOOKS

1. Yunus A. Cengel, "Thermodynamics: An Engineering Approach", McGraw - Hill Education, 9th Edition, 2019.
2. S Domkundwar, C P Kothandaraman, Domkundwar, "A course in Thermal Engineering", Dhanpat Rai Publication, New Delhi India, 6th Edition, 2009,
3. Gordon J. Van Wylan & Richard E Sonntagg, "Fundamentals of Thermodynamics", Wiley Eastern Ltd, 7th Edition, 2009.

JOURNALS/MAGAZINES:

1. https://www.sciencedirect.com/journal/the-journal-of-chemical- thermodynamics

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://www.coursera.org/courses?query=thermodynamics

Course Title	Material Science				Course Type		Hard Core	
Course Code	B20ER0302	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The subject explores the structure of materials and how the structure of materials can be classified as per the materials. Material science is an interdisciplinary subject expended from side to side of physics and chemistry of matter, engineering applications and industrial manufacturing processes. The purpose of study of material science is to understand the relationship between structure and properties of a material. This course focuses of fundamentals of material, properties and applications. Topics include: crystal structures, solidification of metals and alloys, defects in materials, phase diagrams, heat treatment, corrosion, types of engineering materials and characterization techniques.

COURSE OBJECTIVES

1. To provide the basic knowledge and to enhance the knowledge of the structure of materials this includes crystallography, microstructure, defects, and diffusion.
2. To develop the knowledge about the phase diagrams, solidification, heat treatment process, stress strain diagram, mechanical properties, fracture, fatigue and creep.
3. To enhance the knowledge of iron carbon phase diagram, CCT, TTT diagrams, Hardenability, heat treatment and corrosion.
4. To incorporate the knowledge in various class of engineering materials, applications and characterization techniques.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Identify the structure of materials which includes crystallography, microstructure, defects, and diffusion.	1,2	1,2,3
CO2	Identify various phases of metals and alloys through appropriate phase diagrams and will be able to evaluate the effect of alloying elements, properties and application of ferrous and non-ferrous metals.	1,2	1,2,3
CO3	Select suitable heat treatment process based on material properties and will be to provide suitable methods to avoid corrosion	1,2	1,2,3
CO4	Suggest suitable engineering materials for different application and will be able to Correlate the structure-property relationship in metals/alloys in as-received and heat treated conditions	1,2	1,2,3
CO5	Describe the applications of super alloys, composites and nanomaterials	1	1,2,3
CO6	Choose the suitable characterization techniques for analysis of surface topography and to find out the Properties of metals and alloys	1,2,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓				
CO2	✓	✓	✓			
CO3	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		
CO5	✓	✓	✓			
CO6	✓	✓	✓	✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											3	1	3
CO2	3	1											3	1	3
CO3	3	1											3	1	3
CO4	2	1											3	1	3

CO5	3	2											3	1	3
CO6	3	2			1								3	1	3
Average	**2.8**	**1.3**			**1**								**3**	**1**	**3**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Structure of crystalline solids: Basic idea of lattice, crystalline and non-crystalline materials, unit cell, crystal structure of simple cubic, BCC, FCC and HCP, coordination number, packing of atoms. Simple numerical

Defects and diffusion in solids: Point, linear, planar and volume defects, edge and screw dislocations, Burger vector, grain boundaries, twin and stacking faults. Diffusion mechanism, Fick's first law and simple numerical.

Unit-2

Phase diagrams: Isomorphous and eutectic binary phase diagrams, Gibbs phase rule concept of tie line and lever rule, equilibrium and non-equilibrium cooling, microstructure development in eutectic phase diagram. Simple numerical on phase diagrams and lever rule, Solidification of metals and alloys, nucleation and growth phenomena, heterogeneous and homogeneous nucleation,

Mechanical Properties of Materials: concept of stress and strain diagram for ductile and brittle materials, Hooks law, elastic and plastic deformation, tensile properties, fatigue, fracture and creep.

Unit-3

Iron-carbon system, Fe-Fe3C diagram, invariant reactions, different phases. Effect of alloying elements. Isothermal and continuous cooling transformation (CCT) diagrams, TTT diagrams, Hardenability; Jominy-end quench test.

Fundamentals of heat treatments of Steels. Annealing, Homogenisation. Spheroidising, Normalising, Quenching media, Austempering, Martempering, Hardening and Tempering. Age hardening of Al-Cu alloy. Corrosion: introduction, Types of corrosion; dry and wet corrosion, electro chemical and oxidation (chemical) corrosion, factors influencing corrosion.

Unit-4

Engineering materials: Introduction to polymers- properties & applications of thermoplastic engineering polymers. Ceramics- classification of ceramics, applications of ceramics. Types of glasses and their chemical compositions, Physical properties of glasses.

Composite Materials: classification of composite materials based on matrix and reinforcement, matrix and fiber materials. Different types of super alloys: properties and applications of super alloys. Nanomaterials: introduction, bottom up and top down approaches.

Introduction to optical microscopic technique and working principle, Scanning and Transmission Electron **Microscopy:** Introduction to EM, construction and working principle, the necessity of characterization using SEM and TEM techniques, Diffraction: Fundamentals of Diffraction, Bragg's law, X-ray diffraction pattern of crystalline and amorphous material.

CASE STUDIES

1. Do the literature survey on recent development in composite materials and prepare a report.
2. Prepare the detail report the stating the importance of material selection in any product development process.

TEXT BOOKS

1. William D. Callister, "Materials Science and Engineering", (Adopted by R. Balasubramaniam), Wiley-Eastern. 2008.
2. Raghavan V, "Materials Science and Engineering - A First Course", Prentice Hall, India, 2007.

REFERENCE BOOKS

1. James F. Shackelford, "Introduction to Materials Science for Engineers", Prentice Hall, India, 1996.
2. Askeland D.R. and P. P. Fullay, "The Science and Engineering of Materials", Cengage Learning Publishers, 4th Edition, 2007.
3. T.V. Rajan, C.P. Sharma and Ashok Sharma, "Heat Treatment – Principles & Techniques", Prentice Hall of India, New Delhi.
4. Charles S. Barrett &T.B. Massalski, "Structure of Metals – Crystallographic Methods, Principles & Data", Eurasia Publishing House (Pvt.) Ltd., New Delhi.
5. B.D. Cullit, "Elements of X-ray Diffraction", Addison – Wesley Publishing CompanyInc., USA.

6. Robert E, "Physical Metallurgy Principles", Attiliated East-West Press Private. Ltd., New Delhi.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology
2. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/113/102/113102080/
2. https://nptel.ac.in/courses/122/102/122102008/

Course Title	Manufacturing Science				Course Type		Hard Core	
Course Code	B20ER0303	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Manufacturing Science is a basic course of Mechanical Engineering discipline. It focuses on overall view of mechanical engineering areas of manufacturing streams. The course is designed to understand basic concept like molding, casting, welding, metal forming, sheet metal and non-conventional machining manufacturing process. The students are exposed to the molding and joining process like Soldering, Brazing and Welding and various joining process. Students are introduced to the non-conventional machining methods working principles and applications.

COURSE OBJECTIVES

1. To enable the students understand the basic concepts of moulding and the sequence of processes involved in the preparation of green sand mould and sand test.
2. To teach students how to select the metal forming processes.
3. To teach students how to perform simple welding operations using Arc.
4. To understand the use of non-conventional machining processes.
5. To help students acquire knowledge about the behaviour and manufacturing properties of all engineering materials and basic concept of foundry and casting processes.
6. To demonstrate and give hands on training on the moulding and welding process.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the concepts of molding and working principle involved in casting process.	1	1,2
CO2	Explain the metal forming process types and applications and Solve the numerical on forging and extrusion.	1	1,2
CO3	Compare the different metal joining process for the different applications	1,2	1,2
CO4	Discuss the working concept of Non-conventional machining and their applications	1,5	1,2
CO5	Demonstrate an understanding of various methods of casting process involved in manufacturing.	1,2,3	1,2
CO6	Demonstrate to ability to solve engineering problems in welding process and manufacturing techniques for economic production.	1,2,3	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			

CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												1	2	
CO2	2												1	3	
CO3	2	1											3	1	
CO4	2				1								2	1	
CO5	3	1	1										1	2	
CO6	3	1	1										1	2	
Average	**3.0**	**1.0**	**1.0**		**1.0**								**1.5**	**1.8**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Metal Casting Processes: Casting Terminology, Pattern ,Types of Patterns, Pattern allowances, Moulds, Moulding Tools, Machines and Materials, Core, Core Making ,Sand Moulding methods , Melting furnaces fluxing, Inoculation, Die-casting processes, Cleaning, Inspection and repairing of castings.

Sand casting, Shell mould casting, Investment casting, Plaster mould casting, Ceramic mould casting, Die casting, Centrifugal casting, Melting practice and furnaces, Defects in casting, Testing and inspection of casting.

Unit-2

Metal Forming Processes: Hot working & Cold working of metals, Forging Machines, Forging operations, Rolling, Types of Rolling mills, Rolling operations, Extrusion, Extrusion processes, Rod, wire and tube drawing, Bending, Principle and types of Deep drawing, Principle and Types of Sheet metal forming operations such as squeezing, spinning, peen ,stretch forming and super plastic forming.

Unit-3

Fabrication Processes: Classification of welding, Electric Arc Welding Equipment, Consumables, processes, Gas Welding, Equipment, Processes, Resistance welding, Types of Resistance welding, Soldering and Brazing, Adhesive bonding, Welding Inspection, Defects, Causes & Remedies.

Unit-4

Nonconventional Methods of Manufacturing: Introduction, Need, classification, Electro-Discharge Machining , Electro-Chemical Machining, Laser Beam Machining, Abrasive Jet Machining, Water jet Cutting, Ultrasonic Machining, High Velocity Forming of Metals, Explosive Fabrication, Hydro forming, Electro-hydraulic Forming, Magnetic pulse Forming, Electron Beam Machining.

CASE STUDIES

1. Prepare brief report on significance of die casting in aerospace application.
2. Study the characteristics of casting process and machining process, also list the characteristics of cast components and machined components.
3. Case Study on Aluminum Die Casting.
4. Prepare a report showing the application and suitability of Gas welding and Electric arc welding.

TEXT BOOKS

1. S.Gowri, P.Hariharan, A.Suresh Babu “Manufacturing Technology-I”, Pearson Education, 2008
2. P.C.SHARMA, “A Text book of Production Technology”, S.Chand and Co., Ltd., 1999.
3. S. Kalpakjian, “Manufacturing Processes for Engineering Materials”, Fifth edition. Pearson Education, 2009.
4. Ghosh and Mallick A. K., “Manufacturing Science”. Affiliated East-West Press Pvt. Ltd., 2010.

REFERENCE BOOKS

1. R.K.Rajput, “Manufacturing Technology”, Laxmi Publications Ltd., New Delhi, 2007.
2. D.K.Singh, “Fundamentals of Manufacturing Engineering”, Ane Books India, New Delhi, 2008

3. R.S.Parmar, “Welding Processes and Technology”, Khanna Publishers, New Delhi, 2003.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. International Journal of Scientific & Engineering Research

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Course Title	Mechanics of Materials				Course Type		Hard Core	
Course Code	B20ER0304	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course of Mechanics of Solids deals with behavior of bodies subjected to various types of loadings. This course explores the topic of solid objects subjected to stress and strain. The methods taught in the course are used to predict the response of engineering structures to various types of loading, and to analyze the vulnerability of these structures to various failure modes. This course introduces students to the fundamental principles and methods of structural mechanics. Topics covered include: static equilibrium, force resultants, support conditions, analysis of determinate planar structures , stresses and strains in structural elements, states of stress (shear, bending, torsion), statically indeterminate systems, displacements and deformations, elastic stability, and approximate methods. Design exercises are used to encourage creativity in students.

COURSE OBJECTIVES

1. To develop the basic knowledge on different stress & strain in materials under various loading conditions
2. To incorporate the concept of Transformation of Stress and Strain and to understand the concepts of torsion and its application to design of shafts
3. To incorporate the concept of Shear Force, Bending Moment Diagram, Bending stress and deflection of beams
4. To understand the concepts of column loading and its effect due to buckling, stress & strain in cylinders and Static failure criteria

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Explain concept of stress & strain in materials under various loading conditions.	1,2	1,2
CO2	Compute various types of stresses and strains, elastic constants for given load conditions.	1,2	1,2
CO3	Plot Shear Force, Bending Moment Diagrams for various types of beams under different loading and boundary conditions and Mohr’s Circle for given type of loading.	1,2	1,2
CO4	Derive general torsion and bending equations and compute torque, bending moment, shear stress, bending stress, deflection of beams for different loads and boundary conditions.	1,2	1,2
CO5	Explain the behavior of columns under different loads and end conditions and compute crippling load.	1,2	1,2
CO6	Apply Lame’s Theorem to predict the failure of cylinders.	1,2	1,2

BLOOM’S LEVEL OF THE COURSE OUTCOMES

CO	Bloom’s Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create

	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											3	3	
CO2	3	2											3	3	
CO3	3	1											3	3	
CO4	3	3											3	3	
CO5	3	3											3	3	
CO6	3	3											3	3	
Average	**3.0**	**2.2**											**3.0**	**3.0**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Simple Stress and Strain: Types of Loading, Axial, Shear, Concept of stress, Strain, Stress-strain diagram, Hooke's law, Young's modulus, Application to the Analysis and Design of Simple Structures, deformation in statically determinate problems, Elastic Constants, complementary shear stress, lateral strain and Poisson's ratio, Thermal Stresses.

Unit-2

Transformation of Stress and Strain: Transformation of plane stress, Principal Stresses, Maximum Shearing Stress, Mohr's Circle for Plane Stress.

Torsion: Torsion in Solid & Hollow Circular Shafts, Torque and Power Transmitted by Solid and Hollow Shafts, Strength of Shafts.

Unit-3

Analysis of Beams: Shear force and bending moment diagrams of cantilevers, simply supported beams under concentrated, uniformly loaded, varying loads and externally applied moments with and without overhangs. Stresses in beams: beam of uniform strength, bending equation, Beam Deflection: slope and deflection at a section for cantilevers under concentrated and uniformly distributed loads using MaCaulay's method.

Unit-4

Columns: Classification of columns, end connections, Euler's formulae and Rankine Gordon equations.

Cylinders: Thin and thick cylinders, Lame's Theorem, compound cylinders, Static and Dynamic failure criteria.

CASE STUDIES

1. Develop a Python Programming for obtaining shear force and bending moment diagram of beams subjected to concentrated loads, uniform loads, varying loads and externally applied moments.
2. Prepare comparison report on suitability of following materials with respect to their properties and application: Mild Steel, Cast Iron and Aluminum.

TEXT BOOKS

1. F.P.Beer & Russell Johnstan, John T Dewolf, David F Mazurek "Mechanics of Materials", in S.I. Units, TATA Mc Graw Hill, New York, 6th Edition, 2012.
2. S. H. Crandall et al., "An Introduction to Mechanics of Solids (In SI Units)", McGraw-Hill. Third Edition, 2017.
3. Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980.

REFERENCE BOOKS

1. R.C.Hibbeler,"Mechanics of Materials", Printice Hall. Pearson Edu., 2005

2. S.S.Bhavikatti, "Strength of Materials", Vikas publications House -1 Pvt. Ltd., 2nd Edition, 2006.
3. Timoshenko.S.P "Strength of Materials", Part1, D.Van Nostrand Company, Inc. Newyork
4. R K Bansal, “Engineering Mechanics and Strength of Materials”, Laxmi Publications-New Delhi, 2004.

JOURNALS/MAGAZINES

1. International Journal of Mechanics of solids
2. International Journal of Strength of Materials

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/basic-concepts-of-mechanics-of-materials-for-machine-design/
2. https://nptel.ac.in/courses/105/106/105106172/
3. https://www.coursera.org/learn/mechanics-1

Course Title	Manufacturing Technology Lab				Course Type		Hard Core	
Course Code	B20ER0305	Credits	1		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

This course deals with study of desirable properties of moulding sand and involves moulding, melting, and casting of parts; that is, producing castings by filling the prepared moulds with molten metal alloys (aluminium). Also enable the students to prepare forged model and welded model. The practical work enables the students to gain expertise and confidence in manufacturing activities.

COURSE OBJECTIVES

1. The course will introduce desirable properties of molding sand and establish its relevance in preparing the sand mold.
2. To introduce the experimental procedure in determining the GFN, Permeability, Strength of mold, moisture & clay content in sand sample, core hardness & mold hardness.
3. To bring in the effect of clay and water content on the various properties of molding sand.
4. To give students hands on practice in preparing the sand moulds (Cope & Drag box) using single piece, split pattern and without using pattern.
5. To give students hands on practice in preparing forging models and welding models.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe general properties of molding sand.	1, 10	1
CO2	Determine the compression, shear, tensile strength & permeability of molding sand for different proportion of clay.	1,2,9,10	1,2,3
CO3	Identify the different tools used in Foundry and Forging practice with their uses	1, 10	1
CO4	Create the sand mold cavity using cope and drag box with pattern or without pattern	1,2,3,9,10	1,2,3
CO5	Demonstrate the process of preparing the forged model and welding model.	1,2,9,10	1,2,3
CO6	Conduct experiments, Prepare a model, interpret and analyze the result and document the results in the form of technical report.	1,2,4,9,10	1,2,3

BLOOM’S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					
CO2			✓			
CO3		✓				
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2									1			1		
CO2	3	2							3	1			2	1	1
CO3	3									1			2		
CO4	3	2	1						3	1			2	1	1
CO5	3	2							3	1			2	1	1
CO6	3	2		1					3	3			2	2	1
Average	**2.8**	**2**	**1**	**1**					**3**	**1.3**			**1.8**	**1.3**	**1**

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Preparation of sand specimens and conduction of the following tests
   a. Compression and Shear test using Universal Sand Testing Machine.
   b. Permeability test.
2. Sieve analysis to find grain fineness number of base sand.
3. Determination of clay content in base sand.
4. Determination of moisture content test in base sand.

Part-B

1. Preparation of green sand mould with and without using wooden pattern also measure the mould hardness.
2. Demonstration of pouring the nonferrous metal by using crucible tilting furnace
3. Preparation of forged model involving upsetting, drawing and bending operations.
4. Arc welding – straight line beads and butt joint
5. Hands on training on basic welding joints-L joint & T- joint

TEXT BOOKS

1. S.Gowri, P.Hariharan, A.Suresh Babu "Manufacturing Technology-I", Pearson Education, 2008
2. P.C.SHARMA, "A Text book of Production Technology", S.Chand and Co., Ltd., 1999.
3. S. Kalpakjian, "Manufacturing Processes for Engineering Materials", Fifth edition. Pearson Education, 2009.
4. Ghosh and Mallick A. K., "Manufacturing Science". Affiliated East-West Press Pvt. Ltd., 2010.

REFERENCE BOOKS

1. R.K.Rajput, "Manufacturing Technology", Laxmi Publications Ltd., New Delhi, 2007.
2. D.K.Sngh, "Fundamentals of Manufacturing Engineering", Ane Books India, New Delhi, 2008.
3. R.S.Parmar, "Welding Processes and Technology", Khanna Publishers, New Delhi, 2003.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture

2. International Journal of Scientific & Engineering Research

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Course Title	Material Testing Lab				Course Type		Hard Core	
Course Code	B20ER306	Credits	1		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**-**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

This course deals with objective is to give a broad understanding of common materials related to mechanical engineering with an emphasis on the fundamentals of structure-property-application relationships. Which provides ideas on the practical knowledge of test several properties of material like ductility, surface roughness, malleability, and hardenability etc.The practical work enables the students to gain expertise and confidence in manufacturing activities.

COURSE OBJECTIVES

1. To understand the characteristics and behavior of engineering materials used for structures and machines.
2. To select materials based on their properties and their proper use for a particular facility under prevailing loads and environmental conditions.
3. To Predict component behavior using experimental test results and engineering formulae.
4. Students will have exposure to practical applications including writing of a technical report related to each experiment.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Evaluate microstructure of different materials using the metallurgical microscope.	1,2, 9, 10	1,2
CO2	Determine the impact strength of a material using Izod and Charpy tests.	1,2, 9, 10	1,2
CO3	Identify defects using non-destructive testing methods.	1,2, 9, 10	1,2
CO4	Determine the elastic properties of materials using UTM and torsion testing machine.	1,2, 9, 10	1,2,3
CO5	Evaluate surface properties of materials using wear test and determine the hardness of material using different hardness test method.	1,2, 9, 10	1,2,3
CO6	Experimentally determine various mechanical properties of materials and document the results in the form of technical report.	1,2,9,10	1,2

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					
CO2			✓			

CO3		✓				
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3							1	1			1	2	
CO2	3	2							1	1			2	1	
CO3	2	3							1	1			2	1	
CO4	3	2							1	1			2	1	1
CO5	3	2							2	1			2	1	1
CO6	3	2							2	2			2	2	
Average	**2.6**	**2.3**							**1.3**	**1.1**			**1.8**	**1.3**	**1**

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. Determining the impact strength of a given material using Charpy & Izod tests.
3. Estimating the Hardness of different Engineering materials using Brinell, Rockwell and Vickers's Hardness test.
4. Non-destructive test experiments like ultrasonic flaw detection, magnetic crack detection, dye penetration testing, to study the defects of cast and welded specimens.

Part-B

1. Determine the density of given composite materials.
2. To conduct Tensile, shear and compression tests of metallic and non-metallic specimens using Universal Testing Machine.
3. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.
4. To carry out torsion test on metallic specimen.
5. Bending Test on nonmetallic specimens.

TEXT BOOKS

1. F.P.Beer & Russell Johnstan, John T Dewolf, David F Mazurek "Mechanics of Materials", in S.I. Units, TATA Mc Graw Hill, New York, 6th Edition, 2012.
2. S. H. Crandall et al., "An Introduction to Mechanics of Solids (In SI Units)", McGraw-Hill, Third Edition, 2017.
3. Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980.

REFERENCE BOOKS

1. R.C.Hibbeler,"Mechanics of Materials", Printice Hall. Pearson Edu., 2005
2. S.S.Bhavikatti, "Strength of Materials", Vikas publications House -1 Pvt. Ltd., 2nd Edition, 2006.
3. Timoshenko.S.P "Strength of Materials", Part1, D.Van Nostrand Company, Inc. Newyork
4. R K Bansal, "Engineering Mechanics and Strength of Materials", Laxmi Publications-New Delhi, 2004.

JOURNALS/MAGAZINES

1. Journal of Materials Science.
2. Journal of Materials Engineering and Performance

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Course Title	Communication Skills				Course Type		FC	
Course Code	B20AH0301	Credits	2		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**2**	**2**	**2**	**26**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course is aimed to develop basic communication skills in English in the learners, to prioritize listening and reading skills among learners, to simplify writing skills needed for academic as well as workplace context, to examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom.

COURSE OBJECTIVES

The objectives of this course are to:

1. Develop basic communication skills in English.
2. Emphasize on the development of speaking skills amongst learners of Engineering and Technology
3. Impart the knowledge about use of electronic media such as internet and supplement the learning materials used in the classroom.
4. Inculcate the habit of reading and writing leading to effective and efficient communication.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies (SpeakingSkills).	9, 10	
CO2	Build inferences from the text.	10	
CO3	Make use of accurate writing skills using different components of academic writing.	9, 10	
CO4	Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic	9, 10	
CO5	Make use of reading different genres of texts adopting various reading strategies (Reading Skills).	10	
CO6	Apply appropriate vocabulary and grammar in written and spoken context.	9, 10	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4						√
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									2	3					
CO2										3					
CO3									1	3					
CO4									2	3					
CO5										2					
CO6									2	2					
Average									**1.7**	**2.6**					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit – 1

Functional English: Grammar: Prepositions; Modal Auxiliaries, Reading Comprehension, Active and passive voice, Giving Instructions.

Unit – 2

Interpersonal Skills: Grammar: Tenses; Wh-questions, Compound words; Phrasal verbs, Recommendations

Unit – 3

Multitasking Skills Grammar: Conditional Sentences, Homonyms; homophones, Subject-verb agreement.

Unit – 4

Communication Skills Grammar: Direct and indirect speech, Interpreting visual materials (line graphs, pie charts etc.), Single word substitutes.

TEXT BOOKS

1. Green, David, "Contemporary English Grammar Structures and Composition", New Delhi: MacMillan Publishers, 20l0.
2. Thorpe, Edgar and Showick Thorpe, "Basic Vocabulary", Pearson Education India, 20l2.
3. Leech, Geoffrey and Jan Svartvik, "A Communicative Grammar of English", Longman, 2003.

REFERENCE BOOKS

1. Murphy, Raymond, "Murphy's English Grammar with CD", Cambridge University Press, 2004.
2. Rizvi, M. Ashraf, "Effective Technical Communication", Tata McGraw-Hill, New Delhi, 2005.
3. Riordan, Daniel, "Technical Communication", Cengage Publications, New Delhi, 2011.
4. Sen, "Communication and Language Skills", Cambridge University Press, 2015.

Course Title	**Indian Constitution and Professional Ethics**				**Course Type**		**FC**	
Course Code	**B20LS0301**	**Credits**	**2**		**Class**		**III Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**2**	**2**	**2**	**26**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The Constitution of India lays down in defining fundamental political principles, establishes the structure, procedures, powers and duties of government institutions and sets out fundamental rights, directive principles and duties of citizen. It helps to know and understand the human rights and human values. It also helps to know the meaning of ethics and need of ethics in personal and professional life.

COURSE OBJECTIVES

The objectives of this course are to:

1. Explain basic knowledge required to understand Constitution of India.
2. Describe the Fundamental Rights, Duties and other Rights.
3. Discuss different types of ethics.
4. Explore ethical standards followed by different companies.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution.	6,7,8,9, 12	
CO2	Demonstrate the practicality of Constitution perspective and make them to face the world as a bonafide citizen.	8 ,12	
CO3	Illustrate the professional ethics and human values.	6,8,12	
CO4	Summarize ethical standards followed by different companies.	7,8,12	
CO5	Demonstrate the Knowledge of Ethics to protect environment as an Engineer	6, 7, 8, 12	
C06	Apply the principles of Ethics as an employee employer in the professional life	6, 8, 9, 12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				√		
CO2		√				
CO3			√			
CO4			√			
CO5		√				
C06		√				

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2	2	3	2			1			
CO2								3				1			
CO3						2		3				1			
CO4							2	3				1			
CO5						2	2	3				1			
C06						2		3	1			1			
Average						**2**	**2**	**3**	**1.5**			**1**			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit – 1

Indian constitution: Sailent features, fundamental rights and duties (Directive principle and state policy), Legislature (Loka Sabha & Rajya Sabha), Executive (President& Governor) and Judiciary (Supreme court & high court), Composition and function of parliament, Council of ministers, prime minister, Speaker, Passing of bills.

Unit – 2

Human Rights: Nature and Scope of human rights, Universal protection of human rights (UDHR),Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups (children, women & old-age).

Human Values: Truth, Honesty, Loyalty, Love, Peace with examples, Difference between ethics, beliefs and morals.

Unit – 3

Ethics: Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, human values(Good conduct, respect for elders), ethical human conduct (Gender equality), Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

Unit – 4

Engineering Ethics: Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence

TEXT BOOKS

1. Kapoor, S.K., "Human rights under International Law and Indian Law", Prentice Hall of India, New Delhi, 2002.
2. Basu, D.D., "Indian Constitution", Oxford University Press, New Delhi, 2002.
3. Chakraborty, S.K., "Values and ethics for Organizations and Theory Practice", Oxford University Press, New Delhi, 2001.

REFERENCES BOOKS

1. Meron Theodor, "Human Rights and International Law Legal Policy Issues", Vol. 1 and 2, Oxford University, Press, New Delhi, 2000.
2. M V Pylee, "An Introduction to Constitution of India", S Chand & Company, 5th Edition
3. Durga Das Basu, "Introduction to constitution of India", LexisNexis, 23rd Edition.

Self-Learning Exercises: Abuse of Technologies: Hacking and other crimes, addiction to mobile phone usage, video games and social networking websites

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡಿಗರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಪರಿವಿಡಿ

- ಬಿ ಎಂ ಎಸ್ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಕನ್ನಡಿಗರಿಗೆ '**ಕನ್ನಡ ಕಲಿ**' ಪಠ್ಯ ಪುಸ್ತಕ
- ಕರ್ನಾಟಕ ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ವಿಭಾಗ ಕನ್ನಡಿಗರಿಗೆ **ಸಾಹಿತ್ಯ ಸಿಂಚನ**' ಪಠ್ಯ ಪುಸ್ತಕ
- ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ ಕನ್ನಡಿಗರಿಗೆ '**ಬಳಕೆ ಕನ್ನಡ**' ಪಠ್ಯ ಪುಸ್ತಕ

ಹಲವಾರು ಪಠ್ಯಮಸ್ತಕಗಳು ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದಲ್ಲಿ ಕನ್ನಡ ಬೋಧನೆಗೆ ಬಳಕೆಯಲ್ಲಿದ್ದು ಜೊತೆಗೆ ಬಿಎಡ್ ಕನ್ನಡ ಕಲಿಕೆಯ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ರೇವಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ತಾಂತ್ರಿಕ ವಿಭಾಗದ ಕನ್ನಡಿಗರು ಮತ್ತು ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಇಷ್ಟವಾಗುವ ಮತ್ತು ಪ್ರಯೋಜನಕಾರಿಯಾಗುವ ಪಠ್ಯ ಪುಸ್ತಕವನ್ನು ತರಗತಿಗಳು ಪ್ರಾರಂಭವಾಗುವುದರ ಒಳಗೆ ಸಿದ್ಧಪಡಿಸಲಾಗುವುದು.

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡೇತರರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಭಾಷಾ ಕೌಶಲ್ಯಗಳು

ಘಟಕ – 1

1. ಆಲಿಸುವುದು

- ಆಲಿಸುವ ಕೌಶಲ್ಯ
- ಆಲಿಸುವಿಕೆಯಲ್ಲಿನ ದೋಷಗಳು
- ಉತ್ತಮ ಆಲಿಸುವಿಕೆ

ಘಟಕ – 2

2. ಮಾತನಾಡುವುದು

- ಸಂಭಾಷಣೆ
- ವ್ಯವಹಾರಿಕ ಸಂಭಾಷಣೆ
- ದೋಷಗಳು ಮತ್ತು ಪರಿಹಾರಗಳು

ಘಟಕ – 3

3. ಓದುವುದು

- ಓದು ಕಲಿಸುವಾಗ ಗಮನಿಸಬೇಕಾದ ಅಂಶಗಳು
- ಧ್ವನ್ಯಾಂಗಗಳ ಪರಿಚಯ
- ಓದಿನ ವಿಧಗಳು

ಘಟಕ – 4

4. ಬರೆಯುವುದು

- ವರ್ಣಮಾಲೆಯ ಸ್ವರೂಪ
- ಕಾಗುಣಿತ ಸ್ವರೂಪ
- ಕನ್ನಡ ಸಂಖ್ಯೆಗಳು

- ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ ಕನ್ನಡೇತರರಿಗೆ **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಬಿ ಎಂ ಎಸ್ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಕನ್ನಡೇತರರಿಗೆ **'ಕನ್ನಡ ಮನಸ್ಸು'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಕರ್ನಾಟಕ ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ವಿಭಾಗ ಇವರು **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ ತಂದಿದ್ದಾರೆ.

ಹಲವಾರು ಪಠ್ಯಪುಸ್ತಕಗಳು ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದಲ್ಲಿ ಕನ್ನಡ ಬೋಧನೆಗೆ ಬಳಕೆಯಲ್ಲಿದ್ದು ಜೊತೆಗೆ ಬಿಎಡ್ ಕನ್ನಡ ಕಲಿಕೆಯ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ರೇವಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ತಾಂತ್ರಿಕ ವಿಭಾಗದ ಕನ್ನಡಿಗರು ಮತ್ತು ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಇಷ್ಟವಾಗುವ ಮತ್ತು ಪ್ರಯೋಜನಕಾರಿಯಾಗುವ ಪಠ್ಯ ಪುಸ್ತಕವನ್ನು ತರಗತಿಗಳು ಪ್ರಾರಂಭವಾಗುವುದರ ಒಳಗೆ ಸಿದ್ಧಪಡಿಸಲಾಗುವುದು.

4th Semester

Course Title	Probability and Sampling Theory				Course Type		FC	
Course Code	B20AS0403	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**-**	**50 %**	**50 %**

COURSE OVERVIEW

Axiomatic probability theory, independence, conditional probability. Discrete and continuous random variables, special distributions of importance to Mechanical Engineering. Expectation simulation of random variables and Curve fitting, basic statistical inference, parameter estimation, hypothesis testing, and linear regression and correlation. Introduction to stochastic processes and Sampling theory.

COURSE OBJECTIVES

Student will be able to learn,

1. The concept of curve fitting and few statistical methods.
2. Fundamentals of probability- Random variables.
3. Joint probability and regarding stochastic process.
4. Concept of test of hypothesis and able to apply in the various fields of Mechanical engineering.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Approximate a linear and non-linear equation to the given data by the method of least squares.	1,2	1
CO2	Apply the concept of correlation and regression lines for distinct civil engineering problems.	1,2	1
CO3	Define concepts of probability space, random variable, discrete & continuous distribution and use to solve various Mechanical engineering problems	1,2,3	1
C04	Calculate Joint probabilities and derive the marginal and conditional distributions of bivariate random variables.	1,2	1
CO5	Define and use stochastic processes and Markov chains in discrete and continuous time.	1,2	1
C06	Apply sampling theory concepts to solve various Mechanical engineering problems.	1,2,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1	√	√	√		√	
CO2	√	√	√		√	
CO3	√	√	√		√	
CO4	√	√	√		√	
CO5	√	√	√		√	
CO6	√	√	√		√	

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2		
CO2	3	2											2		
CO3	3	2	1										3		
CO4	3	2											2		

CO5	3	2											3		
CO6	3	2											2		
Average	**3.0**	**2.0**	**1.0**										**2.3**		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit -1

Curve Fitting: Curve fitting by the method of least squares and fitting of the curves of the form, $y = ax + b$, $y = ax^2 + bx + c$, $y = ae^{bx}$ and $y = ax^b$

Statistical Methods: Measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression (without proof) –problems.

Unit - 2

Probability Theory: Recap of Probability theory (definition, addition theorem, multiplication theorem and conditional probability and Baye's theorem).

Probability Distributions: Random variables (discrete and continuous), probability mass/density functions, mean, variance and moments. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems.

Unit - 3

Joint Probability Distribution: Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.

Stochastic Process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems.

Unit - 4

Sampling Theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

TEXT BOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 48th edition.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1st edition.

REFERENCE BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 13th edition.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition.

Course Title	**Mechanical Measurements and Metrology**				**Course Type**		**Hard Core**	
Course Code	**B20ER0401**	**Credits**	**3**		**Class**		**IV Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**4**	**4**	**26**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Metrology is the science of pure measurement. It is concerned with the establishment, reproduction, conservation and transfer of units of measurements and their standards. It's also concerned with the methods, execution and estimation of accuracy of measurements, the measuring instruments and the inspectors. Basic applications include measurement of length, diameter, taper, flatness, and squareness. Etc. Further the course intends to introduce the technological and engineering concepts and study the applications of measuring quantities like force, torque, pressure, temperature, strain.

COURSE OBJECTIVES

1. Understand metrology, its advancements & measuring instruments, acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements.
2. To introduce the fundamental concepts & derive the relations for the design of gauges, types of gauges, concepts involving comparators, angular measurements.

3. To gain knowledge about various aspects of pressure, speed and surface roughness measurement.
4. To explore the various aspects regarding the force, torque, strain & temperature measurement.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Outline the objectives of metrology, methods of measurement, standards of measurement and describe slip gauges, manufacturing of slip gauges & building of slip gauge blocks for calibration.	1, 9, 10	1
CO2	Describe the need of limit system and working of different types of comparators.	1	1
CO3	Enumerate the pressure, speed and surface roughness measurement	1	1
CO4	Elaborate the concept of measuring force, torque, temperature and strain measurement.	1	1
CO5	Measure the depth and thickness of the given gear tooth using gear tooth Vernier caliper	1,2, 9, 10	2
CO6	Demonstrate the measurement of cutting forces, thread components, angular components	1, 2, 9, 10	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3		√				
CO4			√			
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3								3	3			3	2	
CO2	3												3	2	
CO3	3												3	2	
CO4	2												3	2	
C05	1	1							3	3			2	3	
C06	1	1							3	3			2	3	
Average	2.2	1							3	3			2.7	2.3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Basic of Metrology, Linear and Angular Measurement: Objectives of metrology, role of standards, standards of length- International prototype meter, Imperial standard yard, wave length standard, subdivision of standards, line & end standard, calibration of end bars-numerical, Slip gauges, Wringing phenomenon, Numerical on building of slip gauges, Vernier bevel protractor, Angle gauges, Sine principle, Sine bar & Sine Centre.

Unit-2

Limit Gauges and Comparators: Need of limit system, Tolerance, Specification of tolerance in assembly, Accumulation tolerance & compound tolerance, principle of interchangeability & selective assembly, concept of limit of size & tolerance, Concept of fits, types of fits, shaft basis & hole basis system, geometric tolerance, tolerance grade, design of GO and NO GO gauges using Taylor's principle. Numerical on Limits, Fits and Tolerances.

Comparators-types and characteristics Johanson Mikrokator, Sigma comparator, Principle of optical comparator, Zeiss ultra-optimeter, Solex pneumatic comparator, LVDT

Unit-3

Measurement of Pressure, Speed and Surface Roughness: Pressure Measurements: principle, use of elastic members in pressure measurement, Bridgeman gauge, McLeod gauge, Pirani gauge. Speed Measurement: Mechanical counters, contact and non-contact type measurement. Surface Roughness: Introduction, modes of defining surface texture, surface roughness evaluation CLA, RMS, Rmax and Rz, surface texture symbols and specifications, profilometer and Tomlinson surface meter.

Unit-4

Measurement of Force, Torque, Temperature and Strain Force Measurement: Analytical balance, unequal arm balance, proving ring. **Torque Measurement:** Prony brake and hydraulic dynamometer, **Temperature Measurement:** Resistance thermometer, thermocouple, law of thermocouple, materials used for construction, optical pyrometer and radiation pyrometer. **Strain Measurement**: Mechanical and optical strain gauge, electrical strain gauge: Bonded and unbounded resistance strain gauges, strain gauge backing and bonding materials, preparation & mounting of strain gauges.

PRACTICE

Sl. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Calibration of Micrometer using slip gauges	Micrometer, slip gauges	Hands on experience
2.	Calibration of LVDT	LVDT, Micrometer	Hands on experience
3	Measurement of taper angle using Sine bar, sine centre and Roller set method.	Sine bar, sine centre and Tapered specimen, slip gauges, rollers	Hands on experience
4	Measurement of effective diameter of the given screw thread by two wire / three wire method	Screw thread, wire, Bench micrometer	Hands on experience
5	Measurement of flatness by using Autocollimator	Autocollimator, Reflector, surface plate.	Hands on experience
6	Measurement of gear tooth thickness using gear tooth vernier	Gear tooth vernier caliper, spur gear	Hands on experience
7	Measurement of cutting forces using lathe tool dynamometer	Lathe machine with dynamometer	Hands on experience
8	Measurement of cutting forces using drill tool dynamometer	Drilling machine with dynamometer	Hands on experience

TEXT BOOKS

1. R.K. Jain, Engineering Metrology, Khanna Publishers, 1994.
2. I.C.Gupta, Engineering Metrology Dhanpath Rai Publications.

REFERENCE BOOKS

1. Beckwith Marangoni and Lienhard, Mechanical Measurements, Pearson Education, 6th Ed., 2006.
2. Anand K. Bewoor & Vinay A. Kulkarni Metrology & Measurement, Tata McGraw.
3. N.V Raghavendra & L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/measurement
2. https://iopscience.iop.org/journal/0957-0233

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/106/112106179/
2. https://nptel.ac.in/courses/112/106/112106139/

Course Title	Machining Process				Course Type		Hard Core	
Course Code	B20ER0402	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course would encompass a comprehensive study of metal cutting and machine tools. The students will go through the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill bits, Computer Numerical Control etc. Tool geometry, chip formation, cutting force calculations and measurement, tool wear and other aspects will be given due attention.

COURSE OBJECTIVES

1. To familiarize the student with tool nomenclature and cutting forces
2. To incorporate the concepts of various machining operations to prepare a model using lathe as per dimensions
3. To give exposure of various machines used for manufacturing of metal components.
4. To incorporate the suitable super finishing process to produce the intricate components and CNC technology
5. To help students acquire knowledge about theory of metal cutting, mechanism of machining and analyze process parameters influence.
6. To explain and demonstrate the different instruments for linear and angular measurements.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Analyze forces acting on the cutting tool in orthogonal and oblique cutting and various process parameters to improve the cutting tool life	1,2	1,2,3
CO2	Describe various machining process used for machining of components.	1	1,2,3
CO3	Explain various machines used for manufacturing of metal components	1	1,2,3
CO4	Identify the cutting tools required for different machining processes.	1,2	1,2
CO5	Demonstrate the cutting forces induced during the metal cutting operations and understand the influence of process parameters.	1,2	1,2
CO6	Compare the working of conventional and CNC machine.	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4		√				
CO5				√		
CO6			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	3	1
CO2	2												2	2	1
CO3	2												3	2	1

CO4	3	2											3	1	
CO5	3	2											3	2	1
CO6	3	2											3	2	1
Average	**2.7**	**2.0**											**2.8**	**2.0**	**1.0**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Theory of Metal Cutting: Introduction -Geometry of a single point cutting tool - Chip formation and types of chips– Orthogonal and oblique cutting – Merchant circle diagram for cutting forces - Shear angle in terms of chip thickness ratio and rake angle, friction –Numerical on shear angle - Machining variables – Factors affecting cutting tool life – Types of tool wear – Taylor's tool life equation – Numerical on Taylor's tool life equation, Cutting tool materials of common use and their characteristics – Functions of cutting fluids – Types of cutting fluids – Heat generation in metal cutting and factors affecting heat generation.

Unit-2

Lathe: Working principle and specifications of lathe, center lathe and its components, lathe operations, Constructional features of turret and capstan lathe.

Drilling Machine-Principle of working, Classification, construction and working of Bench and Radial drilling machines, drilling operations, drill bit nomenclature, simple numerical on machining time.

Shaping Machine: Introduction, types, construction and operations of horizontal shaper.

Unit-3

Milling: Principle of working, Classification of Milling machines, construction and working of Horizontal and vertical milling machines. Milling operations, methods of indexing, simple and compound indexing, numerical on simple indexing.

Grinding: Working principle, constructional features of Cylindrical, Center less and Surface grinding machines, Types of abrasives, bonding process, marking of grinding wheels. Dressing and truing of grinding wheels.

Unit-4

Lapping: Principle of Lapping, Lapping methods, Advantages and limitations of lapping.

Honing: Principle of honing, Types of honing machines, Advantages, limitations and applications of honing.

Broaching: Principle of working – Details of a commonly used broach, construction and working of a horizontal broaching machine, Advantages, limitations and applications.

CNC Machines: Overview, types, construction, tool and work holding devices, feedback devices, part programming, examples.

CASE STUDIES

1. Do a literature on metal cutting tool life and prepare a report on methods/precautions to be followed to enhance the tool life.
2. Prepare document stating the materials used for manufacturing the metal cutting tools and desirable properties of cutting tool materials.
3. Why industries are moving from conventional machines to CNC machines-A detailed report.

TEXT BOOKS

1. R.K Jain, "Production Technology", Khanna Publications, 2003.
2. P N Rao, "Manufacturing Technology", McGraw-Hill Education, (Volume II), 2018
3. Kalpakjian, Serope, "Manufacturing Engineering and Technology", Addison –Wesley publishing co., New York

REFERENCE BOOKS

1. Hajra Choudhury, "Workshop Technology Vol-II", Media Promoters & Publishers Pvt. Ltd. 2004
2. Amitabh Ghosh and Mallik, "Manufacturing Science", affiliated East West Press, 2003
3. G.C Sen & Bhattacharya, "Principle of Machine Tools", Tata McGraw hill, New Delhi.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. Journal of Manufacturing Processes

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://onlinecourses.nptel.ac.in/noc21_me04/preview

Course Title	Kinematics and Dynamics of Machines				Course Type		Hard Core	
Course Code	B20ER0403	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSEOVERVIEW

Kinematics and dynamics of Machines is a subject which deals with the basic components of machines and mechanisms .It also deals with the study of the velocity and acceleration of mechanisms, gears and arrangement of gear trains, types of cam and follower. It also gives an insight about the balancing of rotating and reciprocating parts used in IC engines, CNC Machineries etc. It also helps to predict the unbalanced and balanced forces and keep the system in dynamic equilibrium between the moving parts. It also provides the gyroscopic principles on plane disc, aeroplane, ship, 2 and 4 wheelers. It also aims at the study of controlling forces on governors.

COURSE OBJECTIVES

1. To gain the knowledge on mobility of mechanisms, velocity and acceleration of mechanisms.
2. Computation of degree of freedom for different mechanisms and machines.
3. To analyze velocity, acceleration, different tooth forms, mesh and their arrangements.
4. To introduce the concept of gyroscopic effect in aero plane, ship, two wheeler, and four wheeler vehicle.
5. To explain the working principal, mechanism and application of governors.
6. To develop the analytical approach and graphical methods in balancing the unbalanced forces and couples in engine.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Differentiate the different mechanisms and determine, velocity, acceleration and their instantaneous center	1,2	1,2
CO2	Computation of DOF for different mechanisms and structures	1,2	1,2
CO3	Compare the various types of gears and gear train and evaluating their performance	1,2	1,2
CO4	Draw the various cam profile based on the follower motions and followers and their terminologies	1,2	1,2
CO5	Analyze the balancing forces and couples polygon of engines, and derive the balancing condition for rotating and reciprocating masses.	1,2	1,2
CO6	Evaluate the performance of governor and Analyze the gyroscopic effect and stability of aeroplane, two wheeler and four wheelers.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			

CO3		√				
CO4		√		√		
CO5		√		√		
CO6		√		√		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											1	2	
CO2	3	2											1	3	
CO3	3	2											3	1	
CO4	3	2											2	1	
CO5	3	2											1	2	
CO6	3	2											1	2	
Average	**3**	**2**											**1.5**	**1.8**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Links-types, Kinematics pairs-classification, Kinematic Chain ,Constrained Motions-types, Degrees of freedom of planar mechanism, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain.

Velocity and Acceleration of Mechanism: Velocity of point in mechanism, Relative and Instantaneous Velocities in four bar and slider crank mechanism, Instantaneous center method, Types & location of instantaneous centers for different mechanisms, Kennedy's theorem. Introduction to Acceleration of a point on a link

Unit -2

Gears and Gear Trains: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Analysis of spur gears, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, Gear Trains: Simple, compound, reverted and Epicyclic gear train. **(No derivation and Problems in gears and gear trains)**

Cams and Followers - Classification & Terminology, Cam profile by graphical methods with knife edge and roller follower for uniform velocity, uniform acceleration and retardation, simple harmonic Simple numerical (no offset follower)

Unit 3

Balancing of Rotating Masses: Static and dynamic balancing. Balancing of several rotating masses by balancing masses in same plane and in different planes.

Balancing of Reciprocating Masses: Balancing of primary force in reciprocating engine, partial balancing of multi cylinder locomotives inline engine and V- engine. Numerical.

Unit 4

Governors: Introduction, principles, Types of governors, Terminology, force analysis of Porter, sensitivity, stability, Hunting, Isochronism, effort and power of governor, controlling force diagram. Numerical. Introduction to speed synchronizer.

Gyroscope: Principles, Gyroscopic Torque, effect of gyroscopic couple on the stability of disc, aero plane, two wheeler and four wheeler.

TEXT BOOKS

1. R S Khurmi, "Theory of Machines", S Chand Publishing House.
2. S S Rattan, "Theory of Machines", Tata Mc Graw Hill Education Private Limited New Delhi.

REFERENCE BOOKS:

1. VP Singh, "Theory of Machines", Dhanpat Rai Publishing, 2004

2. Joseph E Shigley, “Theory of Machines and Mechanisms”, Oxford Higher Education International Version.
3. R K Bansal, “Theory of Machines, Lakshmi Publications Ltd, New Delhi.

JOURNALS/MAGAZINES

1. Mechanism and Machine Theory | journal | sciencedirect.com by elsevier
2. Applied Theories on Machines | List of High Impact Articles | PPts | Journals | Videos (longdom.org)

SWAYAM/NPTEL/MOOCs:

1. NPTEL: Mechanical Engineering - Theory of Mechanisms
2. http://ecoursesonline.iasri.res.in/course/view.php?id=522
3. Adams Tutorial Kit for Mechanical Engineering Courses (mscsoftware.com)

Course Title	**Computer Aided Machine Drawing**				**Course Type**		**Hard Core**	
Course Code	**B20ER0404**	**Credits**	**3**		**Class**		**IV Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	2	4	4	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**5**	**5**	**12**	**48**	**50 %**	**50 %**

COURSE OVERVIEW

The students of mechanical engineering program are mainly involved in drafting, manufacturing, inspection and planning activities (such as preparing process plans, preparing bill of materials, etc.) in industries. For all such activities, reference document is the drawing of component/assembly to be manufactured. In this context, it is of utmost important to prepare, read and interpret component drawings correctly for production of components and assemblies accurately and precisely. The industrial practices of drafting are also important for the students to make them aware of drafting practices, symbols, codes, norms and standards generally used in industries. Development of sketching ability also strengthens effective engineering communication & presentation. Now a days the market driven economy demands frequent changes in product design to suit the customer needs. With the introduction of computers the task of incorporating frequent changes as per requirement is becoming simpler. This course has been introduced at B.Tech level in order to develop the skills in student so that they can generate various production drawings as required in industry using various CAD software.

COURSE OBJECTIVES

1. To understand drawing and develop the capacity to represent any matter/object and to impart knowledge of machine component and its conversion into 2D drawing.
2. To develop the ability to apply Limits, Fits, and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
3. To create awareness about the Riveted joints and coupling/joints with their empirical relations.
4. To develop an ability to Create Solid Models of machine components.
5. Able to apply these skills to the solution of a variety of practical problems and be able to employ their knowledge to solve more complicated problems.
6. To develop an ability to Create assembly models of simple machine Parts. The student should be prepared to continue the study of computer aided machine drawing through further subjects/projects in further years of engineering.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Visualize and formulate detail drawing of a given object.	1,2,5,10	1,2,1
CO2	Design and sketch the orthographic view of square headed and hexagonal headed bolt and nut assembly as per BIS.	1,2,10	1,2,1
CO3	Design and sketch single and double riveted butt joints as per stated conditions.	1,2,3,10	1,2,1
CO4	Design and sketch details and assembly of cotter joint and knuckle joint		1,2,1

		1,2,3,10	
CO5	Design and sketch details and assembly of split muff coupling, protected type flanged coupling	1,2,3, 10	1,2,1
CO6	Create 2-D, 3-D models and assemble the parts of mechanical systems by using standard CAD software with manufacturing considerations.	1,2,3,5,10	1,2,1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2					2		1	3	1	1
CO2	3	2	2							2			3	1	1
CO3	3	2	2							2			3	1	1
CO4	3	1	2							2			2	1	1
CO5	3	2	2							3			3	1	1
CO6	3	2	3		3					3		1	3	1	1
Average	**3.0**	**1.8**	**2.2**		**2.5**					**2.3**		**1.0**	**2.8**	**1.0**	**1.0**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerances and its applications.

Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau of Indian Standards conventions are to be followed for the drawings).

Unit-2

Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly).

Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets).

Unit-3

Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.

Couplings: Split Muff coupling, protected type flanged coupling.

Unit-4

Assembly Drawings: Machine Vice, Plumber Block, Connecting rod, Tailstock. (Preparation of Bill of materials and tolerance data sheet.)

PRACTICE

Sl. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Apply GD & T principles on simple machine parts	GD&T, Machine parts	Hands on Experience

2.	Draw orthographic projection of machine components	Drawing tools and CAD Software	Hands on Experience
3.	Draw orthographic projection of Bolts (Hexagonal Head)	Drawing tools and CAD Software	Hands on Experience
4.	Orthographic projection of Bolts (Square Head)	Drawing tools and CAD Software	Hands on Experience
5	Draw orthographic projection of riveted joints	Drawing tools and CAD Software	Creative Thinking
6	Draw orthographic projection of joints for connecting two shafts like Cotter or Knuckle Joint, couplings.	Drawing tools and CAD Software	Creative Thinking
7	Assemble the parts of Machine Vice and Draw the following orthographic views. a) Front view with full section b) Top View	Drawing tools and CAD Software	Hands on experience & Creative Thinking
8	Assemble the parts of PLUMMER BLOCK and Draw the following orthographic views. a) Front view with full section b) Top View	Drawing tools and CAD Software	Hands on experience & Creative Thinking
9	Assemble the parts of CONNECTING ROD and Draw the following orthographic views. a) Front view with full section b) Top View	Drawing tools and CAD Software	Hands on experience & Creative Thinking
10	Assemble the parts of TAILSTOCK and Draw the following orthographic views. a) Front view with full section b) Top View	Drawing tools and CAD Software	Hands of experience & Creative Thinking

TEXT BOOKS

1. K R Gopala Krishna, “Machine Drawing”, Subhas Stores, 2005.
2. N. D. Bhatt and V.M. Panchal, “Machine Drawing”, Charotar Publishing House, 2014
3. P S Gill, “Machine Drawing”, Kataria & Sons, 2009

REFERENCE BOOKS

1. Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-Hill, 2012.
2. Sham Tickoo , “CAD for engineers and designers”, Dream Tech, 2005.
3. P I Vargheese and K C John, “Machine Drawing”, VIP Publishers, 2011.
4. Dr. Alex Krulikowski, “Fundamentals of Geometric Dimensioning and Tolerancing”, University of Michigan, Third Edition, 2014.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

<table>
<tr><td>Course Title</td><td colspan="3">MATLAB for Mechanical Engineers</td><td colspan="2">Course Type</td><td colspan="2">Hard Core</td></tr>
<tr><td>Course Code</td><td>B20ER0405</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>0</td><td>26</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

This Course provides students a practical introduction to MATLAB by going beyond simple explanations of commands and it demonstrates as how to actually program for real-time applications in Mechanical Domain. It is intended to cater to the needs of budding mechanical engineer in advanced computing.

MATLAB integrates mathematical computing, visualization and powerful language to provide flexible environment for technical computing. The open architecture makes it easy to use MATLAB and its companion products to explore data, create algorithms and custom tools that provide early insights and competitive advantages. It is an all-rounder tool for simulations, programming, graphs, and measurement for an engineer. This course covers the analysis of the problems in basic engineering mechanics, strength of materials, theory of machines thermodynamics based applications along with the introduction to basic MATLAB capabilities.

COURSE OBJECTIVES

1. To make the students to understand the basic computation capabilities of MATLAB
2. To understand plotting for various 2D and 3D requirements
3. To make them solve simple problems of engineering mechanics, strength of materials, theory of machines thermodynamics based applications

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply MATLAB to create and manipulate different types of arrays.	1,5, 9, 10	1,2
CO2	Apply MATLAB to analyze, represent and plot 2D and 3D graphs.	1,2,5, 9, 10	1,2
CO3	Use MATLAB's built-in capabilities to solve engineering problems involving systems of linear equations and Curve fitting.	1,2,5, 9, 10	1,2
CO4	Develop, test and debug MATLAB programs using modern, structured programming methods, including graphical user interfaces	1,2,3, 5, 9, 10	1,2
CO5	Apply MATLAB to solve real-time problems in the areas of Engineering Mechanics, Strength of materials and thermal based problems.	1,2,3,5, 9, 10	1,2
CO6	Apply MATLAB to solve real-time problems in the areas of stability analysis of four and two wheelers	1,2,3,5, 9, 10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				3				3	3			3	3	
CO2	3	3			3				3	3			3	3	
CO3	3	2			3				3	3			3	3	
CO4	3	1	3		3				3	3			3	3	
CO5	3	2	3		3				3	3			3	3	
CO6	3	1	3		3				3	3			3	3	
Average	**3**	**1.8**	**3**		**3**				**3**	**3**			**3**	**3**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

PRACTICE

Sl. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Introduction to MATLAB: Starting of MATLAB, elementary functions, commands and variables	MATLAB	Hands on Experience
2	Arrays: Creation and Manipulations of array, built in functions for arrays, Reading Data from Files	MATLAB	Hands on Experience
3.	Graphics: Two dimensional and three dimensional plots and formatting of plots.	MATLAB	Hands on Experience
4.	Numerical Analysis: Curve Fitting, Interpolation and Solving Systems of Linear Equations.	MATLAB	Hands on Experience
5.	Programing in MATLAB: Loops and conditional statements	MATLAB	Hands on Experience
6.	Force analysis in flexible elements like cables of cranes	MATLAB	Hands on Experience
7.	Stress analysis in simple bodies subjected to axial loading, shear loading, bending and torsional loading	MATLAB	Hands on Experience
8.	Beam Analysis for SFD and BMD	MATLAB	Hands on Experience
9.	Analysis of Thermal Systems such as Performance of Air Standard Cycles , Gas Power and Vapor Power Cycles	MATLAB	Hands on Experience
10.	Performance analysis of Compressor and Refrigeration Systems	MATLAB	Hands on Experience
11.	Stability analysis of four and two wheelers	MATLAB	Hands on Experience

TEXT BOOKS

1. Peter I. Kattan,"MATLAB for Beginners: A Gentle Approach", Petra Books, 2008.
2. R. V Dukkipati, "MATLAB for Mechanical Engineers", New Age Science Limited, 2009.
3. Dr.Niranjan H and Siva.S, "Manual on "Mechanical Engineers and MATLAB", School of Mechanical Engineering, REVA University, Bangalore.

REFERENCE BOOKS

1. J. Srinivas and R. V Dukkipati, Solving Engineering Mechanics Problems with MATLAB, New Age International (P) Limited, 2009.
2. Simin Nasseri, "Solving Mechanical Engineering Problems with MATLAB", Linus Learning, 2016.

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/matlab-basics-for-mechanical-engineers/
2. https://www.coursera.org/courses?query=matlab

Course Title	Machine Shop				Course Type		Hard Core	
Course Code	B20ER0406	Credits	1		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**-**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

The Machine Shop Laboratory provides hands-on experience with the basic machining techniques and types of equipment in manufacturing environments and also it is aimed at providing an introduction to the Know-how common processes used in industries for manufacturing parts by removal of material in a controlled manner. The students will go through the fundamentals and principles of metal cutting using lathe, milling machine and shaping machines.

COURSE OBJECTIVES

1. To impart practical and working knowledge of Machine Tools and operations.
2. To develop machining skills with appropriate selection of tools.
3. To give exposure to analyze the speed, feed and depth of cut.
4. To give students hands on practice in preparing lathe models, milling and shaping models.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Demonstrate practical and working knowledge of Machine Tools and operations.	1,9	1
CO2	Perform turning, facing, knurling, thread cutting, tapering, eccentric, turning and allied operations using lathe.	1,2,9	1,3
CO3	Perform plain shaping and keyway cutting using shaping machine,	1,2,9	1,3
CO4	Perform gear cutting operation by selecting suitable indexing method using milling machine.	1,9	1
CO5	Select cutting parameters like cutting speed, feed, depth of cut and tooling for various machining operations.	1,2,4,9	1,2,3
CO6	List the sequence of operation, prepare a model as per given model diagram and document the results in the form of technical report.	1,9,10	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					
CO2			✓			
CO3			✓			
CO4	✓					
CO5		✓				
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2								2				1		
CO2	3	1							3				2		
CO3	3	1							3				2		
CO4	3	2			1				3				2		
CO5	3	2							3				2		
CO6	3	1							3	3			2	1	
Average	**2.8**	**1.4**			**1**				**2.8**	**3**			**1.8**	**1**	

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Introduction to Lathe machine and to establish the cutting speed, feed, depth of cut.
2. Preparation of Facing and Turning model
3. Establishing Taper turning and Step turning models
4. Preparing thread cutting model and knurling by defining the cutting speed.
5. Producing cylindrical hole in the given model

Part-B

1. Gear cutting using milling machine
2. Cutting V-Groove/Dovetail/Rectangular shapes by using Shaping Machine.
3. Demo on eccentric turning.

TEXT BOOKS

1. R.K Jain, "Production Technology", Khanna Publications, 2003.
2. P N Rao, "Manufacturing Technology", McGraw-Hill Education, (Volume II), 2018
3. Kalpakjian, Serope, "Manufacturing Engineering and Technology", Addison –Wesley publishing co., New York

REFERENCE BOOKS

1. Hajra Choudhury, "Workshop Technology Vol-II", Media Promoters & Publishers Pvt. Ltd. 2004
2. Amitabh Ghosh and Mallik, "Manufacturing Science", affiliated East West Press, 2003
3. G.C Sen & Bhattacharya, "Principle of Machine Tools", Tata McGraw hill, New Delhi.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. Journal of Manufacturing Processes

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://onlinecourses.nptel.ac.in/noc21_me04/preview

Course Title	Mechanical System Analysis Lab				Course Type		Hard Core	
Course Code	B20ER0407	Credits	1		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

This course deals with the velocity and acceleration analysis of four bar mechanism, single slider and double slider crank mechanisms. It also deals with the force analysis of gears and cams. This lab helps the manufacturing sector in analyzing the controlling forces and balancing couples acting on the rotating machine element. It also helps the designers in analyzing and predicting the motion of the vehicles their stability and direction during motion.

COURSE OBJECTIVES

1: To analyze the velocity and acceleration of simple mechanisms.
2: To analyze the forces acting on rotating machine elements such as gears and cams.
3: To evaluate governor parameters and analyze balancing criteria for rotating machine members.
4: To predict the stability, velocity and direction of motion for moving mechanical members.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Demonstrate valuate the velocity and acceleration for four bar mechanism and single slider crank mechanism theoretically.	1,2,5, 9	1,2

CO2	Analyze and perform the simulation of the velocity and acceleration for double slider crank mechanism theoretically.	1, 2, 5, 9	1,2
CO3	Analyze and perform the simulation the performance characteristics of gears and cams.	1, 2,5, 9	1,2
CO4	Compute the performance characteristics of porter governor.	1,2, 9	1,2
CO5	Examine the balancing of rotating masses and demonstrate the gyroscopic behavior under free and forced precession.	1,2, 9	1,2
CO6	Analyze and perform the simulation of Mechanical System, also document the results in the form of technical report.	1,2, 5, 9, 10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3				√		
CO4			√			
CO5					√	
CO6				√		

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1			2				2				3	3	1
CO2	3	2			2				3				3	3	1
CO3	3	2			2				2				2	3	1
CO4	2	2							2				3	3	
CO5	3	2							2				3	2	
CO6	3	2							2	3			3	3	
Average	**2.7**	**1.8**			**2**				**2.2**	**3**			**2.8**	**2.8**	**1**

Note: 1-Low, 2-Medium, 3-High

Part-A

1: Analysis of Four bar Mechanism – 2 problems each.
2: Analysis of Single Slider crank Mechanism - 2 problems each.
3: Analysis of Double Slider crank mechanism- 2 problems each.
4: Analysis of spur gear and cams.

Part-B

1. To determine the magnitude, position of unknown rotating masses using Balancing Machine.
2. To determine the power, effort, controlling force, sensitiveness of the porter governor
3. To find the gyroscope couple on a motorized gyroscope experimentally and compare with applied couple.

TEXTBOOKS

1. R S Khurmi, "Theory of Machines", Schand Publishing House.
2. S S Rattan, "Theory of Machines", Tata Mc Graw Hill Education Private Limited New Delhi.

REFERENCE BOOKS

1. VP Singh, "Theory of Machines", Dhanpat Rai Publishing, 2004
2. Joseph E Shigley, "Theory of Machines and Mechanisms", Oxford Higher Education International Version.
3. R K Bansal, "Theory of Machines, Lakshmi Publications Ltd, New Delhi.

JOURNALS/MAGAZINES

1. Mechanism and Machine Theory | journal | sciencedirect.com by elsevier
2. Applied Theories on Machines | List of High Impact Articles | PPts | Journals | Videos (longdom.org)

SWAYAM/NPTEL/MOOCs

1. NPTEL: Mechanical Engineering - Theory of Mechanisms
2. http://ecoursesonline.iasri.res.in/course/view.php?id=522
3. Adams Tutorial Kit for Mechanical Engineering Courses (mscsoftware.com)

Course Title	Management Science				Course Type		Hard Core	
Course Code	B20MGM301	Credits	2		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**2**	**2**	**2**	**26**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The course intends to familiarize students to understand the management principles and applications, which lays a strong foundation for managers and leaders in critical thinking and decisions making process. The course emphasizes on giving an overview of the functional area of management

COURSE OBJECTIVES

1. To help the students gain understanding of the functions and responsibilities of managers.
2. To provide them tools and techniques to be used in the performance of the managerial job.
3. To enable them to analyze and understand the environment of the organization.
4. To help the students to develop cognizance of the importance of management principles.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Make use of Plan organizational structure for a given context in the organization carry out production operations through Work-study.	1, 11	1, 2
CO2	Analyze production operations through Work-study.	1, 11	1, 2
CO3	Understand the markets, customers and competition better and price the given products Appropriately.	1, 11	1, 2
CO4	Summarize the HR function better.	1, 11	1, 2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3				√		
CO4			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2										2	1	1	1	
CO2	2	1									2	1	1	1	

CO3	2										2	1	1	1	
CO4	2	1									2	1	1	1	
Average	**2**	**1**									**2**	**1**	**1**	**1**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit – 1

Introduction to Management and Organization: Concepts of Management and organization- nature, importance and Functions of Management. Systems Approach to Management - Taylor's Scientific Management Theory- Taylor's Principles of Management, Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory - Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management. Designing Organizational Structures: Basic concepts related to Organization Depart mentation and Decentralization.

Unit – 2

Operations and Marketing Management: Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study --Basic procedure involved in Method Study and Work Measurement - Business Process Reengineering(BPR) Statistical

Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis. Purchase Procedure, Stores Management and Store Records - JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix. And Marketing Strategies based on Product Life Cycle. Channels of distribution.

Unit – 3

Human Resources Management (HRM): Concepts of HRM. HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR. Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development. Placement, Wage and Salary Administration, Promotion. Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating -Capability Maturity Model (CMM) Levels - Performance Management System.

Unit – 4

Strategic Management and Contemporary strategic Issues: Mission, Goals, Objectives, Policy, Strategy. Programmes, Elements of Corporate Planning Process, Environmental Scanning. Value Chain Analysis, SWOT Analysis. Steps in Strategy Formulation and implementation, Generic. Strategy alternatives. Bench Marking and Balanced Score and as Contemporary Business Strategies.

TEXT BOOKS

1. Kotler Philip and Keller Kevin Lane, "Marketing Management", Pearson, New York, 15th Edition, 2012.
2. Koontz and Weihrich, "Essentials of management", McGraw Hill, New Delhi, 11th Edition, 2012.

REFERENCE BOOKS

1. Thomas N. Duening and John M. Lvancevich, "Management - Principles and Guidelines", Dreamtech Press; 1st Edition, 2012.
2. Samuel C. Certo, "Modern Management", Prentice Hall, New York, 9th Edition, 2012.
3. Schermerhorn, Capling, Poole and Wiesner, "Management", Wiley, New York, 6th Edition, 2012.
4. John A. Parnell, "Strategic Management – Theory and Practice", Cengage Publications, 2018.
5. Lawrence R Jauch, R. Gupta and William F. Glucek, "Business Policy and Strategic Management Science", McGraw Hill, New York, 5th Edition, 2012.

Course Title	**Environmental Science**			**Course Type**	**FC**
Course Code	**B20AS0303**	**Credits**	**2**	**Class**	**IV Semester**

Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	2	2	2			
	Practice	0	0	0	Theory	IA	SEE
	Tutorial	0	0	0			
	Total	**2**	**2**	**2**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

This introductory course is designed to introduce you to the foundational concepts of environmental engineering, types of resources, biodiversity, threats and methods of conservation, sources and control measures of environmental pollution and ways to protect the environment.

COURSE OBJECTIVES

1. Graduates will be familiar with current and emerging environmental engineering and global issues, and have an understanding of ethical and societal responsibilities.
2. Graduates will have the ability to obtain the knowledge, and will recognize the need for engaging in life-long learning.
3. Will find the need of various types of energy (conventional & non-conventional) resources and natural resources.
4. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem.
5. Acquire knowledge about sources, effects and control measures of environmental pollution, degradation and waste management.
6. Explore the ways for protecting the environment.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Understand, analyze and execute favorable environmental conditions and the role of individual, government and NGO in environmental protection.	1,7,8,10,12	3
CO2	List the causes, effects & remedial measures and find ways to overcome them by suggesting the pollution-controlled products	1,7,8,10,12	3
CO3	Classify different wastes, sources of waste and their effect on population.	1,7,8,10,12	3
CO4	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.	1,7,8,10,12	3
CO5	Critically analyze the ecological imbalances and provide recommendations to protect the environment.	1,2, 7,8,10,12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3	√					
CO4		√				
CO5		√				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1						3	1		1		2			1
CO2	1						3	1		1		2			1

CO3	1						3	1		1		2			1
CO4	1						3	1		1		2			1
CO5	1	1					3	1		1		2			1
Average	**1**	**1**					**3**	**1**		**1**		**2**			**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit – 1

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations, Initiative and Role of Non-government organizations in India and world.

Unit-2

Environmental Pollution: Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile Pollution-Causes, Effects & control measures.

Environmental degradation: Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.

Waste management: Municipal solid waste, biomedical waste and Electronic waste (E-Waste).

Unit-3

Energy: Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Natural resources: Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance. Mineral resources - Types of minerals, Methods of mining & impacts of mining activities. Forest wealth - Importance, Deforestation-Causes, effects and controlling measures

Unit-4

Ecology:-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, **Ecosystem:** Characteristics of an Ecosystem - Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

Field Work: Visit to waste water treatment and biogas plant at REVA university campus, and/or Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

TEXT BOOKS

1. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, Co-authored & Customized by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.
2 R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.
3. Benny Joseph, "Environmental Studies", Tata McGraw – Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008.

REFERENCE BOOKS

1. Dr.S.M.Prakash, “Environmental Studies”, Elite Publishers, Mangalore, 2nd Edition, 2009.
2. Rajagopalan R, “Environmental Studies – from Crisis to cure”, Oxford University Press, New Delhi, 3rd Edition, 2016
3. Anil Kumar Dey and Arnab Kumar Dey, “Environmental Studies”, New age international private limited publishers, New Delhi, 2nd Edition, 2007.
4. Michael Allaby, “Basics of environmental Science”, Routledge-Tayler & Francis e-library, New York, 2nd Edition, 2002.
5. Dr.Y.K Singh, “Environmental Science”, New age international private limited publishers, New Delhi, 1st Edition, 2006

JOURNALS/MAGAZINES

1. International Journal of Environmental Science and Technology, https://www.springer.com/journal/13762/.
2. Journal of Environmental Sciences, https://www.journals.elsevier.com/journal-of-environmental-sciences.

SWAYAM/NPTEL/MOOCs:

1. Environmental Studies: https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
2. Environmental Studies: https://nptel.ac.in/courses/120/108/120108004/

SELF-LEARNING EXERCISES

1. Discussion on the need for public awareness on the environment, Gaia Hypothesis
2. Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes, Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.
3. Hydrology & modern methods adopted for mining activities, Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster.
4. Discussion on the need for balanced ecosystem and restoration of degraded ecosystems.

Course Title	**Universal Human Values**				**Course Type**		**FC**	
Course Code	**B20AHM401**	**Credits**	**0**		**Class**		**IV Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	2	2				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**0**	**2**	**2**	**26**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Basic human values refer to those values which are at the core of being human. The values which are considered basic inherent values in humans include truth, honesty, loyalty, love, peace, etc. because they bring out the fundamental goodness of human beings and society at large. Tis subject focuses on developing holistic perspective and harmony on self-exploration among individuals, family and society.

COURSE OBJECTIVES

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession.	3,6,7,8,9,	
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	3,6,7,8,9,10	

CO3	Understand the role of a human being in ensuring harmony in society and nature.	3,6,7,8	
CO4	Demonstrate the role of human being in the abetment of pollution	3,6,7,9	
CO5	Describe appropriate technologies for the safety and security of the society as responsible human being.	9,10,11,12	
CO6	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	9,10,11,12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2	√	√			√	
CO3		√				
CO4			√		√	
CO5		√				√
CO6				√	√	

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			1			3	3	3	3	3					
CO2			1			3	3	3	3	3					
CO3			1			3	3	3							
CO4			1			3	3		3						
CO5									3	3	3	2			
CO6									2	3	3	2			
Average			**1**			**3**	**3**	**3**	**2.8**	**3**	**3**	**2**			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit- 1

Happiness and Prosperity: A look at basic Human Aspirations. Right understanding, Relationship, basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly, Method to fulfil human aspirations: understanding and living in harmony at various levels, Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seeker and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

Unit- 2

Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

Unit- 3

Understanding the harmony in the Nature: Interconnectedness and mutual fulfilment among the four orders of

nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Unit- 4

Natural acceptance of human values: Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

TEXT BOOKS

1. R R Gaur, R Sangal, G P Bagaria, "Human Values and Professional Ethics", Excel Books, New Delhi, 2010.
2. A.N Tripathy, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. R.R. Gaur, R. Sangal and G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, 2010
4. Bertrand Russell, "Human Society in Ethics & Politics", Routledge Publishers, London, 1992

REFERENCE BOOKS

1. Corliss Lamont, "Philosophy of Humanism", Humanist Press, London, 1997
2. I.C. Sharma, "Ethical Philosophy of India", Nagin & Co Julundhar, 1970
3. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", Navajivan Mudranalaya, Ahmadabad, 1993
4. William Lilly, "Introduction to Ethics", Allied Publisher, London, 1955

JOURNALS/MAGAZINES/ONLINE COURSES

1. Value Education websites, http://uhv.ac.in, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story
6. Gandhi A., Right Here Right Now, Cyclewala Production

SELF-LEARNING EXERCISES

1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect? ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is our living the same as your natural acceptance or different?
2. Out of the three basic requirements for fulfilment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.
3. Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.

5th Semester

Course Title	Design of Machine Elements				Course Type		Hard Core	
Course Code	B20ER0501	Credits	4		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Tutorial	IA	SEE
	Tutorial	1	2	2				
	Total	**4**	**5**	**5**	**39**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Design of Machine elements deals with the basics of design concepts of the structural members, failure theories, stress concentration, fatigue failure. This course covers theories of failure, shafts design, riveted and bolted joints, power screws and impact strength

COURSE OBJECTIVES

1. To understand the concept of normal, shear and torsional stress, codes and standards in the engineering in relevance to mechanical engineering.
2. To know the concept of static & impact strength in machine elements and theories of failure.
3. To understand the fatigue failure.
4. To explain the design procedure of design of shafts.
5. To introduce the concept of safe design of riveted and bolted joints in industry applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply concepts of mechanics of materials to estimate the stresses in a machine element and predict failure of components based on theories of failure	1,2	1,2
CO2	Evaluate the effect of impact and fatigue load on machine elements and factors affecting it.	1,2	1,2
CO3	Analyze the effect of stress concentration for various machine elements	1,2	1,2
CO4	Design machine elements like Shafts, Knuckle and Cotter joints	1,2,3	1,2
CO5	Compute the efficiency of temporary and permanent joints	1,2	1,2
CO6	Calculate the performance characteristics Fasteners and Power screws.	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2					✓	
CO3				✓		
CO4					✓	
CO5					✓	

CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2	3	3											3	3	
CO3	3	3	2										3	2	
CO4	3	2											3	3	
CO5	3	3											3	3	
CO6	3	2											3	2	
Average	**3**	**2.5**											**3**	**2.5**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit – 1

Introduction: Definitions: normal, shear, biaxial and triaxial stresses, Stress tensor, Principal stresses. Stress-strain diagrams for ductile and brittle materials, Failure of brittle materials, Failure of ductile materials, Factor of Safety Design considerations: Codes and Standards.

Design for Static Strength: Static loads subjected to Axial, Bending and torsion loads.

Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory, Stress concentration, Determination of stress concentration factor, simple numerical.

Unit – 2

Impact strength: Introduction, Impact stresses due to axial & bending load. Simple numerical.

Design for Fatigue Strength: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Endurance limit modifying factors, size effect, surface effect, Stress concentration effects; Goodman's and Soderberg's relationship Simple numerical

Unit – 3

Design of Shafts: Materials for shaft, Torsion of shafts, Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads.

Design of Temporary Joints: knuckle joint and cotter joint.

Design of Permanent joints

Riveted joints: Types, rivet materials, failures of riveted joints, Joint efficiency, Boiler joints (Longitudinal joints), Riveted Brackets.

Welded Joints: Types, strength of butt and fillet welds, eccentric loading.

Unit – 4

Threaded Fasteners: Stresses in threaded fasteners, Effect of initial tension, Design of threaded fasteners under static, dynamic and eccentric loading

Power Screws: Mechanics of power screw, Stresses in power screws, efficiency and self-locking, simple numerical.

CASE STUDIES

1. A 32 inch LED TV is decided to be mounted on a clamp. Identify the number of bolts and the profile of clamp which has to withstand the maximum load on the branded TV.
2. Analyze the stress patterns on a clamping plate used to connect the shaft of 100mm diameter.
3. A pedestal fan is to cool the room of 10x8 size. Determine the forces and stresses induced in the rotating shaft and check for safety of the fan.

4. A centrifuge is rotating at 1000rpm to separate butter from curd. Determine the stresses induced and the safety of the equipment.
5. Design a member to absorb an impact load of 80kN falling with a velocity of 25 m/s.
6. Design the bolt of an excavator which is used to lift the debris from the ground of 150 m depth.
7. A GI Sheet is used to cover a boiler of particular diameter. Identify and suggest the type of riveting for fixing the sheet on boiler surface and the diameter of the rivet.

TEXT BOOKS

1. Joseph E Shigley and Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill International Edition, 6th Edition 2009.
2. V.B. Bhandari, "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 4th Edition 2017.
3. Dr. P C Sharma and Dr. D K Aggarwal, "Machine Design", S. K. Kataria & Sons, 13th Edition 2017.

DATA HAND BOOKS

1. K. Lingaigh, "Machine Design Databook", McGraw Hill Education, 2nd Edition 2017.
2. K.Mahadevan and B.Reddy, "Design Data Hand Book", CBS Publisher, 4th Edition, 2018.

REFERENCE BOOKS

1. Robert L. Norton, "Machine Design", Pearson Education Asia, 2001.
2. M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, "Design of Machine Elements", Pearson Education, 2006.
3. Hall, Holowenko, Laughlin (Schaum's Outlines series), "Machine Design", Adapted by S.K. Somani, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/topics/engineering/design of machine elements
2. https://link.springer.com/book/10.1007/978-3-319-06086-6

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in
2. https://nptel.ac.in/courses

<table>
<tr><td>Course Title</td><td colspan="4">Fluid Mechanics and Machines</td><td colspan="2">Course Type</td><td colspan="2">Hard Core</td></tr>
<tr><td>Course Code</td><td>B20ER0502</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Tutorial</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>26</td><td>26</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

Fluid Mechanics and Machines aims to deal with the behavior of fluids under rest and in motion. The course deals with types of fluids, properties of fluids, fluid statics, pressure measurement, fluid kinematics and fluid dynamics. This course also emphasizes the basic fluid mechanics principles and energy transfer in a hydraulic machines along with their performances. The course also highlights the viscous flow and forces over immersed bodies.

COURSE OBJECTIVES

1. To introduce fluid properties, measurement of fluid pressure and behavior of fluids at rest.
2. To identify the flow characteristics and dynamics of flow field for Engineering Applications.
3. To describe the importance of major and minor losses of fluid flows through pipes.

4. To discuss the main properties of viscous flow and flow over the immersed bodies.
5. To analyze the velocity components and energy transfer in fluid machines.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply the fluid properties and basic laws for analyzing fluid static applications.	1,2	1,2
CO2	Apply the principles of fluid kinematics, fluid dynamics and dimensional analysis for solving the fluid flow problems.	1,2,5	1,2
CO3	Evaluate the major and minor losses of fluid flow through pipes.	1,2	1,2
CO4	Apply the fundamentals of fluid flow for analyzing flow of viscous fluid through pipes and around immersed bodies.	1,2	1,2
CO5	Apply the fundamental concepts of energy conversion principles for analyzing fluid flow through generalized turbomachines.	1,2	1,2
CO6	Evaluate the performance parameters of power absorbing and power generating turbomachines.	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2			✓			
CO3			✓			
CO4				✓		
CO5			✓			
CO6					✓	

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2	3	2			2								3	2	
CO3	3	3											3	2	
CO4	3	3											3	2	
CO5	3	3											3	2	
CO6	3	3											3	2	
Average	**3**	**2.7**			**2**								**3**	**2**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Definition of a fluid, Properties of fluids, Newton's law of viscosity, types of fluid, Numerical on viscosity.

Fluid Statics: Pascal's law, Hydrostatic law, absolute, gauge, atmosphere and vacuum pressure, Manometers- simple and differential manometers. Discussion on Total pressure, Centre of pressure, Buoyancy, Centre of buoyancy, Metacenter and Meta centric height, Numerical.

Unit-2

Fluid kinematics: Types of fluid flow, flow lines, three dimensional continuity equation in (Cartesian co-ordinate system), velocity and acceleration, Discussion on velocity potential function and stream function.

Fluid Dynamics: Euler's equation of motion along stream line, Bernoulli's equation and its limitations, Applications of Bernoulli's theorem on flow measuring devices, Numerical.

Dimensional Analysis: Dimensional Homogeneity, Methods of dimensional analysis- Rayleigh's method, Buckingham π theorem, Numerical. Discussion on Similitude and Model studies.

Unit-3

Flow through pipes: Frictional loss in pipe flow, Darcy-Weisbach equation and Chezy's equation for loss of head due to friction in pipes, Discussion on minor loses in pipes, hydraulic gradient line and total energy line, Numerical.

Viscous flow: Reynolds Number, Laminar flow through circular pipes, Hagen – Poiseuille equation. (No-derivation), Numerical.

Flow over immersed bodies: Introduction, Lift and drag forces, Coefficient of lift and drag forces, Numerical.

Unit-4

Energy Exchange in Fluid machines: Fluid flow through a generalized turbomachine, Euler's turbine equation.

Centrifugal Pumps: Parts of centrifugal pump, different heads and efficiencies of centrifugal pump, minimum speed for starting the pump, Work done by the Centrifugal pump, Pumps in series and parallel. Numerical.

Hydraulic Turbines: Classification, efficiencies of hydraulic turbines. Pelton turbine - velocity triangles, design parameters, Francis turbine - velocity triangles, design parameters, Kaplan- velocity triangles, design parameters. Numerical.

CASE STUDIES:

1. Develop a python programming for plot and visualization of stream line of fluid flow.
2. Conduct the experiment to determine the coefficient of friction for fluid flowing through pipes of different diameter and compute the same using MAT lab.
3. Prepare a report on any pumps used in Agricultural field/ Industry by mentioning following details: Make and specifications, operating conditions, construction, working principle, and applications.
4. Prepare a report on any Mini or Macro hydroelectric power station by mentioning the following details: Make and specifications, type and of number of turbines, capacity of power generation, working principle, operating conditions and applications.

TEXT BOOKS

1. Dr. Bansal, "A text book of Fluid Mechanics and Hydraulic Machines", R.K.Lakshmi Publications Pvt. Ltd, 9th Edition, 2018.

2. Jagadish Lal, "Fluid Mechanics and Hydraulic", Metropolitan Book Company, 4th Edition 2012.

REFERENCE BOOKS

1. Yunus A. Cengel and John M.Cimbala, "Fluid Mechanics (SI Units)", Tata McGraw Hill, 4th Edition 2019.

2. Pijush.K.Kundu, "Fluid Mechanics", Taylor & Francis, 3rd Edition, 2015.

JOURNALS/MAGAZINES

1. https://www.cambridge.org/core/journals/journal-of-fluid-mechanics

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_me31/preview
2. https://www.my-mooc.com/en/categorie/mechanical-engineering

Course Title	Thermal Engineering Systems				Course Type		Hard Core	
Course Code	B20ER0503	Credits	4		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	4	4	4				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**4**	**4**	**4**	**52**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Thermal Engineering plays an important role in design of many Mechanical, electrical and electronics system. The course deals with Internal Combustions engines, combustion thermodynamics, psychometry, air conditioning, boilers, gas turbines and jet propulsions. It also deals with evaluation of condenser performance and boiler efficiency.

COURSE OBJECTIVES

1. To study the classification testing and performance evaluation of IC Engines.
2. To understand the basic definitions, concepts of chemical reactions involved in combustion process.
3. To gain the knowledge about basic definitions and concepts of psychometry and air-conditioning.
4. To study different types and working principles of boilers, condensers, accessories and evaluation of boiler performance.
5. To evaluate the performance parameters of gas turbine and Jet Propulsion systems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Evaluate the performance of I.C Engines.	1,2	1,2
CO2	Analyze the combustion processes using thermodynamic principles.	1,2	1,2
CO3	Apply the concept of psychometry to evaluate the performance of air-conditioning systems.	1,2	1,2
CO4	Identify and select the suitable boiler mountings and accessories to improve the performance of boiler.	1,2	1,2
CO5	Compute the thermal parameters to improve thermal efficiency of gas turbines.	1,2	1,2
CO6	Describe classification and working principles jet propulsion systems.	1	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6		√				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	2											1	2	
CO2	3	3											1	3	
CO3	3	3											1	2	
CO4	3	2											1	2	
CO5	3	2											1	2	1
CO6	3	2											1	2	
Average	**3**	**2.3**											**1**	**2.2**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

I.C.Engines: Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation, Performance analysis of I.C Engines, heat balance sheet, Morse test, IC Engine fuels, Ratings and Alternate Fuels**.**

Combustion Thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels. Excess air, balancing of combustion equations, Exhaust gas analysis, A/F ratio, Enthalpy of formation, enthalpy and internal energy of combustion. Combustion efficiency.

Unit-2

Psychometrics: Psychometric properties of Air, Psychometric Chart, Analyzing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist air streams.

Air Conditioning Systems: Process in air conditioning: Summer air conditioning, winter air conditioning and year round air conditioning.

Unit-3

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, air pre heater, feed water heater, super heater. Boiler efficiency. Condenser: Classification of condenser, Air leakage, Condenser performance parameters.

Unit-4

Gas Turbines : Classification of Gas turbines; Gas turbine (Brayton) cycle; description and analysis of open cycle gas turbine; Derivations of equations for efficiency, work ratio and Pressure ratio for maximum power output; actual gas turbine cycles; Numerical problems Methods to improve thermal efficiency of gas turbines

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine.F

CASE STUDIES

1. Develop a python programming for analyzing (drawing PV diagram) the diesel cycle.
2. Prepare a report on causes of boiler and mountings accidents.
3. Prepare a brief report on specifications of latest IC engines used latest in new vehicles.
4. Prepare a report on cooling load and specifications of air-condition systems used in offices or residential places.

TEXT BOOKS

1. P.K. Nag "Engineering Thermodynamics" Tata McGraw Hill, 6th Edition 2018.
2. Ganesan V, "Gas Turbines Tata McGraw Hill, 3rd Edition, 2010.
3. Domkundwar and Arora, "Power Plant Engineering" Dhanpat Rai & Co, 5th Edition, 2010.

REFERENCE BOOKS

1. Saravanamuttoo, H.I.H., Rogers, G.F.C. and Cohen, H., "Gas Turbine Theory" Pearson Education Limited, 5th Edition 2013.
2. Rajput R.K, Thermal Engineering. Lakshmi publications, 10th Edition, 2020.
3. R.B.Mathur and R.P.Sharma, "Internal Combustion Engines", Dhanpat Rai & Sons, 2nd Edition, 2018.

4. Yunus A. Cenegal and Michael A. Boles, "Thermodynamics -An Engineering Approach", Tata McGraw-Hill, 9th Edition, 2019.
5. Mahesh M Rathore, "Thermal Engineering", Tata McGraw-Hill, Prentice-hall of India Pvt. Ltd, 1st Edition, 2010.

JOURNALS/MAGAZINES:

1. International Journal of Heat and Mass Transfer
2. American Institute of Aeronautics and Astronautics

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Course Title	**Smart Materials**				**Course Type**		**Soft Core**	
Course Code	**B20ERS511**	**Credits**	**3**		**Class**		**V Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Overview of the course is to enhance holistic development of students and improve their knowledge about the smart materials, MR, ER fluids, Biomimetics and smart actuators, advanced in smart structures, smart composites and applications of smart materials.

COURSE OBJECTIVES

The objectives of this course are to:

1. Understand the basic concepts of composites and ceramics materials, electro-magnetic materials and shape memory alloys
2. Study about the MR and ER fluids, High-Band Width, Low Strain Smart Sensors and Application of Smart Sensors for Structural Health Monitoring (SHM)
3. Analyze the smart actuators and smart composites, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control and Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Apply the fundamental knowledge of smart materials, smart structures, piezoelectric, MR, ER fluids to solve problems in the field of medicine and engineering.	1	1
CO2	Identify, compare and contrast alternative solution processes to select the best process of smart actuators in automobiles and biomedical field.	1, 2	1
CO3	Generate information through appropriate tests to improve or revise the design of smart composites.	1, 2, 3	2
CO4	Recognize the need of analysis to good problem definition of smart structures.	1, 2, 3	2
CO5	Establish a relationship between measured data and underlying physical principles smart composites applications for corrosion coating and self-healing and MEMs products.	1, 2, 3,4	3
CO6	Examine the relevant methods and techniques of advances in Sensing applications of	1, 2, 3,4,5	3

	smart sensors of structural health monitoring.		

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4			✓			
CO5				✓		
CO6				✓		

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	3	2											2		
CO3	3	2	1										1	2	
CO4	3	2	1										1	2	
CO5	3	3	1	1									1	2	2
CO6	3	2	1	1	1								1	2	2
Average	**3**	**2.2**	**1**	**1**	**1**								**1.3**	**2**	**2**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Overview of Smart Materials: Introduction to Smart Materials - Smart structures - classification of smart structures, common smart materials. Piezoelectric materials, piezoelectric effect, Piezoceramics, Piezopolymers, Shape memory alloys (SMAs) - Shape memory effect - Shape memory polymers, Introduction to Electro-active Materials, Electro-active Polymers, Ionic Polymer - Electro-rheological Fluids - Magneto Rhelological Fluids.

Unit-2

Smart Actuators: Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magneto-volume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control.

Unit-3

Smart composites: Review of Composite Materials, Micro and Macro-mechanics, Laminated Composites based on the Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, governing Equation of Motion. Advances in smart structures; Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials.

Unit-4

Applications: Elastic memory composites, Smart corrosion protection coatings, Self-healing materials, MEMS - MEMS Product development - Deployment devices - Molecular machines.

Sensing Applications; Piezeoelctric Strain Sensors, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM).

TEXT BOOKS

1. Mohsini Shahenpoor (Ed.), "Fundamentals of Smart Materials", RSC, Cambridge, UK, 2020
2. Chander Prakash, Sunpreet Singh, J. Paulo Davim (Ed.), Functional and Smart Materials, CRC Press, 1st Edition, 2021.
3. Chang Liu, "Foundation of MEMS", Pearson Education, 2nd edition, 2012.
4. M.V.Gandhi and B.S.Thompson, "Smart Materials and Structures", Chapmen & Hall, London, 1992.
5. Mel M. Schwartz, "Smart Materials", CRC Press, 1st Edition, 2009.
6. Donald J. Leo, "Engineering analysis of smart material systems", John Wiley & Sons, 1st Edition, 2007.

REFERENCE BOOKS

1. Radhashyam Rai, "Smart Materials for Smart Living", Nova Publishers, USA, 2017.
2. Qun Wang (Ed.), "Smart Materials for Tissue Engineering", RSC, UK, 2017.
3. Johannes Michael Sinapius, Adaptronics – "Smart Structures and Materials", Springer, 2020.
4. Anca Filimon (Ed.), "Smart Materials": Integrated Design, Engineering Approaches and Potential Applications, CRC Press, 2019.
5. Vijay K. Varadan, "Smart material systems and MEMS: design and development methodologies", John Wiley & Sons, 2006.
6. Seung- Bok Choi & Young-Min Han, "Piezoelectric actuators: control applications of smart materials", CRC Press - 2010.
7. Kwang J. Kim & S. Tadokoro, "Electroactive polymers for robotics applications: artificial muscles and sensors", Springer, 2007

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology
2. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/113/102/113102080/
2. https://nptel.ac.in/courses/122/102/122102008/

<table>
<tr><td>Course Title</td><td colspan="3">Experimental Stress Analysis</td><td colspan="2">Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20ERS512</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

Experimental Stress Analysis is the analysis of the mechanical stress state in materials, which is performed through experiments using strain gauge measurements. This course covers the Electrical Strain Gauges, Strain Rosettes, Photo-Elasticity technique in Two-Dimensional & Three-Dimensional problems, Photo-elastic Coatings & Brittle Coatings, and Moire Methods.

COURSE OBJECTIVES

1. To study the working principles of different types of strain gauges
2. To know the fundamentals of photo elastic coatings
3. To understand the photo elastic technique for principal stress measurement on 2-D and 3-D objects
4. To study the stresses in 2-D & 3-D photo elastic materials by different techniques.

5. To provide geometric and displacement Moire fringe techniques.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Outline the basics of experimental methods commonly used in real time problems.	1,2	1,2
CO2	Illustrate the Photo-Elasticity principles in Two-Dimensional stress analysis.	1,2	1,2
CO3	Examine the Photo-Elasticity principles in Three-Dimensional stress analysis.	1,2,3	1,2
CO4	Analyze the coating stress in the Photo-elastic Coatings.	1,2,4	1,2
CO5	Differentiate the types of brittle Coatings and Crack detection methods.	1,2	1,2
CO6	Distinguish the surface strains using Moire fringes techniques.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3		✓				
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2	3	3											3	3	
CO3	3	3	1										3	2	
CO4	3	2		1									3	3	
CO5	3	3											3	3	
CO6	3	2											3	2	
Average	3	2.5	1	1									3	2.5	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Electrical Strain Gauges: Strain sensitivity in metallic alloys, Gage construction, Adhesives and mounting techniques, Gage sensitivity and gage factor, Performance Characteristics, Environmental effects, Strain Gage circuits. Potentiometer, Wheat stone's bridges.

Strain Rosettes: Two element, three element rectangular and delta rosettes, Correction for transverse strain effects, Stress gage, Plane shear gage, and Stress intensity factor gage.

Unit-2

Photo-Elasticity: Nature of light, Wave theory of light - optical interference, Stress optic law – effect of stressed model in plane and circular polariscopes, Isoclinics & Isochromatic, Fringe order determination Fringe multiplication techniques.

Two Dimensional Photo-elasticity: Separation methods: Shear difference method, Analytical separation methods, Model to prototype scaling, Properties of 2D photo-elastic model materials, materials for 2D photo elasticity.

Unit-3

Three-Dimensional Photo elasticity: Stress freezing method, scattered light photoelasticity, scattered light as an interior analyzer and polarizer, Scattered light Polari scope and stress data Analyses.

Photo-elastic (Bi-fringe) Coatings: Birefringence coating stresses, Effects of coating thickness: Reinforcing effects, Poisson's, Stress separation techniques: Oblique incidence, Strip coatings.

Unit-4

Brittle Coatings: Coatings stresses, Crack patterns, Refrigeration techniques, Load relaxation techniques, Crack detection methods, Types of brittle coatings, Calibration of coating. Advantages and brittle coating applications.

Moire Methods: Moire fringes produced by mechanical interference. Geometrical approach, Displacement field approach to Moire fringe analysis, out of plane displacement measurements, Out of plane slope measurements. Applications and advantages.

CASE STUDIES

1. Determine the different types of stresses acting on a motorcycle handle using strain gauges.
2. Determine the stress distribution in a rectangular plate with rectangular cut out using photoelasticity.
3. Using Moire method determine the deformation in thin sheet metals.

TEXT BOOKS

1. Dally J W and Riley W F, "Experimental Stress Analysis", McGraw Hill Inc New York, 2014.
2. Sadhu Singh, “Experimental Stress Analysis", Khanna Publisher New Delhi, 2009.
3. Srinath L.S., “Experimental stress Analysis”, Tata McGraw Hill, New Delhi, 1984.

REFERENCE BOOKS

1. Jindal, “Experimental stress analysis”, Pearson Publishers, 2018.
2. J.Srinivas, “Stress analysis-An introduction to Experimental Techniques”, Narosa Publishers, 2015.
3. Mubin Khanna, “Experimental Stress Analysis”, 2003.
4. Freddi, Olmi, Cristofolini, “Experimental stress analysis for materials and structures”, Springer, 2015

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/topics/engineering/experimental-stress-analysis
2. https://link.springer.com/book/10.1007/978-3-319-06086-6

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_me02/preview
2. https://nptel.ac.in/courses/112106068

Course Title	Energy Technology				Course Type		Soft Core	
Course Code	B20ERS513	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW:

This course explores the concept of thermal energy conversion, also introduces the, different types of fuels used for steam generation and equipment for burning coal in lump form. This course introduces to bio mass energy and its characteristics. It also emphasizes on conversion of various biomass energy into solid, liquid and gaseous forms. Further the course deals with conversion of biomass into methanol, ethanol, biogas, bio diesel etc.

COURSE OBJECTIVES

1. To understand energy scenario, energy sources and their utilization
2. To gain the knowledge about diesel engine power plant.
3. To enhance the knowledge about renewable energy sources.
4. To enable the students to gain the knowledge on hydrogen energy generation.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Summarize the basic concepts of thermal energy systems and identify coal and ash handling systems used in steam power plants.	1	1
CO2	Identify renewable energy resources and their utilization.	1,6,7	1
CO3	Discuss the principles of energy conversion of wind, geothermal, ocean, biomass, and biogas energy systems.	1,6,7	1,2
CO4	Describe the methods used to generate Hydrogen energy.	1, 7	1
CO5	Describe the main characteristics of renewable energy sources and their comparison with fossil fuels.	1,6,7	1
CO6	Investigate the design parameters of biogas digesters.	1,2,3,7	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4		√				
CO5		√				
CO6				√		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3					2	2						3		
CO3	3	2				2	2						3	2	
CO4	3						1						3		
CO5	3					2	1						3		
CO6	3	2	1										3	1	1
Average	**3**	**2**	**1**			**2**	**1.5**						**3**	**1.5**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Thermal Energy Conversion System: Review of energy scenario in India, General Philosophy and need of Energy, Different Types of Fuels used for steam generation, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace,

Coal and Ash Handling: Chimneys: Natural, forced, induced and balanced draft, Cooling towers and Ponds

Unit-2

Diesel Engine Power System: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, filters, centrifuges, Oil heaters, intake and exhaust system, Layout of diesel power plant.

Solar Energy and Applications: Solar radiation - Availability- Measurement and estimation- Solar radiation geometry

Hydrogen Energy: Introduction to hydrogen energy, methods of hydrogen production (electrolytic and thermo chemical method).

Unit-3

Wind Energy: Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine

Tidal Power: Power generation using OTEC - Wave and Tidal energy - Scope and economics - Limitations**.**

Hydro-Electric Energy: General layout of hydel power plants, Hydrographs, flow duration and mass curves and numerical. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves.

Unit-4

Biomass Energy Sources: Biomass production for energy farming, origin of Biomass-Photosynthesis process, Energy through fermentation -Ethanol Production from sugarcane and starch, Biomass characteristics.

Bio-Methanization: Anaerobic digestion, Basic principles, factors affecting biogas yield, biogas digester (floating gas holder and fixed dome type with working principle and diagram).

Geothermal Energy Conversion: Availability - Geographical distribution.

CASE STUDIES

1. Prepare the report on Thermal power plants in INDIA.
2. Prepare the report on Diesel and Hydel power plants in Karnataka.
3. Study on Wind Energy distribution/resources across Karnataka.
4. Parameters to be considered foe site selection of hydroelectric power plant.

TEXT BOOKS

1. P.K Nag, “Power Plant Engineering”, Tata McGraw Hill, 4th Edition, 2017.
2. Morse F.T “Power Plant Engineering”, Van Nostrand Reinholdire, 3rd Edition, 1953.
3. B H Khan, “Non-conventional energy resources”, McGraw Hill Education, 3rd Edition, 2017.
4. A. W. Culp Jr, “Principles of Energy conversion”, McGraw Hill, 2nd Edition, 2000.

REFERENCE BOOKS

1. Stanier, “Plant Engg. Hand Book, McGraw Hill, 1998.
2. Domakundawar, “Power Plant Engineering”, Dhanpath Rai & Co, 5th Edition, 2008
3. S.P. Sukhatme, “Solar Energy: principles of Thermal Collection and Storage”, Tata McGraw-Hill, 3rd Edition, 2009.
4. L.L. Freris, “Wind Energy Conversion Systems”, Prentice Hall, 1990.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/topics/engineering/ash-handling-plant
2. https://www.researchgate.net/publication/267838546_Survey_of_modern_power_plants_driven_by_diesel_and_gas_engines.
3. https://www.journals.elsevier.com/international-journal-of-hydrogen-energy
4. https://www.sciencedirect.com/science/article/pii/S2211467X19300379

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_me86/preview
2. https://nptel.ac.in/courses/103107157
3. https://onlinecourses.nptel.ac.in/noc21_ch11/preview
4. https://onlinecourses.nptel.ac.in/noc22_ch27/preview

Course Title	Automotive Engineering	Course Type	Soft Core

Course Code	B20ERS514	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course deals with the components used in automotive like, engine transmission system, braking system and fuel supply system. It emphasizes on emissions, emitting from various types of vehicles, emission norms and methods of controlling emissions. This course explores the necessity of cooling and lubricating system, the advance ignition systems, steering and brake system to control the vehicles.

COURSE OBJECTIVES

1. To understand the construction and working of components used in petrol and diesel engines.
2. To explore functions of electrical components used in Ignition system of an automobile.
3. To explain the importance of emission control, alternate fuels and engine modifications for alternate fuels.
4. To recognize the need for safety and comfort in automobiles.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the construction and working of engine components, cooling and lubrication systems	1	1
CO2	Illustrate the working of automotive fuel supply systems and their limitations	1	1
CO3	Demonstrate knowledge of engine emissions, its control and emission standards for sustainable development.	1,6,7,8	1
CO4	Identify the different types of Ignition systems used in automobiles and interpret forced induction principles.	1, 2	1
CO5	Illustrate the construction and working of transmission systems and their components.	1	1
CO6	Recognize the different types of suspension systems, Steering systems, braking systems and describe their working principles.	1	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3		✓				
CO4		✓				
CO5		✓				
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3												1		
CO2	3												1		
CO3	3					2	2	2					1		
CO4	3	1											1		
CO5	3												1		
CO6	3												1		
Average	**3**	**1**				**2**	**2**	**2**					1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Engine Components, Cooling and Lubrication: Spark Ignition (SI) & Compression Ignition (CI) engines, cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve-Timing diagram, Types of combustion chambers for S.I. Engine and C.I. Engines, choice of materials for different engine components, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements.

Unit-2

Fuel Supply System: Fuel supply in SI engines- Fuel mixture requirements for SI engines, Working principle of simple carburetors, Injection systems -Single-point body injection, multipoint fuel injection, Inline distributor pump, Common rail, fuel injection pumps and injectors.

Engine Emissions and Control Systems: Automotive emission controls, Controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Catalytic converter, Emission standards.

Unit-3

Ignition System, Superchargers and Turbochargers: Introduction, objectives, Ignition System Types, Comparison between Battery and Magneto Ignition System, Drawbacks (Disadvantages) of Conventional Ignition Systems, Advantages of Electronic Ignition System, Types of Electronic Ignition System, Forced Induction, Types of superchargers, Turbocharger and comparisons.

Transmission System: General arrangement of clutch, Principle of friction clutches, Torque transmitted, Fluid flywheel, Single plate, multi-plate and centrifugal clutches.

Gear Box: Necessity for gear ratios in transmission. Self-study: synchromesh gear boxes.

Unit-4

Suspension, Springs and Brakes: Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system. Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system.

Steering System: Steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer and neutral steer.

CASE STUDIES

1. Prepare literature survey report on “Next generation Tesla cars credibility in Indian road system”.
2. Prepare literature survey report on “compare the efficiency of existing EV (Electric Vehicles) with conventional automotive vehicles”.
3. Prepare report on “How to overcome existing EV (Electric Vehicles) vehicle battery system problems”.
4. Prepare report on” Next-generation low carbon vehicles”
5. Prepare report on “Future of Automotive Industry with integration of software development”.

6. Prepare report on "Existing EV vehicles and their comparative analysis"

TEXT BOOK:

1. Kirpal Singh, "Automobile Engineering", Volume 1&2, The world book depot, 14th Edition, 2021.

2. R.B. Gupta "Automobile Engineering", Aman Book Stall, 1st Edition, 2014.

REFERENCE BOOKS:

1. William.H.Crouse, "Automotive Mechanics", McGraw-Hill, 10th Edition, 2006.

2. Mathur and Sharma "Internal Combustion Engines", Dhanpat Rai Publications, 8th Edition, 2016.

3. V Ganesan, "Internal Combustion Engines", McGraw-Hill, 4th Edition, 2012.

4. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill, 2nd Edition, 2018.

JOURNALS/MAGAZINES

1. https://www.springer.com/journal/International Journal of Automotive Technology
2. https://www.sae.org/publications/magazines/automotive-engineering
3. https://www.resurchify.com/impact/category/Automotive-Engineering

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/Fundamentals of Automotive Systems

Course Title	Statistical Quality Control				Course Type		Soft Core	
Course Code	B20ERS515	Credits	3		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

In industry, graduates are required to judge quality of raw materials, work in process and that of final products continuously to maintain quality as per requirement. This is a very important activity and involves intermittent or continuous manual or automated inspection of parameters to collect data and analyze it using statistical quality control techniques to interpret quality of raw materials, work in process and final products. Based on this need, this course has been designed to provide the necessary knowledge and skills in statistical quality control techniques.

COURSE OBJECTIVES

1. To understand the basic concepts and statistical underpinnings of quality monitoring.
2. To learn various available statistical tools and economical design issues associated with the quality monitoring.
3. To demonstrate the ability to design and implement these tools.
4. Develop strategies for conducting design of experiments in process improvements.
5. Perform Reliability evaluation of Mechanical, Electrical, Electronics and Software Technology Systems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Demonstrate the statistical methods for enhancement of quality technology and management.	1,2	1,2
CO2	Apply and examine the modern statistical methods for process quality control and improvement.	1,2, 9	1,2
CO3	Construct and interpret control charts for variables and attributes to determine their state of statistical control.	1,2,9	1,2

CO4	Analyze the various parameters of operating characteristics curve using Sampling techniques.	1,2	1,2
CO5	Perform analysis of process capability and reliability aspects of production processes.	1,2,3,9,10	1,2
CO6	Analyze the data and develop the process chart using Minitab statistical software.	1,2,3,5,9,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4		√		√		
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											1	2	
CO2	3	2	1						2				1	3	
CO3	3	2	1						2				1	3	
CO4	3	2	2						2				1	3	
CO5	2	2	2										1	3	
CO6	3	3			1				2	1			1	3	
Average	**2.8**	**2.2**	**1.5**		**1**				**2**				**1**	**2.8**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Dimensions of Quality, Statistical Methods for Quality, Quality costs. Quality assurance, ISO 9000, 14000 standards. Design for Six Sigma: Overview of DMAIC phases, DFSS, DMADV Method.

Statistical Process Control: Chance and assignable causes of variation. Statistical basis of control charts, Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational sub groups. Analysis of patterns of control charts.

Unit-2

Control Charts for Variable and Attribute Data: Controls charts for mean and Range, Control charts for mean and standard deviation. Controls chart for fraction non- conforming (p, np, 100p charts), Control chart for non-conformities (c and u charts).

Process capability: Methods of estimating process capability, Process capability indices- cp and cpk

Unit-3

Advanced Control Charts: Control charts for Individual measurements, Cumulative sum, exponentially weighted moving average, Group control charts

Acceptance Sampling: Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and Consumer's Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans.

Unit-4

Reliability and Life Testing: Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, parallel and series-parallel device configurations. Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy, Product life cycle.

Experimental Design for Process Improvement: General model of a process, Examples of designed experiments in process improvement, Principles of experimentation, Guidelines for designing experiments, Completely randomized designs (CRD), Randomized block designs (RBD), Factorial experiments – 22 design..

Simulation on Statistical tool (only for Assignment)

Sl. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Construction and interpretation of statistical control charts a. X-bar & R-chart b. X-bar & s-chart c. np-chart d. p-chart e. c-chart f. u-chart	Minitab software	Hands on Experience
2.	Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves	Minitab software	Hands on Experience
3.	Calculation of process capability	Minitab software	Hands on Experience

CASE STUDIES

1. Application of SQC in packaging Industry
2. Implementation of SQC and Fuzzy failure mode and effect analysis in various automobile and manufacturing sector-A case study review.
3. Assessing the Quality of product using SQC Maps: A Case study
4. SQC in MSME'S/SME'S: A case study

TEXT BOOKS

1. Grant, Eugene .L, "Statistical Quality Control", McGraw-Hill, 7th Edition, 2006.
2. L.S.Srinath, "Reliability Engineering", Affiliated East west press, 4th Edition, 2009.
3. Mahajan, "Statistical Quality Control", Dhanpat Rai, 2016.

REFERENCE BOOKS

1. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
2. R.C.Gupta, "Statistical Quality Control", Khanna Publishers, 6th Edition, India, 2003.
3. Besterfield D.H Quality Control, New Jersey, Prentice Hall, 1993.
4. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 2002.

JOURNALS/MAGAZINES

1. IEEE Transactions on Industrial Informatics
2. International journal of Production Research
3. Journal of Industrial Information Integration
4. International Journal of Production Research
5. International Journal of Production Economics
6. Journal of Manufacturing Technology Management
7. Journal of Product Innovation Management

8. Reliability Engineering & System Safety

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/110105088
2. https://www.udemy.com/course/statistical-quality-control-sqc/
3. https://www.udemy.com/course/mastering-statistical-quality-control-with-minitab/

Course Title	**Smart Materials**				**Course Type**		**Open Elective**	
Course Code	**B20MEO501**	**Credits**	**3**		**Class**		**V Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Overview of the course is to enhance holistic development of students and improve their knowledge about the smart materials, MR, ER fluids, Biomimetics and smart actuators, advanced in smart structures, smart composites and applications of smart materials.

COURSE OBJECTIVES

The objectives of this course are to:

1. Understand the basic concepts of composites and ceramics materials, electro-magnetic materials and shape memory alloys
2. Study about the MR and ER fluids, High-Band Width, Low Strain Smart Sensors and Application of Smart Sensors for Structural Health Monitoring (SHM)
3. Analyze the smart actuators and smart composites, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control and Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Apply the fundamental knowledge of smart materials, smart structures, piezoelectric, MR, ER fluids to solve problems in the field of medicine and engineering.	1	1
CO2	Identify, compare and contrast alternative solution processes to select the best process of smart actuators in automobiles and biomedical field.	1, 2	1
CO3	Generate information through appropriate tests to improve or revise the design of smart composites.	1, 2, 3	2
CO4	Recognize the need of analysis to good problem definition of smart structures.	1, 2, 3	2
CO5	Establish a relationship between measured data and underlying physical principles smart composites applications for corrosion coating and self-healing and MEMs products.	1, 2, 3,4	3
CO6	Examine the relevant methods and techniques of advances in Sensing applications of smart sensors of structural health monitoring.	1, 2, 3,4,5	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4			✓			
CO5				✓		
CO6				✓		

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	3	2											2		
CO3	3	2	1										1	2	
CO4	3	2	1										1	2	
CO5	3	3	1	1									1	2	2
CO6	3	2	1	1	1								1	2	2
Average	**3**	**2.2**	**1**	**1**	**1**								**1.3**	**2**	**2**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Overview of Smart Materials: Introduction to Smart Materials - Smart structures - classification of smart structures, common smart materials. Piezoelectric materials, piezoelectric effect, Piezoceramics, Piezopolymers, Shape memory alloys (SMAs) - Shape memory effect - Shape memory polymers, Introduction to Electro-active Materials, Electro-active Polymers, Ionic Polymer - Electro-rheological Fluids - Magneto Rhelological Fluids.

Unit-2

Smart Actuators: Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magneto-volume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control**.**

Unit-3

Smart composites: Review of Composite Materials, Micro and Macro-mechanics, Laminated Composites based on the Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, governing Equation of Motion. Advances in smart structures; Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials.

Unit-4

Applications: Elastic memory composites, Smart corrosion protection coatings, Self-healing materials, MEMS - MEMS Product development - Deployment devices - Molecular machines.

Sensing Applications; Piezeoelctric Strain Sensors, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM).

TEXT BOOKS

1. Mohsini Shahenpoor (Ed.), "Fundamentals of Smart Materials", RSC, Cambridge, UK, 2020

2. Chander Prakash, Sunpreet Singh, J. Paulo Davim (Ed.), Functional and Smart Materials, CRC Press, 1st Edition, 2021.
3. Chang Liu, "Foundation of MEMS", Pearson Education, 2nd edition, 2012.
4. M.V.Gandhi and B.S.Thompson, "Smart Materials and Structures", Chapmen & Hall, London, 1992.
5. Mel M. Schwartz, "Smart Materials", CRC Press, 1st Edition, 2009.
6. Donald J. Leo, "Engineering analysis of smart material systems", John Wiley & Sons, 1st Edition, 2007.

REFERENCE BOOKS

1. Radhashyam Rai, "Smart Materials for Smart Living", Nova Publishers, USA, 2017.
2. Qun Wang (Ed.), "Smart Materials for Tissue Engineering", RSC, UK, 2017.
3. Johannes Michael Sinapius, Adaptronics – "Smart Structures and Materials", Springer, 2020.
4. Anca Filimon (Ed.), "Smart Materials": Integrated Design, Engineering Approaches and Potential Applications, CRC Press, 2019.
5. Vijay K. Varadan, "Smart material systems and MEMS: design and development methodologies", John Wiley & Sons, 2006.
6. Seung- Bok Choi & Young-Min Han, "Piezoelectric actuators: control applications of smart materials", CRC Press - 2010.
7. Kwang J. Kim & S. Tadokoro, "Electroactive polymers for robotics applications: artificial muscles and sensors", Springer, 2007

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology
2. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/113/102/113102080/
2. https://nptel.ac.in/courses/122/102/122102008/

<table>
<tr><td>Course Title</td><td colspan="3">Flow Analysis Using Ansys Fluent</td><td colspan="2">Course Type</td><td colspan="2">Hard Core</td></tr>
<tr><td>Course Code</td><td>B20ER0504</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>2</td><td>3</td><td>3</td><td>13</td><td>26</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

This course provides practical knowledge related to Ansys-Fluent and demonstrates the concept for real-time applications in Mechanical engineering domain. It is intended to cater to the needs of budding mechanical engineers in fluid flow applications. Ansys-Fluent uses numerical analysis and algorithms to solve and analyse problems of fluid flow and focuses on research culture in Fluid kinematics and dynamics.

COURSE OBJECTIVES

1. To provide the knowledge to understand the basics of Ansys-fluent.
2. To analyse the fluid flow over a flat plate and through the circular pipe.
3. To provide knowledge for fluid flow over the immersed bodies using Ansys-Fluent.
4. To analyse the Aerodynamic properties for various geometries.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply the computational fluid dynamic fundamentals by using advanced solvers.	1,2,5	1,2
CO2	Analyse the flow of fluid over a flat plate, through circular pipe and document the results in the form of technical report.	1,2,3,5,9,10	1,2,3
CO3	Analyze the flow measuring devices and document the results in the form of technical report.	1,2,3,5,9,10	1,2,3
CO4	Investigate the behavior of flow around different structured objects and document the results in the form of technical report.	1,2,3,5,9,10	1,2,3
CO5	Validate the Aerodynamic properties for flow over cylinder and document the results in the form of technical report.	1,2,3,5,9,10	1,2,3
CO6	Estimate the Aerodynamic properties for flow over Symmetrical Aero foil and document the results in the form of technical report.	1,2,3,5,9,10	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2				✓		
CO3				✓		
CO4				✓		
CO5				✓		
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1				1	1			2	1	
CO2	3	3	1		1				1	1			2	1	1
CO3	3	3	1		1				1	1			2	1	1
CO4	3	3	1		1				1	1			2	1	1
CO5	3	3	1		1				1	1			2	1	1
CO6	3	3	1		1				1	1			2	1	1
Average	**3**	**2.83**	**1**		**1**				**1**	**1**			**2**	**1**	**1**

Note: 1-Low, 2-Medium, 3-High

Theory

Basics of Computational Fluid Dynamics

Fluid properties, Types of Fluid flow, Introduction to CFD, Capabilities of CFD, Discussion on Governing Equations for Fluid Dynamics, Models of the Flow- Basic discretization method, Finite Control Volume, Initial and Boundary conditions, Discussion on Turbulent fluid flow models and Basics of Ansys Fluent- Preprocessor, Processor, and post processor.

Practice

Sl. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1	Analysis of Flow over a flat plate	Ansys-Fluent	Hands on Experience
2	Analysis of Flow through circular pipe	Ansys-Fluent	Hands on Experience

3	Analysis of Flow Measuring devices (Venturi meter and orifice meter)	Ansys-Fluent	Hands on Experience
4	Estimation of minor losses in flow domain in a circular pipe	Ansys-Fluent	Hands on Experience
5	Analysis of Notches	Ansys-Fluent	Hands on Experience
6	Flow over a cylinder	Ansys-Fluent	Hands on Experience
7	Flow over a symmetrical Aero foil	Ansys-Fluent	Hands on Experience

TEXT BOOKS

1. Suhas V Patankar, "Numerical Heat Transfer and Fluid Flow", CRC Press, 1st Edition, 2018.

REFERENCE BOOKS

1. Norman Rhodes, "Computational Fluid Dynamics in Practice", Wiley, 1st Edition, 2001.
2. Jhon D Anderson, "Fundamental of Computational fluid dynamics", McGraw-Hill Publications, 6th Edition, 1995

JOURNALS/MAGAZINES

1. International Journal of Computational Fluid Dynamics, Taylor and Francis.
2. Progress in Computational Fluid Dynamics, An International Journal, Inderscience Publishers.

SWAYAM/NPTEL/MOOCs:

1. Computational Fluid Dynamics, by Prof. Suman Chakraborty, IIT Kharagpur (https://onlinecourses.nptel.ac.in/noc21_me126/preview)
2. Foundation of Computational Fluid Dynamics, by Prof. Vengadesan, IIT Madras (https://onlinecourses.nptel.ac.in/noc20_me64/preview)

Course Title	**Fluid Machines Lab**				**Course Type**		**Hard Core**	
Course Code	**B20ER0505**	**Credits**	**1**		**Class**		**V Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Fluid Machines Lab is focused on the applications of theoretical concept learned from the Fluid mechanics and machines course. The students will be conducting experiments in the laboratory pertaining to determination of losses of fluid flow through pipe, calibration of flow measuring devices, performance testing of Hydraulic turbines, Centrifugal Pumps, blowers and Reciprocating pumps.

COURSE OBJECTIVES

1. The course will impart practical knowledge in verification of principles of fluid flow.
2. To introduce various fluid flow measuring devices and determine discharge.
3. To introduce the experimental procedure in conducting the performance testing of various fluid machineries.
4. To understand the performance characteristics of various fluid machineries.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the properties of fluids.	1	1
CO2	Determine the energy losses for fluid flow through pipe and its fittings and document the results in the form of technical report.	1,2,3,9,10	1,2,3

CO3	Determine the discharge for fluid flow through pipes and open channel and document the results in the form of technical report	1,2,3,9,10	1,2,3
CO4	Compute the coefficient of impact for jet striking the vanes and document the results in the form of technical report.	1,2,3,9,10	1,2,3
CO5	Conduct experiments, interpret the data, analyze the Centrifugal and reciprocating power absorbing machines and document the results in the form of technical report.	1,2,3,9,10	1,2,3
CO6	Conduct experiments, interpret the data, analyze the hydraulic power generating machines and document the results in the form of technical report.	1,2,3,9,10	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3			✓			
CO4			✓			
CO5				✓		
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3									1			2		
CO2	3	2	1						3	2			3	2	1
CO3	3	2	1						3	2			3	2	1
CO4	3	2	1						3	2			3	2	1
CO5	3	3	1						3	3			3	2	1
CO6	3	3	1						3	3			3	2	1
Average	**3**	**2.4**	**1**						**3**	**2.2**			**2.8**	**2**	**1**

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Determination of friction factor and Reynold's number for the fluid flowing through pipes.
2. Determination of minor losses for fluid flow through pipe fittings.
3. Calibration of Veturimeter, Orifice meter, flow nozzle and V notch.
4. Determination of force developed by impact of jets on vanes.

Part-B

1. Performance test on Single stage Centrifugal pump to draw Main and Operating characteristic curves.
2. Performance test on Multi- stage Centrifugal pump to draw Main and Operating characteristic curves.
3. Performance test on Reciprocating pump to draw Main and Operating characteristic curves.
4. Performance test on two stage Reciprocating air compressor.
5. Performance test on Centrifugal air blower.
6. Performance test on Pelton turbine to draw Main and Operating characteristic curves.
7. Performance test on Francis turbine to draw Main and Operating characteristic curves.
8. Performance test on Kaplan turbine to draw Main and Operating characteristic curves.

TEXT BOOKS

1. Dr. Bansal, "Fluid Mechanics and Machinery", R.K.Lakshmi Publications, 2018.
2. Jagadish Lal, "Fluid Mechanics and Hydraulic", Metropolitan Book Company, 4th edition 2012.

REFERENCE BOOKS

1. Yunus A. Cengel and John M.Cimbala, "Fluid Mechanics (SI Units)", 4th edition, Tata McGraw Hill, 2019.
2. Pijush.K.Kundu, "Fluid Mechanics", Taylor & Francis, 3rd edition, 2015.

JOURNALS/MAGAZINES:

1. https://www.cambridge.org/core/journals/journal-of-fluid-mechanics

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_me31/preview
2. https://www.my-mooc.com/en/categorie/mechanical-engineering

Course Title	Heat Engine Lab				Course Type		Hard Core	
Course Code	B20ER0506	Credits	1		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

This course deals with the conduction of experiments to find the various properties of fuel such as Flash point, Fire point, Calorific value, Viscosity and these properties are essential to find the substitute fuel for IC engine. This course also deals with evaluation of performance parameters of IC Engines and enable the students to have hands on experience to conduct performance test on IC engines. Also describes the method of determining the area of regular and irregular geometry by using planimeter. The practical work enables the students to gain expertise and become familiar automobile sector.

COURSE OBJECTIVES

1. This course will provide a basic understanding of fuel properties and its measurements using various types of measuring devices
2. To determine area of regular and irregular geometrical figures
3. Energy conversion principles, analysis and understanding of I C Engines will be discussed. Application of these concepts for these machines will be demonstrated.
4. Performance analysis will be carried out using characteristic curves
5. To give students hands on practice to evaluate performance of petrol and diesel engines.
6. To know the various heat losses by drawing heat balance sheet.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Evaluate the flash and fire point of the given petroleum products by using suitable apparatus and suggest the suitable lubricant for stated engine conditions.	1,2,9	1
CO2	Calculate the area of regular and irregular geometrical surfaces.	1,9	1
CO3	Compare calorific value of the fuels and estimate the amount of energy content.	1,2, 9	1,2
CO4	Draw and interpret the valve timing diagram of four stroke engine.	1,9	1,2,3

CO5	Evaluate the frictional power in a multi cylinder engine by Morse test.	1,2,9	1,2,3
CO6	Conduct experiments, interpret and analyze the result of IC engine performance and document the results in the form of technical report.	1,2,4, 9,10	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2		✓				
CO3				✓		
CO4				✓		
CO5				✓		
CO6					✓	

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1							1				1		
CO2	2								1				2	1	
CO3	3	2							1				2	1	
CO4	3								3				2	1	1
CO5	3	3							3				2	1	1
CO6	3	2		1					3	3			2	2	1
Average	**2.6**	**2**		**1**					**2**	**3**			**1.8**	**1.2**	**1**

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Determination of area of regular and irregular surface Using Planimeter.
2. Draw the Valve timing diagram of four stroke diesel engine.
3. Determination of Viscosity of a lubricating oil using Redwoods, Saybolt and Torsion Viscometers.
4. Determination of Calorific value of gaseous fuels.
5. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleveland's (Open Cup) Apparatus.

Part-B

Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio heat balance sheet for the engines.

a. Four stroke diesel Engine
b. Four stroke petrol Engine
c. Multi cylinder petrol Engine (Morse test)
d. Two stroke petrol engine
e. Variable compression ratio I.C. Engine.

TEXT BOOK

1. P.K. Nag "Engineering Thermodynamics" Tata McGraw Hill, 6th Edition 2018.

REFERENCE BOOKS

1. R.B.Mathur and R.P.Sharma, Internal Combustion Engines., Dhanpat Rai publication, 2002.

2. Yunus A. Cenegal and Michael A. Boles, “Thermodynamics -An Engineering Approach”, Tata McGraw-Hill publication, 2002.
3. Mahesh M Rathore, “Thermal Engineering”, Tata McGraw-Hill, Prentice-hall of India Pvt. Ltd.

JOURNALS/MAGAZINES

1. International Journal of Heat and Mass Transfer
2. American Institute of Aeronautics and Astronautics

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Course Title	Indian Traditions and Culture				Course Type		FC	
Course Code	B20PA0501	Credits	1		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**1**	**1**	**13**	**0**	**50 %**	**50 %**

COURSE OBJECTIVES

1. Provide conceptual knowledge of Indian culture and traditions
2 .Introduce students to the science and technological advancements related to Indian culture
3. Help students understand the Indian spiritual aspects of Indian culture
4. Help learners understand the factors which unite the diverse cultures of India

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Gain conceptual understanding of Indian culture and traditions.	8,9,10	
CO2	Describe various ancient theories in treatment of any disease.	8,9,10	
CO3	Appreciate the science and technological advancements in ancient India.	8,9,10	
CO4	Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.	8,9,10	
CO5	Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food	8,9,10	
CO6	Understand India as a land united by cultural diversity.	8,9,10	

BLOOM’S LEVEL OF THE COURSE OUTCOMES

CO	Bloom’s Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√				
CO3	√	√				

CO4	√	√				
CO5	√	√				
CO6	√	√				

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								2	2	2					
CO2								2	2	2					
CO3								2	2	2					
CO4								2	2	2					
CO5								2	2	2					
CO6								2	2	2					
Average								**2**	**2**	**2**					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Indian Tradition

Culture: Indus Valley Civilization and early cultural practices, The Vedic culture, Influence of Buddhism and Jainism on Indian Culture, Influence of Islam and Christianity, Indian Cultural Renaissance of the 19th Century

Religion: Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity

Art: Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, puppetry

Architecture: – Engineering and Architecture in Ancient India, Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India v. Literature- Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

Unit-2

Contribution of ancient India to Science and Maths

Development of Science in Ancient India: Astronomy, Mathematics, Medicine, Metallurgy.

Scientists of Ancient India: Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya. Science- Kanad, Varahamihira, Nagarjuna. Medical Sciences (Ayurveda and Yoga) - Susruta, Charaka, Yoga and Patanjali

Science and Scientists in Medieval India: Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.

Scientists in Modern India: Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir Bhabha, Dr,Vikram Ambalal Sarabhai, ,Dr. APJ Abdul Kalam.

Unit-3

Indian Spiritual Aspects

Hindu Spirituality Based on Shruti and Smriti: Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata and Bhagavat Gita.

Hata Yoga and Pranayama: Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga;

Bhakti Yoga: Yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

Buddhist, Jaina Spiritualities: Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - Ashtanga Marga.

Unit-4

Unity in Diversity

Commensality and the Significance of Food: Eating Together as Family and as a Society, Food at Rituals, annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World

Celebrating Diverse Festivals: Festival Types: Religious and Seasonal, Religious - Holi, Diwali, Ganesh Chaturthi, Janmashtami, Mahavir Jayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals) - Baisakhi, Pongal, Sankranti

Attire: Indus Valley Civilization, Vedic period, Modern India.

TEXT BOOKS

1. Sundararajan K.R., "Hindu Spirituality - Vedas through Vedanta, Cross Road Publications", New York, 1997.
2. Griffiths Bede, "Yoga and the Jesus Prayer Tradition, Asian Trading Corporation", Bangalore, 1992
3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998
4. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.
5. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

6th Semester

Course Title	Heat Transfer				Course Type		Hard Core	
Course Code	B20ER0601	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Tutorial	IA	SEE
	Tutorial	1	2	2				
	Total	**3**	**4**	**4**	**26**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Heat Transfer is the study of the modes of heat transfer and the laws governing the modes of Heat Transfer. It provides the knowledge on insulation for various thermal applications. Application of concept of heat transfer for applications in the field of Heat Exchanger design and phase change phenomenon.

COURSE OBJECTIVES

1. To introduce the basic modes of heat transfer and their governing equations.
2. To identify the combined heat transfer processes for steady and unsteady state.
3. To analyze conduction, convention and radiation problems.
4. To design heat exchangers and analyze boiling and condensation process.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the three modes of heat transfer and their governing equations.	1	1
CO2	Analyse the combined mode of heat transfer through composite walls and fins.	1,2	1,2
CO3	Apply Lumped system and Heisler chart analysis to interpret transient heat conduction phenomenon.	1,2,3,5	1,2
CO4	Identify and apply the appropriate method to solve heat transfer problems.	1,2	1,2
CO5	Design heat exchangers using LMTD and Effectiveness-NTU method.	1,2,3,5	1,2
CO6	Analyse the phase change convective process during boiling and condensation process.	1,2	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4		✓				
CO5			✓			

CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	2											1	2	
CO3	3	3	2		1								2	1	
CO4	3	2											1	1	
CO5	3	2	2		1								1	1	
CO6	2	3											1		
Average	**2.8**	**2.4**	**2**		**1**								**1.5**	**1.25**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Heat transfer: Modes and Basic governing laws of heat transfer, Boundary conditions, Thermal contact resistance, Overall heat transfer coefficient, 3-D heat conduction equation in Cartesian co-ordinates, Discussion on 3-D conduction equation in Cylindrical & Spherical coordinates, 1-D steady state heat conduction without heat generation (plane wall, cylinders & spheres), Thermal Resistances in Series and in Parallel, Numerical.
Conductive Heat transfer: Critical thickness of insulation on spheres and cylinders, Introduction to fins, Discussion on governing equations for different conditions of fins, effectiveness & efficiency of fin, Numerical.

Unit-2

1-D Transient Conduction: Lumped system Analysis, Use of Heisler's charts for transient conduction in plane slab, long cylinder, and sphere. Numerical examples, Introduction to Numerical analysis of Heat conduction
Natural Convection: Hydrodynamic and thermal boundary layer over a flat plate and Flow through duct, critical Reynolds number, Application of dimensional analysis for free convection, Numerical.

Unit-3

Forced Convection: Applications of dimensional analysis for forced convection, physical significance of Reynolds, Prandtl, Stanton, Nusselt numbers, Numerical on applications involved with laminar and turbulent flow.
Radiation Heat transfer: Thermal radiation, definitions of various terms, Laws of black body radiation-Stefan Boltzmann, Wein's displacement law, Kirchhoff's law, Planck's law, Black body concept, Discussion on radiation shape factor, Discussion on heat exchange between two gray bodies (Infinite parallel planes), Discussion on effect of radiation shields, Numerical.

Unit-4

Heat Exchangers: Classification, Overall heat transfer coefficient, fouling and fouling factors, LMTD, Discussion on effectiveness-NTU method of analysis of heat exchangers, Numerical.
Phase Change Convective Process: Condensation and its types, Discussion of condensation with Nusselt theory, Reynolds number for condensate flow. Boiling-types of boiling, Regimes of pool boiling, Pool boiling correlations, Numerical.

CASE STUDIES

1. Develop the python programming to understand the one dimensional heat equation and draw the temperature variation.
2. Develop the python programming for analyzing the 2D temperature distribution.
3. Development of a MATLAB Program for Transient Heat Transfer Coefficient Studies.
4. How refractory layers are organized in furnace construction and explain the conceptual design.
5. Discuss the heat transfer theory behind the design of Microwave oven and Egg boiler.

TEXT BOOKS

1. Tirumaleshwar, "Heat & Mass Transfer", Pearson Education, 2nd Edition, 2012.
2. Ozisik, "Heat transfer-A basic approach", Tata McGraw Hill, 1st Edition, 1985.

REFERENCE BOOKS

1. Yunus A-Cengel, "Heat and Mass Transfer", Tata McGraw hill, 6th Edition, 2020.
2. Mahesh M Rathore, "Heat and Mass Transfer", Laxmi publications, 3rd Edition, 2016.
3. Frank Kreith, Raj. M. Manglik, Mark. S. Bohn, "Principles of Heat Transfer", Thomas Learning, 7th Edition, 2010.
4. Frenk P.Incropera and DavidP.Dewitt, "Principles of Heat and Mass transfer", John Wiley and sons, 6th Edition, 2018.
5. R K Rajput, "A Textbook of Heat and Mass Transfer", S Chand Publications, 7th Edition, 2019.

JOURNALS/MAGAZINES

1. The Journal of Heat Transfer, ASME.
2. International Journal of Heat and Mass Transfer, Elsevier.

SWAYAM/NPTEL/MOOCs:

1. Heat Transfer, By Prof. Ganesh Viswanathan, IIT Bombay, https://onlinecourses.nptel.ac.in/noc20_ch12/preview
2. Heat Transfer, By Prof. Sunando Dasgupta, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc19_ch23/preview

Course Title	**Finite Element Methods**				**Course Type**		**Hard core**	
Course Code	**B20ER0602**	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Tutorial	IA	SEE
	Tutorial	1	2	2				
	Total	**3**	**4**	**4**	**26**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

The FEM course deals with the Steps involved in FEM, Selection of Elements, and analyze 1D and 2D solutions. This course covers higher Order Elements, the Hermite Shape function and 1D heat transfer problems.

COURSE OBJECTIVES

1. To enable the students to understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and heat transfer problems.
2. To provide systematic and comprehensive knowledge of the basics of the Finite element method as an analysis tool.
3. To teach the students the characteristics of various elements and the selection of suitable elements for the problems being solved.
4. To make the students derive finite element equations for simple and complex elements.
5. To make the student solve for field variable for thermal composite wall problems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Discuss the steps involved in the Finite Element Method.	1	1,2
CO2	Select the suitable elements and apply boundary conditions for structural analysis.	1,2,3	1,2
CO3	Provide FE solutions for bars, trusses, and beam for stated structural boundary conditions.	1,2,3,5, 12	1,2,3

CO4	Develop shape functions for Higher-Order Elements by using Lagrange's interpolation Method.	1,2,3	1,2, 3
CO5	Develop and apply the Hermite Shape function to determine the deflection in beams carrying concentrated and UDL loads.	1,2, 3	1,2,3
CO6	Apply the FEM method to solve 1D heat transfer on the pin- fins and composite walls.	1,2,3,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3				✓		
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3	2	
CO2	3	1											3	3	
CO3	3	3	2		3							1	3	2	1
CO4	3	3	2										3	3	1
CO5	3	3	2										3	2	1
CO6	3	3	3		3							1	3	3	1
Average	**3**	**2.66**	**2.2**		**3**							**1**	**3**	**2.5**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Introduction to FEM, Steps involved in FEM, Phases of FEM, Engineering applications, Advantages, Disadvantages, List of commercial FEM Packages.

Discretization: Types of elements used in FEM, Shape and behavior, Choice of element types, size and number of elements, Location of nodes, Node and Element numbering, coordinate systems, and Convergence criteria. Stiffness matrix and its properties.

Unit- 2

Interpolation polynomials: 1D Linear, quadratic and cubic. Simplex, complex, and multiplex elements. 2D PASCAL's triangle CST elements, 1D linear shape functions in NCS, and Jacobian for triangular element, numerical.

Solution of 1-D Bars: Derivation of element stiffness matrix, Numerical on bars on the uniform, stepped, and tapered cross-sections to analyze displacements, reactions and stresses by using penalty and elimination approaches.

Unit-3

Introduction: Types of trusses, Derivation of stiffness matrix, Numerical with 2 and 3 elements.

Higher Order Elements: Lagrange's interpolation, shape functions for higher order 1D elements - Quadratic and cubic element, iso-parametric, sub-parametric and super parametric elements, Shape function for linear

quadrilateral element, numerical

Unit-4

Beams: Hermite shape functions for beam element, Derivation of stiffness matrix using Hermite shape functions, Numerical on beams carrying concentrated & UDL.

Heat transfer: Steady-state heat transfer, 1D heat conduction governing equation, Boundary condition, Numerical on heat conduction and convection in composite walls, and pin fins.

CASE STUDIES

1. Parametric Finite Element Analysis of Bicycle Frame Geometries
2. Truss bridge structure frame section analysis by using Finite element analysis
3. Stress Analysis of the truck chassis using Finite Element Analysis (FEA)
4. Structural dynamic analysis of storage frames.

TEXT BOOKS

1. S. S. Bhavikatti, "Finite Element Analysis", New Age International publishers, 3rd Edition, 2015.
2. Tirupathi. R. Chandrapatla, Ashok. D. Belegundu, "Finite Elements in Engineering", Pearson Education India, 4th Edition, 2015.

REFERENCE BOOKS

1. J. N. Reddy, "Introduction to Finite Element Method", McGraw Hill, 4th Edition, 2020.
2. David Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Education, 2017.
3. Robert D. Cook, "Concepts and Applications of Finite Element Analysis", Wiley 4th Edition, 2009

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/finite-elements-in-analysis-and-design
2. https://www.hindawi.com/journals/mpe/si/632341/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112104116
2. https://onlinecourses.nptel.ac.in/noc20_me91/preview

Course Title	**Design of Transmission Elements**				**Course Type**		**Hard Core**	
Course Code	**B20ER0603**	**Credits**	**3**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Design of transmission elements deals with the basics of design concepts Involved in curved beams, springs, clutches and brakes. It provides the students with fundamental skills of engineering, and the ability to apply the theories of science to practice. This course would help to fill the gap the knowledge at graduation and step into producing the detailed design of gears & bearings in Industries.

COURSE OBJECTIVES

1. To enable students to design important machine elements such as springs, brakes, curved beams, flexible power transmission elements such as belts and ropes.
2. To enable students to design different gears such as spur gear, helical gear and bevel gear.
3. To help students in understanding and selection of ball and roller bearings from the standard design catalogue.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Solve for stresses in curved beams and design of springs.	1,2,3,6,8	1,2
CO2	Design belt and rope drives used in mechanical power transmission.	1,2,3,6,8	1,2
CO3	Design clutches and brakes for automotive applications.	1,2,3,6,8	1,2
CO4	Design spur and helical gears subjected to static, dynamic & wear load conditions.	1,2,3,6,8	1,2
CO5	Design bevel gear for different load conditions and recommend appropriate solution.	1,2,3,6,8	1,2
CO6	Design ball and roller bearings subjected to cyclic loads and speeds.	1,2,3,6,8	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2					✓	
CO3			✓			
CO4					✓	
CO5					✓	
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1			1		1					3	3	
CO2	2	2	3			1		1					3	3	
CO3	3	3	3			1		1					3	3	
CO4	2	3	3			1		1					3	2	
CO5	2	2	3			1		1					2	3	
CO6	2	3	1			1		1					3	3	
Average	**2.16**	**2.66**	**2.33**			**1**		**1**					**2.83**	**2.83**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Design of Belts and Ropes: Introduction to transmission systems, Selection and design of Flat & V-belts for different applications. Rope drives: selection of wire ropes.

Curved Beams: Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps.

Unit-2

Clutches and Brakes: Design of single plate and multi plate clutch, Design of Block / Shoe brakes (Single Shoe Brake only), Band brakes - Simple Band brakes, Self-locking of brakes, Heat generation in Brakes.

Design of Springs: Types of springs - stresses in helical springs of circular section. Leaf Springs: Stresses in leaf springs and problems.

Unit-3

Design of Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load.

Design of Helical Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.

Unit-4

Design of Bevel Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.
Ball and Roller Bearings: Bearing Life, equivalent bearing load, selection of bearings, Bearings for cyclic loads and speeds.

CASE STUDIES

1. Design a spring to withstand the weight of an elevator which varies from 800N to 1200N force and operating 8 Hrs /day.
2. Design a crane hook to lift the load of 8000N from a mine of depth 800m.
3. Design a clutch for a 150 cc bike by considering all the factors into consideration.
4. Design a gear of sugarcane crusher by considering all the factors into consideration.
5. Design a bearing for front suspension of a 350 cc bike.

DESIGN DATA HAND BOOKS

1. Lingaiah K, "Machine Design Databook", McGraw Hill Education, 2nd Edition, Vol1 & 2, 2017
2. Balaveera K Reddy and K Mahadevan, "Design Data Hand Book for Mechanical Engineers", CBS Publisher, 4th Edition, Kindle Edition, 2018.

TEXT BOOKS

1. Richard G Budynas and J Keith Nisbett, " Shiegly's Mechanical Engineering Design", McGraw Hill Education, 11th Edition, 2020.
2. V. B. Bhandari, **"**Design of Machine Elements" Tata McGraw Hill Publishing Company Ltd., 3rd Edition 2017.

REFERENCE BOOKS

1. Robert L. Norton, "Machine Design- An Integrated Approach", Pearson Education, 5th Edition, 2018.
2. M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R, SI Contributions by A P Harsha, "Design of Machine Elements", Pearson Education, 8th Edition, 2019.
3. C S Sharma and Kamlesh Purohit, "Design of Machine Design Elements", PHI, 10th Printing, 2015.

JOURNALS/MAGAZINES

1. Clutches and Brakes: Design and Selection - 2nd Edition - William C. (routledge.com)
2. http://www.ijerd.com/paper/vol12-issue1/Version-1/G12015667.pdf

SWAYAM/NPTEL/MOOCs:

1. NPTEL: Design of Machine Elements I (Mechanical Engineering) (digimat.in)
2. Gear and Gear Unit Design: Theory and Practice - Course (nptel.ac.in)

<table>
<tr><td>Course Title</td><td colspan="4">Product Design by Additive Manufacturing</td><td colspan="2">Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20EOS611</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practical</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

Additive Manufacturing (AM) which is commonly known as 3D printing is a process of joining materials to make objects from 3D model data by building the model layer on layer, as opposed to subtractive manufacturing methodologies, such as traditional machining. The basic principle of AM is that a model, initially generated using a three-dimensional Computer Aided Design (3D CAD) system, can be fabricated directly. AM technologies have

significantly evolved over the last decade because of their potential to extensively transform the nature of manufacturing processes, e.g., by enabling "Freedom of Design" in several industries are attracted by these technologies. Using AM, manufacturing of highly complex parts can be an economically viable alternative to convention al manufacturing technologies.

COURSE OBJECTIVES

Additive Manufacturing (AM) is an economically viable alternative to conventional manufacturing technologies for producing highly complex parts. The main objective of this course is to acquaint students with the concept of AM, various AM technologies, selection of materials for AM, basics of Design for Additive Manufacturing, and their applications in various fields. The course will also cover AM process plan including building strategies and post-processing

COURSE OUTCOMES (COs)

On successful completion of this course; the student shall be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply the fundamental knowledge of the working principles and process parameters of additive manufacturing processes to manufacture the components.	1	1,2,3
CO2	Identify, compare and contrast alternative solution processes to select the best process of additive manufacturing processes and suggest suitable methods for building a component.	1,2, 3	1,2,3
CO3	Generate information through appropriate tests to improve or revise the design of suitable post processing operation based on product repair requirement.	1,2, 3, 4	1,2,3
CO4	Recognize the need of analysis to good problem definition of **a** development of working model using additive manufacturing Processes.	1, 2, 3	1,2,3
CO5	Establish a relationship between measured data and underlying physical principles to Identify the need of design for additive manufacturing.	1, 5	1,2,3
CO6	Examine the relevant methods and techniques to Identify design constraints and choose a metal additive manufacturing process.	1, 3, 5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												1	2	1
CO2	2	1	3										1	2	1
CO3	2	1	2	1									1	2	1
CO4	3	1	1										1	2	1

CO5	1				1								1	2	1
CO6	3		2		1								1	2	1
Average	**2.2**	**1**	**2**	**1**	**1**								**1**	**2**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Additive Manufacturing: Introduction to Powder Metallurgy, Reverse engineering, Different AM processes and relevant process physics, AM process chain, Application level: Direct processes – Rapid Prototyping, Rapid Tooling. Rapid Manufacturing; Indirect Processes - Indirect Prototyping. Indirect Tooling, Indirect Manufacturing.

Guidelines for Process Selection: Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control.

UNIT – 2

Materials Science for Additive Manufacturing: Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship, Grain structure and microstructure

Post Processing of Additive Manufacturing Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques,

UNIT – 3

Additive Manufacturing Technologies: Powder-based AM processes involving sintering and melting (selective laser sintering, shaping, and electron beam melting involvement).

Directed Energy Deposition Processes: Process Description, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.

Sheet Lamination Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.

Wire Arc Additive Manufacturing: Process, parameters, applications, advantages and disadvantages, case studies.

UNIT – 4

Introduction to Design for Additive Manufacturing: Introduction to geometric modelling, Modelling of Synthetic curves like Hermite, Bezier and B-spline, Parametric Representation of freeform surfaces, Design freedom with AM, Need for Design for Additive Manufacturing (DFAM), CAD tools vs. DFAM tools, Requirements of DFAM methods, General Guidelines for DFAM, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post-processing

Design for Metal Additive Manufacturing: Powder Morphology, Powder Size Distribution, Material Characteristics, Designing to Minimize Stress concentrations, Residual Stress, Overhangs, shrinkage, warpage and Support Material, Design Guidelines for Wall Thickness, Clearance Between Moving Parts, Vertical Slots, Circular Holes, fillets, channels, vertical Bosses, circular pins, External Screw Threads and part positioning.

TEXT BOOKS

1. Ian Gibson, David W. Rosen and Brent Stucker, “Additive manufacturing technologies: rapid prototyping to direct digital manufacturing”, Springer, 2010.
2. C.K. Chua, K.F. Leong and C.S. Lim, “Rapid prototyping: Principles and applications, 3rd Edition”, World Scientific, 2010.
3. Diegel, Olaf, Axel Nordin, and Damien Motte “A Practical Guide to Design for Additive Manufacturing”, Springer,

2020.
4. Redwood, Ben, Filemon Schoffer, and Brian Garret "The 3D Printing Handbook: Technologies, Design and Applications", 3D Hubs, 2017.

REFERENCE BOOKS

1. Patri K. Venuvinod and Weiyin Ma,"Rapid Prototyping: Laser-based and Other Technologies", Springer, 2004.
2. D.T. Pham and S.S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", Springer 2001.
3. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley & Sons, 2006.
4. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing, CRC Press, Second Edition, 2020.
5. C.P Paul and A.N Junoop, "Additive Manufacturing: Principles, Technologies and Applications", Mc Graw Hill, 2021.
6. Laroux K and Gillespie, "Design for Advanced Manufacturing: Technologies and Process", Mc Graw Hill, 2017.

Course Title	**Design for Manufacturing and Assembly**				**Course Type**		**Soft core**	
Course Code	**B20ERS612**	**Credits**	**3**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Design for manufacturing and assembly course deals with introduction to DFMA and selection of materials product design for manual assembly and also covers design for high speed automatic assembly, robot assembly. The course covers the DFMA, CAD and TRIZ.

COURSE OBJECTIVES

1. To enable the students to understand general design principles for manufacturability, strength and mechanical factors, mechanisms selection.
2. To provide systematic basic knowledge for working principle, material, manufacture, design possible solutions and materials choice.
3. To enable the students to understand the design features to facilitate machining-drills, milling cutters, keyways, doweling procedures.
4. To formulate the identification of uneconomical design.
5. To design for economy, design for clamp-ability, design for accessibility and modifying the design.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Describe the importance of DFMA and its impact on industry in product design and material selection.	1,2,5	1,2
CO2	Apply the DFMA design guidelines for economical design and ease of manual assembly.	1,2,5	1,2
CO3	Implement DFMA in the design of high speed automatic and robot assembly.	1,2,5	1,2
CO4	Design of parts for feeding and orienting as per DFMA guidelines for accessibility.	1,2,3,5,	1,2
CO5	Integrate CAD and DFMA and understanding its effect.	1,2,5	1,2
CO6	Discuss TRIZ and its relevance in industry.	1	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

	Bloom's Level

CO	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1								3	2	
CO2	3	3			1								3	3	
CO3	3	3			1								3	2	
CO4	3	2	1		1								3	3	
CO5	3	3			1								3	3	
CO6	3												3	2	
Average	**3**	**2.3**	**1.0**		**1**								**3**	**2.5**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to DFMA and Selection of Materials: Meaning of design for manufacture and assembly, how DFMA works, advantages of applying DFMA in product design, typical DFMA case studies, overall impact of DFMA on industry, general requirements for early materials and process selection, selection of manufacturing processes, process capabilities, selection of materials, primary process/material selection.

Unit-2

Product Design for Manual Assembly: Introduction, General design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, effect of part symmetry, thickness, weight on handling time, effects of combinations of factors, effect of chamfer design on insertion operations, avoiding jams during assembly, application of the DFA methodology, types of manual assembly methods, assembly quality.

Unit-3

Design for High speed Automatic Assembly and Robot Assembly: Introduction, Design of Parts for High-Speed Feeding and Orienting– Example, Additional Feeding Difficulties, High-Speed Automatic Insertion, Analysis of an Assembly, General Rules for Product Design for Automation, Design of Parts for Feeding and Orienting, Product Design for Robot Assembly.

Unit- 4

Linking DFM with CAD and Introduction to TRIZ: Introduction: General Considerations for Linking CAD and DFMA, Geometric Representation Schemes in CAD Systems, Design Process in a Linked CAD/DFMA Environment, Expert Design and Cost Estimating Procedures, Introduction to TRIZ.

CASE STUDIES

1. Develop the dimensions with limits required for the components assembled together in their working condition of the Carrier Wheel Assembly.
2. Develop the dimensions with limits required for the components assembled together in their working condition of the Automobile Steering Box Assembly.
3. Develop the dimensions with limits required for the components assembled together in their working condition of the Plate Block Assembly.

TEXT BOOKS

1. George E, Dieter,"Engineering Design - Material & Processing Approach", McGraw-Hill, 2nd Edition, 2015.
2. Geoffrey Boothroyd, "Hand Book of Product Design", Marcel and Dekken, 1st Edition, 2013.

REFERENCE BOOKS

1. Geoffrey Boothroyd, "Hand Book of Product Design", Marcel and Dekken, 1st Edition, 2013.
2. Geoffrey Boothroyd, Peter Dewhurst, Winston, "Product Design for Manufacturing and Assembly", CRC Press, 1st Edition, 2014.

<table>
<tr><td>Course Title</td><td colspan="4">Turbomachines</td><td colspan="2">Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20ERS613</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

Turbomachines are rotary machines that fall under the categories of mechanical work producing machines or work absorbing machines. Machines like hydro turbines, steam turbines, gas turbines are mechanical work producing machines. Air compressors, hydraulics and other fluid pumps are work absorbing machines. The course on turbo machinery deals with terminologies, classification, principles and efficiency of energy conversion in power generating or absorbing machines.

COURSE OBJECTIVES

1. To introduce working principles, classification of turbo machines.
2. To define dimensionless parameters for a generalized fluid flow through turbo machines.
3. To derive Euler Turbine equation, degree of reaction and utilization factor of axial flow, radial flow and mixed flow Turbomachines.
4. To derive equations for work done, power developed and efficiencies of impulse and reaction steam turbines.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Introduce the concepts of turbomachines and compare with positive displacement machines.	1,2	1,2
CO2	Apply the concepts of dimensional analysis to formulate mathematical models of turbomachines.	1,2,3,5	1,2
CO3	Evaluate work done, power developed and efficiencies of axial and radial flow turbo machines.	1,2	1,2

CO4	Analyse the performance of 50% reaction power generating turbomachines.	1,2	1,2
CO5	Compute the performance parameters of axial flow and radial flow power absorbing turbomachines.	1,2,3	1,2
CO6	Interpret the velocity triangles and estimate the forces, power developed, and blade efficiency of Impulse and reaction steam turbines.	1,2,3	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2	1	
CO2	3	2	1		1								2	1	
CO3	3	3											2	1	
CO4	3	3											2	1	
CO5	3	3	1										2	1	
CO6	3	3	1										2	1	
Average	**3**	**2.6**	**1**		**1**								**2**	**1**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Turbomachines: Definition of a Turbo machine; parts of a Turbo machine, Classification, Comparison with positive displacement machine, Dimensionless parameters and their physical significance; Specific speed; Unit and specific quantities, model studies, Numerical.

Unit-2

Fundamentals of Energy Conversion in Turbomachines: Euler's turbine equation and its alternate forms, Components of energy transfer, General expression of degree of reaction, Relation between degree of reaction and utilization factor, Construction of velocity triangles for different values of degree of reaction for axial flow turbines, Numerical.

Energy Transfer in Turbomachines: Velocity diagrams and Condition for Maximum Utilization factor in axial flow Impulse and 50% reaction machines, Numerical.

Unit-3

Axial Flow Power Absorbing Turbo Machines: General analysis of axial flow Compressors, velocity triangles and general expression for degree of reaction, Numerical.

Radial Flow Power Absorbing Turbomachines: General analysis of Centrifugal flow Compressors and pumps , velocity triangles and general expression for degree of reaction , Theoretical head – capacity relationship, Types of centrifugal pump impeller, Numerical.

Unit-4

Impulse Steam turbines: Classification, Need and methods of compounding, single stage impulse turbine, condition for maximum blade efficiency, Numerical.

Reaction Steam turbines: Parsons's steam turbine, condition for maximum utilization factor, Numerical.

CASE STUDIES:

1. Prepare a report on any Compressors/Pumps/Blowers used in industry by mentioning following details: Make and specifications, operating conditions, construction, working principle, and applications.
2. Prepare a report on any Thermal power station by mentioning the following details: Make and
3. Specifications, type and of number of turbines, capacity of power generation, working principle, operating conditions and applications.
4. Prepare a report on applications of Steam turbines by literature survey.

TEXT BOOKS

1. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion, Volume III, Turbo machinery", New Age International Publishers, 2nd Edition, 2013,
2. S. M. Yahya," Turbines, Compressors & Fans", Tata McGraw Hill Co. Ltd., 4th Edition, 2002.

REFERENCE BOOKS

1. D. G. Shepherd, "Principals of Turbomachines", The Macmillan Company, 2nd Edition, 2002.
2. S. L. Dixon, "Fluid Mechanics & Thermodynamics of Turbomachines", Elsevier, 7th Edition, 2014.
3. B.K.Venkanna "Fundamentals of Turbomachinery", PHI New Delhi, 2nd Edition, 2013.

JOURNALS/MAGAZINES

1. https://www.researchgate.net/topic/Steam-Turbine/publications
2. https://www.sciencedirect.com/topics/engineering/steam-turbines

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_me31/preview

Course Title	**Electric and Hybrid Vehicles**				**Course Type**		**Soft Core**	
Course Code	**B20ERS614**	**Credits**	**3**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course is targeting students who wish to pursue research & development in industries or higher studies in the field of Electric and Hybrid Vehicles and upcoming market for retrofit of existing IC engine vehicles with electric motors. It also offers in depth knowledge about working of an Electric Vehicle by covering study of Vehicle fundamentals of EVs and its various components. The course gives an introductory level knowledge on working fundamentals of different electric motors, motor controllers, control techniques, electric vehicle drive train, regenerative braking and different types of hybrid vehicles.

COURSE OBJECTIVES

1. To provide the students with sufficient knowledge on series, parallel and complex hybrid architectures of automobile vehicles.
2. To enable the students to understand the concept of electric drive trains, hybrid architectures and hybrid power plant specifications.
3. To help the students to understand the concept of sizing the drive system, energy storage and their alternatives, energy management and control system.
4. To provide the knowledge of the various hybrid and load tracking architectures with knowledge on Hybrid power plant specifications.
5. To impart knowledge on various energy management and control strategies, energy storage systems like batteries and alternate energy storage systems like fuel cells.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the systems of electric vehicles, hybrid electric vehicles and their relevance to society and environment.	1,6,7	1
CO2	Recognize different configurations of power trains used in hybrid vehicles and identify the hybrid load tracking architectures.	1	1
CO3	Illustrate the working of different types of electrical machines, motors and drive topologies.	1	1
CO4	Demonstrate the electric propulsion unit and Identify the communication protocols and technologies used in vehicle networks.	1	1
CO5	Analyze performance of battery based energy storage and problems associated with battery systems used in electric hybrid vehicles.	1, 2	1
CO6	Describe the characteristics of fuel cell technology.	1	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4			✓			
CO5		✓				
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2	2						2		
CO2	3												3		
CO3	3												2		
CO4	3												3		
CO5	3	1											2		
CO6	2												3		
Average	2.8	1				2	2						2.5		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Sustainable Transportation, A Brief History of EHVs, Need of EHV technology, Architectures of EHVs, social and environmental importance of hybrid and electric vehicles, Challenges and Key Technology of EHVs.

EHV Fundamentals: Basics of vehicle performance, vehicle power source characterization, transmission characteristic and mathematical models to describe vehicle performance

Unit-2

Hybrid Electric Drive-trains: Basic Architecture of Hybrid Drive Trains, Energy Savings Potential of Hybrid Drivetrains, Hybrid drive train configurations- series configuration, Parallel configurations, Series-Parallel configurations and complex configurations, power flow control in hybrid drive-train topologies

Basic Architecture of Electric Drive Trains: Electric Vehicles drive train configurations, Introduction to various electric drive-train topologies, Electric Vehicle (EV) drivetrain Alternatives Based on Drivetrain Configuration, Electric Vehicle (EV) Drivetrain Alternatives Based on Power Source Configuration.

Unit-3

Electric Propulsion unit: Electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, introduction to Permanent Magnet Motors.

Control Systems for the EHV and EVs: In vehicle networks- CAN, Energy Management Strategies: Energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

Unit-4

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery Parameters, Different types of Battery used in EHVs, Battery based energy storage and its analysis, Problems associated with battery systems in EHVs, Temperature controlling methods, advanced battery technologies.

Fuel Cells: Fuel Cell Characteristics - Fuel Cell Types – Alkaline Fuel Cell - Proton Exchange Membrane - Direct Methanol Fuel Cell - Solid Oxide Fuel Cell- Hydrogen Storage Systems- Reformers - Fuel Cell EV - Super and Ultra Capacitors -Flywheels.

CASE STUDIES

1. Advances in battery health monitoring and prognostics technologies for electric vehicle (EV) safety and mobility
2. Energy storage systems for electric vehicle applications: issues and challenges
3. Design of a hybrid electric vehicle powertrain for optimum performance parameters
4. A comprehensive review on estimation strategies used in hybrid and battery electric vehicles
5. Data-driven reinforcement learning–based real-time energy management system for plug-in hybrid electric vehicles
6. Impacts assessment of plug-in hybrid vehicles on electric utilities and regional Indian power grids

TEXT BOOKS

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 3rd Edition, 2021.
2. M. Ehsani, Y. Gao and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press London, 3rd Edition, 2019.
3. James Larminie, John Lowry, “Electric Vehicle Technology”, Wiley Blackwell, 2nd Edition, 2003.

REFERENCE BOOKS

1. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, 3rd edition, Wiley, 2003
2. Seth Leitman, Bob Brant, “Build Your Own Electric Vehicle” McGraw-Hill, 3rd Edition, 2013.
3. Chris Mi, M A Masrur, D W Gao, “Hybrid Electric Vehicles – Principles and applications with practical perspectives”, 4th edition, Wiley, 2011
4. C.C Chan, K.T Chau, “Modern Electric Vehicle Technology”, Oxford University Press Inc., New York, 1st Edition, 2001

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/book/9780444535658/electric-and-hybrid-vehicles
2. https://www.scimagojr.com/journalsearch.php?q=11600153305&tip=sid

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/103/108103009/
2. https://www.edx.org/course/electric-cars-technology
3. https://www.classcentral.com/course/edx-hybrid-vehicles-10285

Course Title	Production and Operations Management				Course Type		Soft core	
Course Code	B20ERS615	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course provides insight in to various fundamental aspects of production planning and forecasting techniques. It also presents various decision making techniques, aggregating and master production scheduling methods, various inventory monitoring and controlling methods are discussed. Handling dependent demand items and techniques for MRP and continuous improvement methods are included. The course contains routing methods and supply chain managements. Quantitative techniques are heavily used in analyzing operations and improving their efficiency and effectiveness. Overall objective of this course is to manage production systems in a better way

COURSE OBJECTIVES

1. To acquire the knowledge of production planning process and its functions
2. To study the fundamentals of Inventory management
3. To provide knowledge about MRP and ERP systems
4. To introduce the concepts of purchasing and supply chain management

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the concept of operations management and apply the decision models to solve real time problems.	1,2,3	1,2,3
CO2	Recognize the role of operations management in business functions and organizations strategic planning.	1,2,3,11	1,2,3
CO3	Formulate and analyze aggregate planning and master production schedule concepts.	1,2,11	1,2,3
CO4	Analyze inventory models for a range of operations.	1,2,11	1,2,3
CO5	Evaluate a selection of frameworks used in the design and delivery of operations using MRP and ERP	1,2,3,11	1,2,3
CO6	Summarize the concepts of routing, purchasing and SCM.	1,2,3,11	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				✓		

CO2				✓		
CO3				✓		
CO4				✓		
CO5				✓		
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	1	1
CO2	3	3	1								1		3	1	1
CO3	3	2									1		3	1	1
CO4	3	3									1		3	1	1
CO5	3	2	1								1		3	1	1
CO6	3	2	1								1		3	1	1
Average	3	2.3	1								1		3	1	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Process Planning, Control and Forecasting: Definitions, Objectives of production Planning and Control, Functions of production planning and control, Types of production, Organization of production planning and control.

Forecasting: Importance of forecasting, Types, principles, qualitative and quantitative methods, time series methods, Exponential smoothing, Regression methods, numerical.

Unit-2

Operations Decision: Introduction, Characteristics of decisions, framework for Decision Making, Decision methodology, Decision supports systems, Economic models**-**Break-even analysis in operations, numerical.

Aggregate Planning and Master Scheduling: Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods, numerical.

Unit-3

Inventory Management: Definition and need, components of Inventory, inventory control. Functions of inventories, inventory costs, EOQ model, Inventory control systems, P–Systems and Q-Systems, ABC analysis, VED analysis, numerical.

MRP & ERP: Introduction to MRP & ERP, JIT inventory, MRP Logic, Capacity Management, CRP activities. Concept of continuous improvement of process, numerical.

Unit-4

Routing – Dispatching: Definition, Routing & Dispatching procedure, Route sheets, Bill of material, Factors affecting routing procedure.

Supply Chain Management: Introduction to supply chain management- Approaches to purchase and supply chain management, Bull whip effect, make or buy decision, e-Procurement, Vender development, vendor rating methods, simple numerical.

CASE STUDIES

1. Forecasting of CSP (Critical Spare Parts for an Indian Automobile Industry
2. SAP Successful story of developing ERP software in Manufacturing Industry

3. Inventory Management - "A case study at Various Manufacturing Sectors"
4. Implementation of supply chain management at various global enterprise - Honda / TVS / Motorola /Amazon / Flipkart.

TEXT BOOKS

1. Samuel Eilon, "Elements of Production Planning and Control", 1st Edition, Universal Publishing Corp., 1999.
2. Joseph Monks, "Operations Management Theory and Problems", 3rd Edition, McGraw-Hill's, 1987.

REFERENCE BOOKS

1. P Rama Murthy, "Production and Operations Management", 1st Edition, New Age, 2002
2. Baffa & Rakesh Sarin, "Modern Production / Operations Management", 8th Edition, John Wiley & Sons, 2002.
3. S.N. Chary, "Operations Management", 1st Edition, TMH, 1996
4. Pannerselvam R, "Production and Operation Management", PHI publications, 2nd Edition
5. Everett E. Adams, Ronald J. Ebert "Production and Operations Management", Prentice Hall of India Publications, Fourth Edition

JOURNALS/MAGAZINES

1. https://www.tandfonline.com/toc/tprs20/current- International journal of Production research
2. https://www.emerald.com/insight/publication/issn/0144-3577-- International journal of operation and production management

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/110107141
2. https://nptel.ac.in/courses/112107238

Course Title	**Automation in Manufacturing**				**Course Type**		**Soft Core**	
Course Code	**B20ERS621**	**Credits**	**3**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course explores the production facilities, need of automation in the manufacturing sectors. It deals with different industrial control system, support system for automation in this competitive environment. This course describes about the flexibility concept for manufacturing products, group technology and inspection process through automation to provide the products with better quality.

COURSE OBJECTIVES

1. Explore the concept of automation and building blocks, Fundamentals of manufacturing.
2. Identify the manufacturing support systems to different industries.
3. Enumerate the knowledge of automated production, group technology and cellular manufacturing concept.
4. Exposure to gain knowledge about automated inspection technologies.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Infer the need of digitalization for manufacturing to achieve higher quality and productivity.	1,2	1,2

CO2	Identify and use suitable manufacturing support systems for productivity enhancement.	1	1,2
CO3	Compare and identify suitable manufacturing process like group technology or flexible manufacturing system to meet the industrial requirement.	1	1,2
CO4	Apply the knowledge of intelligent manufacturing system to manufacture the product with good quality and cost effective.	1,5	1,2
CO5	Implement the automated inspection technology for modern industry requirements.	1,5	1,2
CO6	Understand the role of PLC and SCADA in modern industrial applications.	1,5	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3		✓				
CO4			✓			
CO5		✓				
CO6		✓				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2	2	
CO2	2												2	2	
CO3	3												2	2	
CO4	3				2								2	2	
CO5	3				2								2	2	
CO6	3				2								2	2	
Average	2.8	2			2								2	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Production System Facilities, Automation definition, type and Importance of automation in the manufacturing industry, Manual labor in production system, product and production relationship, cost of manufacturing operation.

Basic Elements of an Automated System: Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.

Unit-2

Manufacturing Support System: Process Planning, Computer Aided Process Planning, and Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean manufacturing tools and techniques and agile manufacturing and its case studies, Toyota production system.

Elements of Electro-Pneumatic: advantages over hydraulics & pneumatic control, solenoid valves, relays, factory automation sensors, electrical sensors, process automation sensors and their interfaces.

Unit-3

Group Technology and Flexible Manufacturing Systems: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems (FMS) and its components, FMS Applications & Benefits, FMS Planning & Implementation Issues. Case studies.

Intelligent Manufacturing Systems: Introduction, need of intelligent manufacturing system & applications.

Unit-4

Inspection Technologies: Automated Inspection, Coordinate Measuring Machines Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Non-contact Non-Optical Inspection Technologies, Case studies on automated inspection.

Industrial Control Systems: Programmable Logic Controllers (PLC) based control system, programming languages & instruction set, ladder logic, functional blocks, structured text, and their applications with various automation examples. Human Machine Interface (HMI), Supervisory Control and Data Acquisition System (SCADA), motion controller, smart sensors, RFID technology and its application, machine vision and control applications.

Demonstration: Ladder logic programming using ISP Delta software.

CASE STUDIES

1. Study on lean manufacturing and agile manufacturing, Toyota Production System.
2. Study on Flexible Manufacturing Process, Group Technology and intelligent manufacturing.
3. Study on automated inspection techniques in different industries.

TEXT BOOKS

1. M. P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education. 5th Edition, 2019.
2. John R. Hackworth & Frederick D. Hackworth Jr, "Programmable Logic Controllers – Programming Methods and Applications", Pearson, 2011.
3. Rao, P. N., "CAD/CAM Principles and Applications", Tata McGraw Hill, New Delhi, 2nd Edition, 2010.

REFERENCE BOOKS:

1. Georges Friedmann, "The Anatomy of Work: Labor, Leisure and the Implications of Automation", Hassell Street Press, 2021.
2. Viswanandham, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India Learning Private Limited, 2015.
3. Krishna Kant, "Computer Based Industrial Control", Prentice Hall India Learning Private Limited, Revised 2nd Edition 2011.
4. Nakra, B. C., "Theory and Applications of Automatic Controls", New Age International Publishers, Revised 2nd Edition, 2014.
5. John W. Webb & Ronald A. Reis, "Programmable Logic Controllers – Principles and Applications", Pearson Education, 5th Edition, 2008.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/search?qs=automation
2. https://asmedigitalcollection.asme.org/manufacturingscience
3. https://www.industrialautomationindia.in/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112103293
2. https://www.digimat.in/nptel/courses/video/112104288/L01.html

Course Title	Robotic Systems Kinematics	Course Type	Soft Core

Course Code	B20ERS622	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Robots all have some kind of mechanical construction, a frame, form or shape designed to achieve a particular task. This course deals with the construction, operation, transformation, types of end effectors used, programming and industrial and non-industrial applications of robots as well as the computer-vision systems.

COURSE OBJECTIVES

1. Identify the types of industrial robots.
2. Compute the concepts of robot representation using concepts of kinematics.
3. To attain knowledge about the uses & limitation of robotic applications.
4. To describe the basic methods & algorithms used in path planning for industrial robots.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Understand the fundamentals of robotic systems and their terminologies.	1	1,2
CO2	Analyze direct kinematics of manipulator configurations.	1,2	1,2
CO3	Design manipulator configuration and end-effector for industrial applications.	1,2,3	1,2
CO4	Apply the knowledge of path planning to develop robots to perform basic operations.	1,2	1,2
CO5	Develop the part program for various robotic applications.	1,2,3	1,2
CO6	Understand the role of vision system for the robot applications.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4		✓				
CO5			✓			
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	1	
CO2	3	3	1										3	1	
CO3	3	2											3	1	
CO4	2	1											3	1	
CO5	3	2	1										3	1	
CO6	3	1	1										3	1	

Average	2.8	1.8	1										3	1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Fundamental laws of Robotics, Brief History of Robotics, Classification of Robots, robot anatomy and configuration, Robot Evaluation- resolution, repeatability and accuracy of robot, Numerical.

Structure of Robots: Types of Joints, Representation of Joint, Degrees of Freedom and workspace.

Unit-2

Spatial Description: Description of position and orientation of a rigid body, Types of Frames, Euler angle representation for XYZ, XYZ frames.

Transformations: Translation, Rotation, Scaling (numerical with real applications), Homogeneous representation of Transformations, Properties of rotation matrices and combined transformations (numerical with real applications). D-H Convention: Forward Kinematics, Implementation of D-H convention and obtaining transformation matrices for 3R Manipulator, SCARA Manipulator, PUMA 560 Manipulator. Inverse Kinematics, Inverse Kinematics of 3R Manipulator.

Demonstration: Design and simulation of different types of robot like ABB, KUKA, FANUC robots models using Robot Simulation Software.

Unit-3

Robot End Effectors: Types of end effectors, Mechanical gripper, types of mechanical grippers, magnetic gripper, Vacuum gripper, Adhesive gripper, other special grippers.

Trajectory planning: Joint space scheme, Cubic trajectory, Joint space schemes with via points, third order polynomial trajectory planning.

Case study: Robot Applications, Industrial and non-industrial application, mobile application, limitations and future application of robot.

Unit-4

Robot Programming: Methods of Programming, Lead through Programming Methods, Three levels of Robot Programming, Teach by Showing, Explicit Robot Programming Language, Task Level Programming Language. Requirements of Robot Programming Language, World Modelling, Motion Specifications, Flow of Execution. Programming Environment, Sensor Integration, AML and VAL. Simple example, programming with graphics.

Machine Vision System: Introduction to Machine vision, functional block diagram of machine vision system, Sensing and Digitizing, Image processing and analysis.

CASE STUDIES:

1. Robotics post-test processing of ABB Robot
2. How ABB Robotics reduced development time
3. ABB Robotic calibration

TEXT BOOKS

1. Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, 2nd edition, Pearson Education India, PHI, 2003.
2. Ganesh S Hegde, “Industrial Robotics”, University Science Press, Second edition, 2009.

REFERENCE BOOKS

1. M.P. Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw-Hill, USA, Second Edition, 1986.
2. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, “Machine Vision”, Tata McGraw-Hill, Second Edition 1991.
3. Yoremkoren, “Robotics for Engineers”, McGraw-Hill, USA, Second Edition 1987.

4. P.A. Janaki Raman, “Robotics and Image Processing”, Tata McGraw-Hill, Second Edition 1991.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/robotics-and-autonomous-systems
2. https://www.sciencedirect.com/journal/robotics

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_me76/preview

Course Title	Refrigeration and Air conditioning				Course Type		Soft Core	
Course Code	B20ERS623	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course provides the knowledge on refrigeration and air conditioning system. Understand the concept of thermodynamic cycles applicable to produce cooling effect through various systems. It gives information about various components and working fluids used in various refrigeration systems. It also provides knowledge on estimation of the capacity of the plant for particular cooling application. This course enlightens the uses of refrigeration and air conditioning in various real time applications. This course provides basic knowledge to work in R&AC industries.

COURSE OBJECTIVES

1. To understand various refrigeration cycles and refrigeration systems
2. To acquire the knowledge on refrigerants and their effects and various components used in R&AC system
3. To understand principles of psychrometry and develop the skills to estimate cooling load and heating load for summer and winter air conditioning
4. To gain the knowledge on how refrigeration and air conditioning will be useful in domestic and commercial application
5. To expose the students to field of refrigeration and air conditioning, so that they can get an opportunity to work in R&AC industries.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Explain working of refrigeration and air conditioning systems.	1	1,
CO2	Summarize the application of refrigerants and working of components used in refrigeration and air-conditioning systems.	1,7	1
CO3	Evaluate the performance of vapour compression, vapour absorption and air refrigeration systems.	1,2	1,2

CO4	Design summer and winter air conditioning systems based on cooling and heating loads.	1,2,3	1,2,3
CO5	Demonstrate the knowledge on construction, working of water coolers and air conditioning systems used in food storage, automotive vehicles, hospitals and theaters.	1,2	1
CO6	Discuss cryogenic concept used for liquefaction of air and oxygen.	1	1

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4				✓		
CO5			✓			
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												3		
CO2	2						1						2		
CO3	3	2											3	1	
CO4	3	3	1										3	1	1
CO5	2	2											3		
CO6	2												2		
Average	**2.3**	**2.33**	**1**				**1**						**2.6**	**1**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Refrigeration Cycles: Methods of refrigeration, Vapour compression refrigeration cycle and actual vapour compression cycle, Air refrigeration cycle, Aircraft refrigeration system- simple and boot strap system with performance analysis. Vapour absorption systems-COP of the system, simple Ammonia-water vapour absorption system with performance evaluation-actual vapour absorption system, Lithium bromide, three fluid vapour absorption systems, and simple numerical.

Unit-2

Refrigerants: Refrigerant classification, Designation, Refrigerant properties, Oil Compatibility – Environmental Impact- ozone layer depletion, global warming, Alternate refrigerants, Refrigerant absorbent combinations for vapor absorption system.

Refrigeration Components: Reciprocating Open & Hermetic type, Screw Compressors and Scroll Compressors, Condensers-types, Evaporators-types, chillers-types, Expansion devices-capillary tube- automatic expansion valve - thermostatic expansion valve- Low side-high side float, low pressure and high pressure cut outs, solenoid valves.

Unit-3

Design of Air conditioning systems: Review of Moist air properties-various psychrometric process, Summer and Winter Air-conditioning, Cooling load calculations-comfort chart-SHF-GRSHF-ERSHF, cooling load estimate, Cooling load calculation using HVAC Design software

Unit-4

Air-conditioning Systems: Different Air-Conditioning Systems-Central – Station Air-Conditioning System, Unitary Air-Conditioning System, Window Air-Conditioner and Packaged Air-Conditioner, Air handling system- ducts and its arrangements, room air distribution- supply air outlets.

Application of Refrigeration and Air conditioning: Food storage, Domestic refrigerator-construction- working and maintenance, Cold storage plants, Water coolers-storage type and pressure type, Dessert cooler, Air conditioning systems for automobiles-car-bus-truck container, Air conditioning system in hospital, Air conditioning system in theaters, Introduction to cryogenics-liquefaction of air and oxygen.

CASE STUDIES

1. Cooling Load calculation of the residential house using HVAC software.
2. Study of Air conditioning system installed in hospital.
3. Study of Air conditioning system installed in theaters/auditorium.

TEXT BOOKS

1. R S Khurmi and J K Gupta, "A Text Book on "Refrigeration and Air conditioning", S Chand Publication., New Delhi, 1st Edition, 2019.
2. W.F.Stocker and J.W.Jones "Refrigeration & Air Conditioning", 2nd Edition, McGraw Hill Book Company, 1st Edition, 2014.

REFERENCE BOOKS

1 Manohar Prasad, "Refrigeration and Air conditioning", 3rd Edition New Age International (P) Ltd, New Delhi,1st Edition, 2021
2. Ananthanarayanan.P.N, "Basic Refrigeration and Air Conditioning", Tata McGraw Hill, 4th Edition, 2013
3. Roy J. Dossat,"Principles of Refrigeration", Pearson Education Asia, 5th Edition, 2001
4. Arora, C. P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 4th Edition, 2021

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/international-journal-of-refrigeration
2. https://www.journals.elsevier.com/international-journal-of-refrigeration

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112105129
2. https://nptel.ac.in/courses/112105128

Course Title	**Aircraft Fundamentals**				**Course Type**		**Soft Core**	
Course Code	**B20ERS624**	**Credits**	**3**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course introduces the historical evaluation of Aircraft with various configurations of aircraft, propulsion systems, and their performance analysis. The course discusses the operating principles of the aircraft engine major components. The course discusses the Aircraft Structures, materials with their instruments and principles of navigation schemes.

COURSE OBJECTIVES

1. To provide the basic knowledge on Aircraft fundamentals, early development of airplanes (space vehicles, advance propulsion and their applications)
2. To enhance the knowledge on configuration of Aircrafts (Anatomy of flight vehicles, components of an airplanes and their function lift generation, significance of L/D ratio, aerodynamic forces, pressure)
3. To enhance the Knowledge on essential features of propulsion with their aircraft structures and their materials
4. To gain the knowledge of sensing devices, data acquisition, measurements in aerodynamics, flight control and principles of navigation with atmospheric entry missions

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Acquire the knowledge on history of aircrafts and developments.	1	1
CO2	Recognize the classifications of aircraft components and their configurations.	1	1
CO3	Apply the basic concepts of propulsion systems for the study of spacecraft and aircraft performance	1	1
CO4	Interpret the different types of fuselage and their constructions.	1	1
CO5	Gain the knowledge of the different types of aircraft materials.	1	1
CO6	Analyze the different types of navigation systems and instruments for flight.	1, 2	1, 2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					
CO2		✓				
CO3			✓			
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												3		
CO2	2												3		
CO3	3												3		
CO4	2												3		
CO5	2												3		
CO6	3	2											3	2	
Average	**2.3**	**2**											**3**	**2**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Aircraft Fundamentals: History of aviation, early development of airplanes, biplanes and monoplanes, history of spaceflight, development of space vehicle, International standard atmosphere, classification of duct jet propulsion, rocket propulsion, advance propulsion and applications.

Unit-2

Configurations of Aircraft: Anatomy of flight vehicles, components of an airplanes and their functions, configuration of space vehicle, Importance of aerodynamics; Airfoils and streamlines; Forces acting on an airplane - lift and drag, types of drag; Factors affecting lift and drag; Types of flow and their governing equations; Speed and power. Straight and level flight; Conditions for minimum drag and minimum power; Gliding, cruise and climbing flight; Range and endurance; Takeoff and landing; V-n diagram.

Unit-3

Aircraft Propulsion: Classification and essential features of propulsion, jet propulsion, general characteristics of rocket engines, theory of propulsion, elementary gas dynamics, spacecraft and aircraft performance

Aircraft Structures and Materials: General types of construction and structural layout, monocoque, semi monocoque, corrugated, sandwich structure, reinforced and honeycomb structures, geodesic construction, aerospace materials, metallic and nonmetallic materials, use of aluminum alloy, titanium, stainless steel, composite and ceramic materials.

Unit-4

Aircraft Instruments and Navigation: Instrument displays; Introduction to navigation instruments; Basic air data systems and probes- Mach meter, air speed indicator, vertical speed indicator, Altimeter, gyro based instruments. Measurements in aerodynamics, flight structures, and flight control, principles of navigation, celestial, radio, and inertial navigation schemes, navigational and guidance requirements for orbital, planetary, and atmospheric entry missions.

CASE STUDIES

1. Conceptual Aero-Design Analysis
2. Case Study on Investigation of Aero foil for Flapping Wing Aircraft
3. Fundamentals of Aircraft and Airship Design
4. Increasing the Efficiency of Aircraft Ground Handling—A Case
5. Case Study: REVA Transports with a Technology Edge.
6. Aircraft Conceptual Design Practices & Case Studies.

TEXT BOOKS

1 Merrill, G., "Principle of Guided Missile Design", Literary Licensing, LLC, 1st Edition, 2011.

2 Richard S. Shevell, “Fundamentals of Flight”, Pearson Education, 2nd Edition, 2004.

3 Pallet, E.H.J., “Aircraft Instruments & Principles”, Pitman Publishing; 2nd Edition, 1981.

4. Mattingly J.D., “Elements of Propulsion: Gas Turbines and Rocket”, AIAA, 2nd Edition, 2017.

5. Leland M. Nicolai and Grant E. Carichner, Fundamentals of Aircraft and Airship Design Volume I – Aircraft Design, AIAA Education Series, 2010

REFERENCE BOOKS:

1 Kermode, A.C., “Flight without Formulae”, Pearson India, 5th Edition, 2004.

2 Lalit Gupta and O P Sharma, “Fundamentals of Flight Vol-I to Vol-IV”, Himalayan Books, 2006

3 Anderson, J. D., "Introduction to Flight", McGraw-Hill, 8th Edition, 2015.

4. Cohen, H.Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Pearson Education, 7th Edition, 2019.

JOURNALS/MAGAZINES

1. http://airspot.ru/book/file/73/hull_airplane_flight_mechanics.pdf
2. https://fas.org/irp/doddir/army/fm3-04-203.pdf
3. http://ae.sharif.edu/~iae/Download/Introduction%20to%20flight.pdf
4. http://www-pw.physics.uiowa.edu/~dag/lectures/Flight_Dec12-2003.pdf
5. https://www.freeengineeringbooks.com/AeroSpace/Aircraft-Structures-Books.php
6. https://docs.google.com/file/d/0Bw8MfqmgWLS4RlNqaE1oUzdOajQ/view?pref=2&pli=1
7. https://www.scribd.com/document/63588270/Aerospace-Propulsion-Systems
8. https://www.crcpress.com/Aircraft-Propulsion-and-Gas-Turbine-Engines/ElSayed/p/book/9780849391965

SWAYAM/NPTEL/MOOCs:

1. https://www.educba.com/course/elements-of-aeronautics/
2. https://www.udemy.com/airplane-engineering-from-zero-to-100-for-everyone/
3. https://www.edx.org/course/introduction-to-aeronautical-engineering
4. https://www.educba.com/course/elements-of-aeronautics/

Course Title	Industrial Engineering				Course Type		Soft Core	
Course Code	B20ERS625	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Industrial engineering is an engineering profession which deals with the development, improvement and implementation of integrated systems of knowledge, information, equipment, human resources, and finance to optimize the complex engineering processes or systems and organizations, dealing in engineering work. Industrial engineering is closely associated with production engineering which intends to work towards improving the overall industrial production by design, development, implementation, operation, maintenance, and control of all processes in the manufacture of a product. Industrial and production engineering course are mostly studied as a single specialization with institutes offering production and industrial engineering degree.

COURSE OBJECTIVES

1. Develop concepts related to principles of productivity & work study.
2. Apply the concepts related to operational analysis & measuring work for designing the work systems.
3. Review the emerging concepts and principles in work system design for productivity improvement.
4. The students will be capable to do the design of jobs and work environments.
5. To provide a detailed understanding of work study and working environment.
6. To provide an adequate background for applying the concept of work study and work environment in industries.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Discuss the industrial engineering principles that influence the productivity improvement in organizations.	1	1,2,3
CO2	Apply the methods of engineering and operational analysis in re-designing of work systems.	1,2	1,2,3
CO3	Apply engineering work measurement principles in analyzing and measurement of work.	1,2	1,2,3
CO4	Analyze the work processes using advanced work study tools and techniques.	1,2, 5	1,2,3
CO5	Demonstrate an understanding of emerging concepts and applications in designing work systems.	1,2,3	1,2,3
CO6	Evaluate work study and working environment towards improving productivity	1,2	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**

CO1		✓				
CO2				✓		
CO3			✓			
CO4				✓		
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	3	2											2	2	
CO3	2	1											2	2	
CO4	2	1			1								2	2	
CO5	2	2	1										2	2	
CO6	3	2											2	2	
Average	2.3	1.7	1		1								2	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Scope of Industrial Engineering, Evolution of Industrial Engineering approach. Nature of work, Physical work systems, Work systems as a field of professional practice, Type of Occupation, Productivity concepts, Manual Work Systems, Worker-Machine Systems, Automated Work systems, Cycle time analysis of Manual work and in Worker machine systems, numerical, Service operations , Office work, Work study.

Unit-2

Methods Engineering and Operations Analysis: Evolution and Scope of Methods Engineering, Systematic Approach in Methods Engineering, Techniques of Methods Engineering, Selecting Alternative Improvement Proposals, Basic Data Collection and Analysis Techniques, Methods Engineering and Automation.

Charting and Diagramming Techniques for Operations Analysis: Overview of the techniques, Network diagrams, Traditional Charting and Diagramming techniques, Block diagrams and Process maps.

Motion Study and Work Design: Basic motion elements and Work analysis, Principles of motion economy and work Design, Case Studies.

Unit-3

Introduction to Work Measurement: Determination of Time Standards – Methods, Work Measurement Techniques, Prerequisites for valid time standards, Allowances in Time Standards, Accuracy and Precision, Application of Speed Ratio.

Direct Time Study: Procedure, Determination of Number of Work Cycle to be Timed, Performance Rating, Time Study Equipment, Numerical.

Predetermined Motion Time Systems: Over view, Methods – Time Measurements, Maynard Operations Sequence Technique.

Unit-4

Standard Data Systems: Standard Data Systems overview, steps, elements classifications. Work Sampling: Statistical Basis of work sampling, Application issues in work sampling (including numerical).

Learning Curves: Determining the Learning Rate, Factors effecting the Learning Curve, Applications, Time standards vs. Learning Curve.

Computerized Work Measurement and Standards Maintenance: Computer Systems for Direct Time Study and Work Sampling, Computerized Systems Based on Predetermined Motion Times, Work Measurement Based on Expert Systems, Maintenance of Time Standards.

CASE STUDIES

1. Reducing Labor Cost using industrial Engineering techniques.
2. Work Measurement approach for productivity improvement in shop floor.
3. Enhancing of productivity for manual and automated assembly line.
4. Improvements in material handling “a case study of cement manufacturing plant".

TEXT BOOKS

1. Mikell P Groover, "The Methods, Measurement & Management of Work", Pearson India Education, 2017.
2. George Kanawaty, "Introduction to Work Study", ILO, 1992.
3. Avraham Shtub, “Introduction to Industrial Engineering”, CRC Press, 2015.

REFERENCE BOOKS

1. Fred E.Meyers and James R.Stewart, "Motion and Time study for Lean Manufacturing", Prentice Hall, ISBN: 0-13-031670-9, 2002.
2. Benjamin W Niebel, Andris Freivalds, Niebel's, "Methods, Standards, and Work Design", McGraw-Hill, ISBN: 9780073376363, 2014
3. Industrial engineering Handbook: Maynard.

JOURNALS/MAGAZINES

1. IEEE Transactions on Industrial Informatics
2. Journal of Industrial Information Integration
3. Journal of Manufacturing Systems
4. International Journal of Production Research
5. International Journal of Production Economics
6. Journal of Manufacturing Technology Management
7. Journal of Product Innovation Management
8. Journal of Management in Engineering

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_me04/preview

<table>
<tr><td>Course Title</td><td colspan="4">Energy Technology</td><td colspan="2">Course Type</td><td colspan="2">Open Elective</td></tr>
<tr><td>Course Code</td><td>B20MEO601</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

This course explores the concept of thermal energy conversion, also introduces the, different types of fuels used for steam generation and equipment for burning coal in lump form. This course introduces to bio mass energy and its characteristics. It also emphasizes on conversion of various biomass energy into solid, liquid and gaseous forms. Further the course deals with conversion of biomass into methanol, ethanol, biogas, bio diesel etc.

COURSE OBJECTIVES

1. To understand energy scenario, energy sources and their utilization

2. To gain the knowledge about diesel engine power plant.

3. To enhance the knowledge about renewable energy sources.

4. To enable the students to gain the knowledge on hydrogen energy generation.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Summarize the basic concepts of thermal energy systems and identify coal and ash handling systems used in steam power plants.	1	1
CO2	Identify renewable energy resources and their utilization.	1,6,7	1
CO3	Discuss the principles of energy conversion of wind, geothermal, ocean, biomass, and biogas energy systems.	1,6,7	1,2
CO4	Describe the methods used to generate Hydrogen energy.	1, 7	1
CO5	Describe the main characteristics of renewable energy sources and their comparison with fossil fuels.	1,6,7	1
CO6	Investigate the design parameters of biogas digesters.	1,2,3,7	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4		√				
CO5		√				
CO6				√		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3					2	2						3		
CO3	3	2				2	2						3	2	
CO4	3						1						3		
CO5	3					2	1						3		
CO6	3	2	1										3	1	1
Average	**3**	**2**	**1**			**2**	**1.5**						**3**	**1.5**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Thermal Energy Conversion System: Review of energy scenario in India, General Philosophy and need of Energy, Different Types of Fuels used for steam generation, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace,

Coal and Ash Handling: Chimneys: Natural, forced, induced and balanced draft, Cooling towers and Ponds

Unit-2

Diesel Engine Power System: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, filters, centrifuges, Oil heaters, intake and exhaust system, Layout of diesel power plant.

Solar Energy and Applications: Solar radiation - Availability- Measurement and estimation- Solar radiation geometry

Hydrogen Energy: Introduction to hydrogen energy, methods of hydrogen production (electrolytic and thermo chemical method).

Unit-3

Wind Energy: Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine

Tidal Power: Power generation using OTEC - Wave and Tidal energy - Scope and economics - Limitations**.**

Hydro-Electric Energy: General layout of hydel power plants, Hydrographs, flow duration and mass curves and numerical. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves.

Unit-4

Biomass Energy Sources: Biomass production for energy farming, origin of Biomass-Photosynthesis process, Energy through fermentation -Ethanol Production from sugarcane and starch, Biomass characteristics.

Bio-Methanization: Anaerobic digestion, Basic principles, factors affecting biogas yield, biogas digester (floating gas holder and fixed dome type with working principle and diagram).

Geothermal Energy Conversion: Availability - Geographical distribution.

TEXT BOOKS

1. P.K Nag, “Power Plant Engineering”, 3rd Ed. Tata McGraw Hill, 2nd edition 2001.
2. Morse F.T, Van Nstrand, “Power Plant Engineering”, 1998.
3. B H Khan, “Non-conventional energy resources”, McGraw Hill Education, 3rd Edition, 2017.
4. A. W. Culp Jr, “Principles of Energy conversion”, McGraw Hill. 1996

REFERENCE BOOKS

1. Stanier, “Plant Engg. Hand Book, McGraw Hill, 1998.
2. Domakundawar, “Power Plant Engineering”, Dhanpath Raisons, 2003
3. S.P. Sukhatme, “Solar Energy: principles of Thermal Collection and Storage”, Tata McGraw-Hill, 1984.
4. L.L. Freris, “Wind Energy Conversion Systems”, Prentice Hall, 1990.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/topics/engineering/ash-handling-plant
2. https://www.researchgate.net/publication/267838546_Survey_of_modern_power_plants_driven_by_diesel_and_gas_engines.
3. https://www.journals.elsevier.com/international-journal-of-hydrogen-energy
4. https://www.sciencedirect.com/science/article/pii/S2211467X19300379

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_me86/preview
2. https://nptel.ac.in/courses/103107157
3. https://onlinecourses.nptel.ac.in/noc21_ch11/preview
4. https://onlinecourses.nptel.ac.in/noc22_ch27/preview

Course Title	**Heat Transfer Lab**				**Course Type**		**Hard Core**	
Course Code	**B20ER0604**	**Credits**	**1**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE

	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Heat Transfer laboratory provides fundamental and industrial knowledge about modes of heat transfer, like conduction, convection and radiation, and their application. Concepts of heat transfer are applied in the field of Heat Exchanger design and phase change phenomenon. This course deals with the concepts of thermal conductivity, convective heat transfer coefficient, Stephen Boltzmann constant, transient heat transfer, vapor compression refrigeration and Air conditioning systems.

COURSE OBJECTIVES

1. Provide knowledge on modes of heat transfer and laws governing the Heat and Mass transfer.
2. Analyze various techniques to compute the heat transfer coefficient in various heat transfer problems.
3. Conduct experiment to study variation of temperature along the length of the pin fin under forced and free Convection.
4. Carryout analysis of boiling and condensation phenomenon and design heat transfer equipment.
5. Conduct experiments related to various heat transfer processes and heat exchangers and analyze measurements data.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the three modes of heat transfer and their governing equations.	1	1,2
CO2	Perform conduction heat transfer experiment to estimate thermal conductivity of metal rod, overall heat transfer coefficient of composite slab and document the results in the form of technical report	1,2,4,10	1,2
CO3	Evaluate the heat transfer coefficients in forced convection, free convection and Correlate with theoretical values and document the results in the form of technical report.	1,2,4, 9,10	1,2
CO4	Perform experiments on radiation heat transfer to determine surface emissivity and Stefan- Boltzmann's constant and document the results in the form of technical report.	1,2,4,9, 10	1,2
CO5	Evaluate heat transfer coefficients in condensation, boiling, LMTD and effectiveness of heat exchangers and document the results in the form of technical report.	1,2,4,9, 10	1,2
CO6	Conduct experiments, interpret the data, analyse Vapour compression refrigeration, Air conditioning system and document the results in the form of technical report.	1,2,4,9, 10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	1	
CO2	3	3		1					3	3			1	2	
CO3	3	3		1					3	3			2	1	
CO4	3	3		1					3	3			1	1	
CO5	3	3		1					3	3			1	1	
CO6	3	3		1					3	3			1	1	1

Average	**3**	**3**		**1**					**3**	**3**			**1.5**	**1.16**	**1**

Note: 1-Low, 2-Medium, 3-High

List of Experiments

1. Determination of thermal conductivity of a metal rod.
2. Determination of overall heat transfer coefficient of composite slab.
3. Analysis of heat transfer through pin-fin.
4. Experiment on transient conduction heat transfer.
5. Estimation of heat transfer coefficient for natural convection heat transfer.
6. Estimation of heat transfer coefficient for forced convection heat transfer.
7. Determination of emissivity of a surface
8. Determination of Stefan Boltzmann constant.
9. Determination of LMDT and effectiveness in a parallel flow and counter flow heat exchangers.
10. Experiment on boiling of liquid and condensation of vapour.
11. Performance test on vapour compression refrigeration.
12. Performance test on a vapour compression air – conditioner

TEXT BOOKS

1. Tirumaleshwar, "Heat & Mass transfer", Pearson Education, 2014.
2. Ozisik, Heat transfer-A basic approach, Tata McGraw Hill, 1985.

REFERENCE BOOKS

1. Yunus A-Cengel, "Heat transfer-A practical approach", Tata McGraw Hill, 2nd Edition, 2002.
2. Mahesh M Rathore, "Heat and mass transfer", Laxmi publications, 2017.
3. Frank Kreith, Raj. M. Manglik, Mark. S. Bohn, "Principles of Heat transfer", Thomas Learning, 7th Edition, 2010.
4. Frenk P.Incropera and DavidP.Dewitt, "Fundamentals of heat and mass transfer", John Wiley and son's, 5th Edition, 2007.
5. R K Rajput, "Heat and Mass transfer", S Chand Publications, 2018.

JOURNALS/MAGAZINES

1. The Journal of Heat Transfer, ASME
2. International Journal of Heat and Mass Transfer, Elsevier

SWAYAM/NPTEL/MOOCs:

1. Heat Transfer, By Prof. Ganesh Viswanathan, IIT Bombay, https://onlinecourses.nptel.ac.in/noc20_ch12/preview
2. Heat Transfer, By Prof. Sunando Dasgupta, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc19_ch23/preview

Course Title	**Computer Aided Engineering Analysis Lab**				**Course Type**		**Hard Core**	
Course Code	**B20ER0605**	**Credits**	**1**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

This course deals with the numerical approximation of complex physical structures that cannot be analyzed using standard mathematical solutions, such as Slope, Deflection, Work, energy principle etc., further the Steps involved in FEM, Selection of Elements, and A Hands-on Introduction to Engineering Simulations to analyze real-world engineering problems using ANSYS simulation software.

COURSE OBJECTIVES

1. To acquire basic understanding of Modeling and Analysis software
2. To understand the different kinds of analysis and apply the basic principles to find out the stress and other related parameters of bars, beams and truss loaded with loading conditions

3. To lean to apply the basic principles to carry out thermal and dynamic analysis

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Define and Understand the steps involved in FEM, and various commands used in ANSYS simulation software	1,2	1
CO2	Formulate finite elements like the bar, truss, and beam for linear static structural analysis.	1,2,3,5,9,12	1,2,3
CO3	Determine the Stress analysis of a rectangular plate with a circular hole	1,2,3,5,9,12	1,2,3
CO4	Demonstrate the deflection of beams subjected to point, uniformly distributed and varying loads and further to use the available results to draw shear force and bending moment diagrams	1,2,3,5,9,12	1,2,3
CO5	Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyse with forcing function	1,2,3,5,9,12	1,2,3
CO6	Develop finite element equations for 1D and 2D heat transfer elements and record the results in the form of technical report.	1,2,3,5,9,10,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2				✓		
CO3			✓			
CO4				✓		
CO5			✓			
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2	1	1
CO2	2	3	2		3				3			3	2	1	1
CO3	2	2	1		3				3			3	2	1	1
CO4	2	3	2		3				3			3	2	1	1
CO5	2	3	2		3				3			3	2	1	1
CO6	2	3	2		3				3			3	2	1	1
Average	**2**	**2.8**	**1.8**		**3**				**3**			**3**	**2**	**1**	**1**

Note: 1-Low, 2-Medium, 3-High

Part-A

Study of an FEA package and modeling, stress analysis of

1. Bars of uniform cross-section area, tapered cross-section area, and stepped bar
2. Trusses – (Minimum 2 exercises).
3. Beams – Simply supported, cantilever, beams with UDL, beams with varying load, etc

Part-B

1. Stress analysis of a rectangular plate with a circular hole
2. Thermal Analysis – 1D & 2D problem with conduction and convection boundary Conditions
3. Dynamic Analysis of Fixed – fixed beam for natural frequency determination subjected to forcing function

TEXT BOOKS

1. S.S.Bhavikatti, "Finite Element Analysis", New Age International publishers, 2006

2. Tripathi. R .Chandrapatla, Ashok.D.Belegundu, “Finite Elements in Engineering”, 3rdEdition, PHI Publishers, New Delhi

REFERENCE BOOKS

1. Daryl. L. Logon, “Finite Element Methods”, Thomson Learning 3rdedition, 2001
2. J.N.Reddy, “Finite Element Method”, Mc Graw – Hill International Edition

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/finite-elements-in-analysis-and-design
2. https://www.hindawi.com/journals/mpe/si/632341/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112104116
2. https://onlinecourses.nptel.ac.in/noc20_me91/preview

Course Title	**Technical Documentation**				**Course Type**		**FC**	
Course Code	**B20ER0606**	**Credits**	**1**		**Class**		**VI semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**1**	**1**	**13**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course describes the method used to document the procedures and tools used in testing or research and aims to describe the primary purpose of preparing an Engineering technical report. Also helps in preparing report that describes the progress, process, or results of scientific or technological research. It also covers how to prepare and include some recommendations and conclusions in report.

COURSE OBJECTIVES

1. To understand the purpose of technical documents/specifications.
2. To create effective technical documents.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Create effective written documents after an audience analysis.	1,5,9,10,12	
CO2	Recognize various forms of technical communication and Select the most appropriate format to convey the technical information.	1,5,9,10,12	
CO3	Discuss the complex technical concepts lucidly for the common man to understand easily.	1,5,9,10,12	
CO4	Adhere to formatting, best practices and avoid pitfalls.	1,5,9,10,12	
CO5	Write formal reports detailing the process, result or progress of a project.	1,5,9,10,12	
CO6	Create visually appealing documents with the incorporation of design elements, enhancing the reading experience as well.	1,5,9,10,12	

BLOOM’S LEVEL OF THE COURSE OUTCOMES

CO	**Bloom’s Level**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**

CO1		√				
CO2		√				
CO3			√			
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1				1				1	3		1			
CO2	1				1				2	3		1			
CO3	1				1				3	3		1			
CO4	1				1				2	2		1			
CO5	2				1				2	2		1			
CO6	1				1				2	3		1			
Average	**1.2**				**1**				**2**	**2.6**		**1**			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: A basic understanding of the role of a technical writer in an organization, Audience Analysis, Topic Research, Writing the document, competitor analysis and writing own document.

Creating the Content and Technical Report: Developing Flowcharts, Block diagrams/schematics, Infographics, using MS application or other open-source tools. Creating a technical report using different styling techniques.

Unit-2

Interpretation and Report Writing: Meaning of Interpretation, need of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report , Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions

TEXT BOOK

1. C R Kothari, "Research Methodology- Methods and Techniques", New Age International, 2nd Edition, 2015.

SWAYAM/NPTEL/MOOCs:

1. Technical Writing Master Course: https://iimskills.com/technical-writing-course/
2. Technical Report Writing for Engineers The University of Sheffield: https://www.futurelearn.com/courses/technical-report-writing-for-engineers.

Course Title	**Research Based Mini Project**				**Course Type**		**Hard Core**	
Course Code	**B20ER0607**	**Credits**	**1**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	2	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Mini project is one of the integral parts of mechanical engineering curriculum where the students can learn and equip new skill sets by building projects practically. By doing mini projects, students can develop more skills in addition to the technical skills like critical thinking, problem solving ability, collaborating with team members, solving problems hands-on etc. This will also help them to showcase their practical skills to the recruiters and impress them.

COURSE OBJECTIVES

1. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
2. To inculcate the process of self-learning and research.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Identify problems based on societal /research needs.	1,6	1
CO2	Apply Knowledge and skill to solve societal problems in a group.	1,2,3,6	1,2
CO3	Develop interpersonal skills to work as member of a group or leader.	1,9,10	1,2
CO4	Draw the proper inferences from available results through theoretical / experimental/simulations.	1,2,5	1,2
CO5	Demonstrate project management principles during project work.	9.10,11	1,2
CO6	Communicate effectively the procedure to solve engineering problems with the engineering community and with society at large through effective reports and design documentation.	1,9,10,11,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√	√		
CO4				√		
CO5				√		
CO6				√	√	

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2							3		
CO2	3	3	2			2							3	2	
CO3	1								3	3			3	2	
CO4	1		2		3								3	2	
CO5									3	2	3		3	2	
CO6	1								3	3	2	2	3	2	
Average	**1.8**	**3**	**2**		**3**	**2**			**3**	**2.6**	**2.5**	**2**	**3**	**2**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Research based project is aim to identify the research gap though extensive literature survey on a recent trends in mechanical engineering and allied areas. The research focus may be on modelling, simulation, experimental & analysis, model/prototype design, fabrication of new equipment, analysis of data, software development, etc. or a combination of these. Through this the team should publish a review research paper in the selected field of study. The students have to make a project team consisting of two, three or four members. Every student in a group shall take up a project in the beginning of sixth semester in consultation with the guide and the project must be completed before the end of semester. The project team has to work to identify the research gap though extensive literature survey on a recent trends in mechanical engineering and allied areas and formulate the problem statement. The team submit a report prepared as per the guidelines/format of the university (one report per group).

TEXT BOOKS

1. Biswajit Mallick, "Innovative Engineering Projects", Entertinement Science and Technology Publication, Bhubaneswar, India, 1st Edition 2015.
2. C R Kothari, "Research Methodology- Methods and Techniques", New Age International, 2nd Edition, 2015.
3. A.K. Chitale, R.C. Gupta, "Product Design and Manufacturing", Prentice –Hall of India, Sixth Edition, 2013.

REFERENCE BOOKS

1. O. Molloy, S. Tilley and E. A. Warman, "Design for Manufacturing and Assembly: Concepts, Architectures and Implementation", Springer. USA, 2012.
2. Boothroyd, G.Peter Dewhurst and Winston A, "Knight, Product Design for Manufacture and Assembly", CRC Press, Taylor & Francis, Third Edition, 2010.
4. Navi Radjou, Jaideep Prabhu and Simone Ahuja, "JUGAAD Innovation: A Frugal and Flexible Approach to Innovation for the 21st Century", Random house India, Noida, 2012.
5. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw-Hill, Sixth Edition, 2015.

JOURNALS/MAGAZINES

1. Global Innovative research Journal: https://freeprojectsforall.com/journal-publication/
2. International Journal of Project Management: https://www.journals.elsevier.com/international-journal-of-project-management

SWAYAM/NPTEL/MOOCs:

1. Project Management: https://nptel.ac.in/courses/110104073

7th Semester

Course Title	Vibrations and Noise Engineering				Course Type		Hard Core	
Course Code	**B20ER0701**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practical	0	0	0	Theory	Tutorial	IA	SEE
	Tutorial	1	2	2				
	Total	**3**	**4**	**4**	**26**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

The course aims to deal with mechanical vibration and its effects on mechanical systems. The course defines terminology associated with mechanical vibrations; study of free and forced vibrations under un-damped and damped conditions for single degree of freedom mechanical systems. The course further deals with vibration of multi-degree of freedom mechanical systems, vibration measurement and Noise Engineering.

COURSE OBJECTIVES

1. To enable the students to understand the theoretical principles of vibration and vibration analysis techniques for the practical solution of vibration problems.
2. Formulate mathematical models of problems in vibrations using Newton's second law or energy principles.
3. To analyze the free and forced (harmonic, periodic, non-periodic) vibration analysis of single and two degree of freedom linear systems.
4. To enable the students to determine sound pressure level measurement in specified acoustic environment.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the causes, effects of vibration in mechanical systems and apply basics of engineering to vibrating mechanical system and develop mathematical models to obtain their governing equations of motion and their response.	1,2,3,4	1,2
CO2	Compute the natural frequency for free and forced vibration of a single degree of freedom of un-damped and damped systems.	1,2,3	1,2
CO3	Analyze the vibratory responses of Mechanical systems for harmonic, periodic and non-periodic excitation.	1,2,3,6	1,2
CO4	Formulate the mathematical models for Two DOF mechanical vibrating system and Analyze its natural frequencies and mode shapes.	1,2,3,4	1,2
CO5	Demonstrate the Vibration measurements and its functionality.	1,2	1,2

CO6	Interpret the principles of vibration and noise reduction techniques to real life engineering problems.	1,2,3,6	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3				✓		
CO4				✓		
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1									3	3	
CO2	3	3	2										3	3	
CO3	3	3	2			1							3	3	
CO4	3	3	2	2									3	3	
CO5	3	3				1							3	3	
CO6	3	2	1			1							3	3	
Average	**3**	**2.8**	**1.8**	**1.5**		**1**							**3**	**3**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force

Undamped Free Vibration - Single Degree of Freedom Systems: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring, numerical.

Unit-2

Damped free vibrations- Single Degree of Freedom Systems: Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement, numerical.

Forced vibration - Single Degree of Freedom Systems: Introduction, Analysis of forced vibration with constant harmonic excitation- magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping, numerical.

Unit-3

Vibration Measurements: Whirling of shafts with and without damping, discussion of speeds above and below critical speed of shafts, numerical.

Vibration of Two Degree of Freedom Systems: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, Undamped dynamic vibration absorber, numerical.

Unit-4

Noise Engineering: Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level(SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging, sound spectra and Octave band analysis; loudness; weighting networks; equivalent sound level, auditory effects of noise; hazardous noise, exposure due to machines and equipment; hearing conservation and damage risk criteria, daily noise doze.

CASE STUDIES

1. Develop python programming to for understanding the vibration of single degree freedom systems.
2. Develop python programming plot frequency response of single degree and multi Degree spring mass system.
3. Study the response of the Quarter car vibration.
4. Study the Bounce and pitch response of the vehicle (2 DOF).
5. Study the response of Mechanical system with variation of stiffness/Damping.

TEXT BOOKS

1. S. S. Rao, "Mechanical Vibrations", Pearson Education Inc, 6th Edition, 2016.
2. S. Graham Kelly, "Fundamentals of Mechanical Vibrations ", Schaum's outline Series, Tata McGraw Hill.
3. W. T. Thomson, "Mechanical Vibrations", Pearson Education Inc, 5th Edition, 2008
4. C Sujatha, "Vibrations and Acoustics – Measurements and signal", Tata McGraw Hill.

REFERENCE BOOKS

1. W. T. Thomson, "Theory of Vibration with Applications", Pearson Education Inc, 5th edition, 2008.
2. V. P. Singh, "Mechanical Vibrations", Dhanpat Rai & Company, 3rd Edition, 2006.
3. Amberkar A.G, Mechanical Vibrations and Noise Engineering, PHI Learning Pvt. Ltd, 2006.

JOURNALS/MAGAZINES

1. Journal of Sound and Vibration
2. Noise & Vibration Worldwide - SAGE Journals
3. Journal of Vibration and Acoustics
4. Journal of Vibration Engineering & Technologies
5. https://www.inceusa.org/publications/noise-news-international

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/112107212 (Introduction to Mechanical Vibration)
2. https://nptel.ac.in/courses/112104194 (Basics of Noise and Its Measurements)
3. https://www.classcentral.com/course/swayam-sound-and-structural-vibration-58554
4. https://onlinecourses.nptel.ac.in/noc22_me34/preview (Sound and Structural Vibration)

Course Title	**CAD/CAM/CIM**				**Course Type**		**Hard Core**	
Course Code	**B20ER0702**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This subject explores with the technology related to the use of digital computers to perform design activities and manufacturing activities in an organization, the basic concepts and applications of conventional numerical control along with NC part programming. This course also focuses on computer technology to automate each and every function starting from market information, production processed, design activities, materials, commercial, financial required for the industry. It also deals with the reliability and performance of automated flow line

involving three methods of line balancing of minimizing the total amount of idle time for a given job at a given assembly line speed.

COURSE OBJECTIVES

1. To obtain the fundamentals of CAD/ CAM / CIM and related concepts to understand the various modeling features and its manufacturing.
2. Interpret various concepts of CAD /CAM /CIM, the product development cycle can be reduced in the design stages and also reduction of Manufacturing Lead time.
3. Developing the NC programming and its importance in practical applications by using coding system.
4. To have a hands on experience on various tools used for modeling and manufacturing aspects.
5. To study about the line balancing in automated flow lines.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply the basic principles of CAD & CAM in engineering applications.	1,2	1,2
CO2	Develop the manual NC part programming for given profile.	1,2,3,5	1,2
CO3	Identify the suitable type of automation for different production systems.	1	1,2
CO4	Criticize the mathematical model used in production system.	1,2	1,2
CO5	Analyze the various work transport system used in high volume production.	1,2	1,2
CO6	Formulate the line balancing of an automated assembly lines and study advanced emerging technologies used in manufacturing.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2			✓			
CO3		✓				
CO4			✓			
CO5				✓		
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2	3	2	1		1								3	2	
CO3	3												3	2	
CO4	3	2											3	2	
CO5	3	2											3	2	
CO6	3	2											3	2	
Average	3	2	1		1								3	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Fundamentals of CAD: Definition of CAD/CAM/CIM, Product cycle and its cad / cam over laid, Design process & application of computers for design, creating the manufacturing database, Benefits of CAD/CAM/CIM.

Computer Graphics: Coordinate Systems, Database Structure for Graphic Modeling, functions of graphics package, Transformation of geometry, 2D transformations – Simple problems. Geometric Modeling, types, Windowing and clipping.

Unit-2

Introduction to NC Technology Basic components of NC system, NC Coordinate system, types of NC motion control systems, advantages and applications of NC. CNC & DNC Systems: Types, advantages and its functions. Adaptive control systems.

NC/CNC Programming: NC Procedure, Manual programming and computer assisted part programming, syntax formats in part programming, G & M codes, Cutter Radius Offset, Tool Length Offset, Fixed Cycles/canned cycles, Turning and milling programs. (Using CAM software demonstrate turning and milling operations).

Unit-3

Computer Integrated Manufacturing System: Introduction to CIM and Automation, types of Automation, Model of manufacturing, Information processing cycle in manufacturing, Types of Production systems, Production Concepts & its Mathematical models, Problems. Automation Strategies.

Introduction and Analysis of Automated Flow Line: High Volume Production system: Introduction, Automated flow line, Work part transport, Buffer storage and its control functions. General terminology and analysis, Analysis of Transfer line with and without storage, numerical.

Unit-4

Assembly and Line balancing: Types of assembly system, Minimum rational work element, cycle time. Precedence constraints and diagram, Balance delay. Methods of Line balancing – Largest candidate rule (LCR), Kilbridge and Westers method, Ranked positional weight method, numericals only on LCR and RPW.

Advanced Techniques in Manufacturing: Smart Manufacturing, Digital Manufacturing, intelligent Manufacturing, Internet of things, Cloud based Manufacturing, Cloud computing for manufacturing, Web based manufacturing.

CASE STUDIES

1. Study on Industrial Automation using IOT.
2. Study on Assembly Line balancing methods.

TEXT BOOKS

1. M.P.Groover and Emory W.Zimmer, "CAD/CAM, Computer Aided Design and Manufacturing", Pearson India, 2nd Edition. 2007
2. Mikell P.Groover, "Automation, Production System & Computer Integrated Manufacturing", Pearson India, 2nd Edition. 2007

REFERENCE BOOKS

1. Ibrahim Zeid, "CAD/CAM theory and practice", Tata McGraw Hill. 2007.
2. P. Radha Krishnan, S. Subramanyan & V. Raju, "CAD/CAM/CIM", New Age international Publishers, 2nd Edition. 2008.
3. P. Radha Krishnan, "Computer Numerical Control Machines and CAM", New Age international Publishers, 1st Edition 2012.
4. P. N. Rao, "CAD/CAM Principles and applications", Tata McGraw Hill.2010.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/Computer Aided Design
2. https://www.sciencedirect.com/journal/Advancements in CAD/CAM technology: Options for practical implementation

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112102102
2. https://nptel.ac.in/courses/112104289

Course Title	Mechatronics and Control Systems				Course Type		Hard Core	
Course Code	B20ER0703	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course focuses on various aspects of mechatronics and control engineering. Over view on various sensors and transducer used for measurement and detecting the input signal for various applications. It provides information about signal conditioning devices and micro controllers to be used in mechatronics devices. It also provides knowledge on control engineering about mathematical modeling and analysis of mechanical system and electrical system. Construction of root locus plot will give the information about stability and design of various controllers.

COURSE OBJECTIVES

1. To understand various aspects of mechatronics system
2. To acquire the knowledge on transducers, sensors and actuators
3. To understand working of signal conditioning devices and micro controllers
4. To develop the skills on mathematical modeling and analysis of system under time domain
5. To study the stability by using root locus technique and R H criteria

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Interface the sensors and transducer output with microprocessor for controlling of the system and describe the function of controllers.	1,2	1,3
CO2	Explain construction and working of electrical actuators used in mechatronics system	1,2	1,3
CO3	Select suitable signal conditioning devices and micro controllers for specific real time application	1,2,3	1,2,3
CO4	Develop mathematical models and transfer function model for mechanical and electrical system	1,2,3	1,2,3
CO5	Perform time response analysis of first and second order system.	1,2,3	1,2,3
CO6	Examine the stability of the system using Routh's-Hurwitz Criterion and root locus plot.	1,2,3	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4				✓		

CO5				✓		
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											3	1	2
CO2	2	2											3	1	2
CO3	3	2	2										3	2	2
CO4	3	3	2										3	3	2
CO5	3	3	2										3	3	2
CO6	3	3	1		1								3	3	2
Average	**2.6**	**2.5**	**1.7**		**1**								**3**	**2.1**	**2**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Transducers, Sensors and Actuators: Definition of mechatronics, components of mechatronics, Basic Terminologies, Open loop & Closed loop control systems, microprocessor based control systems, ATM, Washing machine, Static and dynamic characteristics of sensor, Capacitance sensor, Eddy current sensor, Hall effect sensor-Light sensors, optical encoders, touch & tactile sensor, Actuation System- mechanical-Electro mechanical, electrical switches, solid state switches, solenoid.

Unit-2

Drives: AC, DC, Servo motors, stepper motors, hybrid motors.

Signal Conditioning Devices: amplifier, filters, multiplexers, de multiplexers, ADC, DAC.

Micro controllers: Microcontrollers and its classification, Arduino processor-construction and working.

Unit-3

Introduction to Control Systems & system Modeling: Real time applications, Transfer Functions- models of mechanical systems (translational and rotational), Electrical systems.

Time Response Analysis: Transient and Steady State Response Analysis: types of inputs, first order and second order system response to step input, time response specifications and concepts of time constant, numerical problems.,

Unit-4

Stability Analysis: Routh's-Hurwitz Criterion, stability analysis using root locus plots, Introduction to PI, PD and PID controllers.

CASE STUDIES

1. Mathematical modeling of shock absorber used in Indian Automobile vehicles.
2. Time response analysis of shock absorber using Matlab / Simulink software.
3. Stability analysis by constructing root locus plot using Matlab / Python Code.

TEXT BOOKS

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, 5th Edition, 2015.
2. W.Bolton "Mechatronics", Pearson Publications, 4th Edition, 2017.

REFERENCE BOOKS

1 Devdas shetty and Richard A. Kolk "Mechatronics System Design" Cengage Learning, 2010
2. HMT ltd. "Mechatronics", Tata McGraw-Hill, New Delhi, 2017
3. B.C.Kuo, F.Golnaraghi "Automatic Control Systems", John Wiley & Sons, 9th Edition 2014.
4. Richard C Dorf & Robert H Bishop," Modern Control Systems", Prentice Hall, 12th Edition, 2021.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/mechatronics
2. https://www.sciencedirect.com/journal/mechatronics
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=87
4. https://www.journals.elsevier.com/control-engineering-practice

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112103174
2. https://www.classcentral.com/course/swayam-mechatronics-23047
3. https://nptel.ac.in/courses/107106081
4. https://www.edx.org/course/dynamics-control-upvalenciax-dc201x-0

<table>
<tr><td colspan="2">Course Title</td><td colspan="4">Engineering Economics and Financial Management</td><td colspan="2">Course Type</td><td colspan="2">Hard Core</td></tr>
<tr><td colspan="2">Course Code</td><td>B20ER0704</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

This course explores the importance of economics in the industries. Engineering economics is an interdisciplinary subject in which financial aspect of the industrial product and investment interest rates are discussed. The course emphasis on evaluation of different interest rates, comparison of different alternatives using PW, AW, FW and Internal rate of return. This subject also deals with evaluation of selling price and depreciation, financial aspects such as book keeping, ratios and budgeting.

COURSE OBJECTIVES

1. To Study principles and techniques of economic evaluation in different field of Engineering
2. To know the assessment procedure for the evaluation of alternatives.
3. To calculate interest under various conditions.
4. To learn Budgeting process and its preparation.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the economic and financial benefits of organization in the decision making process related to engineering activities.	1,11	1,2
CO2	Analyze the financial statements to evaluate financial status of engineering projects for different interest rates.	1,2,11	1,2
CO3	Estimate the present, annual and future worth comparisons for each of the cash flows.	1,2,11	1,2
CO4	Calculate the rate of return, depreciation charges and income taxes.	1,2,11	1,2
CO5	Identify financial strength and weakness of organization by considering various financial Ratios.	1,2,11	1,2
CO6	Use management techniques to enumerate different cost entities in estimation, costing and budgeting.	1,2,11	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2				✓		
CO3			✓			
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3								1		1		1	3	
CO2	3	3									3	1	1	3	
CO3	3	3	2	1					1		3	1	1	3	
CO4	3	3	2	1							3	1	1	3	
CO5	3	3	1								3		1	3	
CO6	3	3									3		1	3	
Average	3	3	1.6	1					1		2.6	1	1	3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Engineering Economy: Introduction to Indian Economy, Basic terminologies used in economy, Engineering Decision- Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Law of demand and supply, Interest and Interest factors: Interest rate, Cash – flow diagrams, numerical.

Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth Comparisons, Present-worth equivalence, Net Present worth, Assets with unequal lives, infinite Lives, Future-worth comparison, Simple Exercises.

Unit-2

Evaluation of Projects and Depreciation: Annual worth method, and internal rate of return method. Numerical covering all the above method with comparisons. Rate-of-Return Calculations, Minimum acceptable rate of Return, ERR, IRR.

Depreciation: Causes of Depreciation, Methods of depreciation. Simple Numerical, Tax- Direct and Indirect tax, GST and simple concepts of taxing.

Unit-3

Estimation, Costing and Final Accounts: Estimation for simple components (with calculations of all types of costs involved in it). Introduction, Scope of Finance, and Finance Functions, Statements of Financial Information: Source of financial information, financial statements, Balance sheet, Profit and Loss Account, relation between Balance sheet and Profit and Loss account, Numerical.

Unit-4

Financial Ratio Analysis: Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power, numerical.

Profit Planning: Financial planning, Profit planning, Objectives of Profit planning, type of budgets in Indian Economy, preparation of Budgets, advantages, problems on flexible budget, cash budget and production budget.

CASE STUDIES:

1. Computation of different financial ratios for various sectors by using current financial annual report.
2. Comparison of the quarterly results of various manufacturing and IT sectors for the financial year and preparation of the financial statement with total revenue and Net profit.
3. SWOT analysis of Manufacturing sectors and Interpretation of opinions for the Investors.

TEXT BOOKS

1. R Paneerselvam, "Engineering Economy", PHI Publishers, 2nd Edition, 2013.
2. Thuesen H.G. "Engineering Economy", PHI, 9th Edition, 2002.

REFERENCE BOOKS

1. Riggs.J L, "Engineering Economy", McGraw Hill, 4th edition, 2002.
2. O P Khanna, "Industrial Engineering and Management", Dhanpat Rai & Sons. 2018
3. Prasanna Chandra, "Financial Management", TMH, 10th Edition, 2019.
4. IM Pandey, "Financial Management", Pearson, 12th Edition, 2021.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology
2. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/113/102/113102080/
2. https://nptel.ac.in/courses/122/102/122102008/

Course Title	**IoT in Manufacturing**				**Course Type**		**Soft Core**	
Course Code	**B20ERS711**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle. In this course, Introduced to the series objectives and an overview of digital transformations in manufacturing in today's business world. This course involves the area of Industrial Internet of things, which includes predictive and preventative maintenance, condition based monitoring of the machines, production optimization, energy optimization, supply-chain optimization and uptime of manufacturing utilities etc.,

COURSE OBJECTIVES

1. To impart the knowledge of IoT and M2M in different applications
2. To familiar with the IoT enabling technologies
3. To impart the concepts of industrial internet of things (IIoT)
4. To introduce the digitization in manufacturing

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Design the IoT enabling technologies	1,2,3,5	1,2,3
CO2	Develop IoT structures for the given applications	1,2,3,5	1,2,3
CO3	Apply the concept of M2M for building architectural block of IoT device	1,2,5	1,2,3
CO4	Build the real time machine monitoring using IoT device	1,2,3,5	1,2,3
CO5	Analyze the remote monitoring and predictive maintenance using IoT	1,2,3,5	1,2,3
CO6	Apply the concept of IoT in Digital Twins and Additive manufacturing	1,2,3,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2			✓			
CO3			✓			
CO4				✓		
CO5				✓		
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		2								3	1	3
CO2	3	3	3		2								3	1	3
CO3	3	3	3		2								3	1	3
CO4	3	2	2		2								3	1	3
CO5	3	2	2		2								3	1	3
CO6	3	2	3		2								3	1	3
Average	3	2.5	2.67		2								3	1	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to IoT: Definition, Significance of IoT, Characteristics of IoT-Physical Design of IoT, Logical Design of IoT- IoT enabling technologies, Scope, Sensors for IoT Applications, Structure of IoT, IoT Map Device.

M2M to IoT: A Basic Perspective, Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, Emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

Unit-2

M2M to IoT-An Architectural Overview: Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. IoT Device, Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi.

IoT Platforms Design Methodology: Introduction, IoT Design Methodology, concept of the Industrial Internet of Things, Case study IoT enables CNC Machining, Real time machine monitoring

Unit-3

IoT Applications in Manufacturing: Introduction to remote monitoring, IoT in to monitoring the performance of

machines, Predictive maintenance, Predicting and Preventing Tool Failure, Optimizing Equipment Utilization, case study.

IoT in Supply Chain: Introduction to supply chain management, Real-time tracking of assets and products, Automation of warehouse tasks, control of Inventory using IoT, Demand forecasting using IoT, Automated E-commerce, case study.

Unit-4

IoT in Digital Twins: Digital Twins Platforms, Future Trends, 3D representation of physical assets (any machine), operational systems, and structures.

IoT in Additive Manufacturing: Introduction to additive manufacturing, Applications of additive manufacturing, IoT based web interface for controlling 3D Printers.

CASE STUDIES

1. Remote machine monitoring as an extension of machine service options using IoT Remote machine monitoring: A Game changer for machine builders.
2. IoT in logistics and supply chain management: Evaluating the adoption rate, associated challenges and impact on cost and business efficiency.
3. Reduce Downtime, Improve Performance, Increase Profitability in an industry using IoT
4. Material handling to monitor materials and products using IoT

TEXT BOOKS

1. Arshadeep Bahaga, Vijay Madisetti, "Internet of things-A hands –on approach", Universities Press, 1st Edition, 2015
2. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley, 1st Edition, 2014

REFERENCE BOOKS

1. Dominique DGuinard and Vlad M.Trifa,"Building the Web of things with examples in Node.js and Raspberry Pi", Manning Publications Co, 2016.
2. Richard Zurawski, "The Industrial Communication Technology Handbook", CRC Press, 2017.
3. Deon Reynders and Edwin Wright, "Practical TCP/IP and Ethernet Networking", IDC Technologies, 2016.
4. James Powell, Henry Vandelinde, "Catching the Process Fieldbus an Introduction to PROFIBUS for Process Automation", Momentum Press, 2013.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/internet-of-things
2. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6488907

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106105195/

Course Title	**Robotic Systems Dynamics and Control**				**Course Type**		**Soft Core**	
Course Code	**B20ERS712**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW:

Robot Dynamics is really important since it will give you a complete understanding not only how robots move (kinematics) but also WHY they move (dynamics). In this course, you will learn to develop the dynamics models of basic robotic systems, as well as create intelligent controllers for them.

COURSE OBJECTIVES

1. To control both the position and orientation of the tool in the three dimensional space.
2. The relationship between the joint variables and the position and the orientation of the tool.
3. Planning trajectories for the tool to follow on order to perform meaningful tasks.
4. To precisely control the high speed motion of the system.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply the transformation methods for defining new position and orientation of the objects in 3 dimensional space.	1,2	1,2
CO2	Understand Langrangian equation of motions and link tensors.	1,2	1,2
CO3	Apply the knowledge of Lagrange-Euler dynamic model to different axis robots.	1,2	1,2
CO4	Elaborate the plan of trajectories for the robot end effectors to perform specific task.	1,2	1,2
CO5	Identify workspace and work envelope for different types of robots.	1,2	1,2
CO6	Apply Langrangian mechanics to solve dynamic equation of planer and articulated robot.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2		✓				
CO3			✓			
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	1	
CO2	3	2											3	1	
CO3	2	3											2	3	
CO4	2	3											2	3	
CO5	3	2											3	1	
CO6	2	3											2	3	
Average	2.5	2.5											2.5	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate Transformations, Joint variables and position of end effector, Dot and cross products, coordinate frames, Rotations, Homogeneous coordinates.

Unit-2

Manipulator Dynamics: Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity, Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange - Euler formulation, problems.

Unit-3

Work Space Analysis and Trajectory Planning: Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning.

Unit-4

Introduction to Motion Control: Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar and articulated robot.

TEXT BOOKS

1. Schilling, Robert J. "Fundamentals of Robotics: Analysis and Control". Simon & Schuster Trade, 1996.
2. Niku, Saeed B. "Introduction to Robotics: Analysis, Systems, Applications". Vol. 7. New Jersey: Prentice hall, 2001.

REFERENCE BOOKS

1. Craig, John J. "Introduction to Robotics: Mechanics and Control". Pearson Education, 2005.
2. Deb, Satya Ranjan, and Sankha Deb. "Robotics Technology and Flexible Automation". McGraw-Hill Education, 2010.
3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
4. Saha S K, "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd, 2010.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/robotics-and-autonomous-systems
2. https://www.sciencedirect.com/journal/robotics

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_me76/preview

<table>
<tr><td>Course Title</td><td colspan="3">Computational Fluid Dynamics</td><td colspan="2">Course Type</td><td colspan="2">Soft Core</td></tr>
<tr><td>Course Code</td><td>B20ERS713</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

This course deals with introduction to computational dynamics, solution of continuity, momentum, and energy equations using the finite volume method. Students are trained to use commercial CFD tools for fluid flow modelling, discretization and solution of equations.

COURSE OBJECTIVES

1. To acquire the basic knowledge of concepts of Computational fluid dynamics.
2. To provide the students with sufficient background to understand the mathematical representation of the

governing equations of fluid flow and heat transfer applications.

3. To enable the students to solve the problem using the discretization technique.
4. To analyze the techniques, skills, & engineering tools necessary for engineering practice by applying numerical methods to a "real-world" fluid-flow problems,
5. To integrate various numerical techniques in formulating a numerical solution method.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Gain the fundamental Knowledge of computational fluid dynamics and describe boundary conditions and numerical errors.	1	1,2
CO2	Derive the governing equations related to CFD applications.	1,2	1,2
CO3	Analyze the fluid flow fields using discretization techniques.	1,2	1,2
CO4	Apply turbulence models for fluid flow analysis over immersed bodies.	1,2,3,4,5,6	1,2
CO5	Demonstrate the procedure used for analyzing fluid flow characteristics performance using CFD tool.	1,2,3,4,5,6,9	1,2,3
CO6	Solve real-world applications related fluid flow analysis using CFD tools.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2				✓		
CO3				✓		
CO4			✓			
CO5					✓	
CO6					✓	

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2	3	3	1	1									3	2	
CO3	3	3	1	1									3	2	
CO4	3	3	1	1									3	2	
CO5	3	3	1	1	2				1				3	2	2
CO6	3	3	1	1	2				1				3	2	2
Average	3	2.83	1	1	2				1				3	2	2

Note: 1-Low, 2-Medium, 3-High

Unit-1

Introduction and Basic Governing Equations: Introduction to CFD, advantages, Limitations of CFD, applications of CFD in different fields, the future of computational fluid dynamics, Different forces acting on the fluid, Governing equations of fluid dynamics-Continuity, Momentum and energy equations in differential form, Boundary conditions-Neumann, and Dirichlet, Numerical errors -.truncation error, round off error, Discretization error.

Unit-2

CFD Techniques: Basic aspects of discretization, Discretization techniques- Finite Element Method, Finite difference method and Finite volume method, Comparison of discretization by the three methods - three-dimensional continuity equation in Cartesian coordinates, Introduction to Finite differences- – Explicit, Implicit and Crank-Nicolson methods, Stability criterion.

Unit-3

Simulation Techniques: Important features of turbulent flow, Reynolds average Navier Stokes (RANS) equation, Necessity of turbulence modeling, Different types of turbulence model: discussion on - Turbulent kinetic energy and dissipation, one equation- Spalart-Allmaras, two-equation model: κ-ε model, Advantages and disadvantages, RNG κ-ε model and κ-ω model, Multiphase flow.

Unit-4

Application of CFD: Geometry creation, meshing, grid-independent test, mesh refinement analysis, practical boundary condition, validation, and results. Convergence, accuracy, Discussion on Advanced topics in CFD - Virtual reality meets, Fluid structure interaction, Physiological Fluid Dynamics, Discussion on Practical problems using CFD tools.

CASE STUDIES

1. Analysis of Laminar Flow through Pipe
2. Analysis of orifice meter
3. Analysis of Fluid Flow over a Car.
4. A Numerical Investigation of the Incompressible Flow through a Butterfly Valve Using CFD
5. Explain briefly how to simulate a NACA 0012 Airfoil at a 6 degree angle of attack placed in a wind tunnel, using FLUENT.
6. Study of Flow around a Rotating Cylinder

TEXT BOOKS

1. J. D Anderson, "Fundamental of Computational fluid dynamics", McGraw-Hill Publications, 6th Edition, 2017.
2. Jiyuan Tu "Computational Fluid Dynamics – A practical approach", Butterworth Heinemann, 3rd Edition, 2018.

REFERENCE BOOKS

1. K. Muralidhar, T. Sundarajan "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2nd Edition, 2003.
2. Suhas V Patankar, "Numerical Heat Transfer and Fluid Flow", CRC Press, 1st Edition, 2018.

JOURNALS/MAGAZINES

1. International Journal of Computational Fluid Dynamics, Taylor and Francis.
2. Progress in Computational Fluid Dynamics, An International Journal, Inderscience Publishers.

SWAYAM/NPTEL/MOOCs:

1. Computational Fluid Dynamics, by Prof. Suman Chakraborty, IIT Kharagpur (https://onlinecourses.nptel.ac.in/noc21_me126/preview)
2. Foundation of Computational Fluid Dynamics, by Prof. Vengadesan, IIT Madras

Course Title	**Micro Electro Mechanical Systems**				**Course Type**		**Soft Core**	
Course Code	**B20ERS714**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course explores the field of micro electro mechanical systems (MEMS). This necessitates an understanding of the design, manufacturing, and materials concerns associated with microsystems. The course will cover fabrication technologies, material properties, basic sensing and actuation principles and MEMS applications. The course will emphasize the fabrication and materials of microsystems.

COURSE OBJECTIVES

1. Understand the fundamentals of micro manufacturing methods.
2. Recognize and connect the different sensors and actuators to applications.
3. Identify the materials and the fabrication processes that are used in MEMS devices
4. Analyze the materials used in MEMS.
5. To develop MEMS applications for several fields

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Recognize MEMS and Microsystems applications in engineering	1	1,2
CO2	Explain the working of micro devices, micro systems and their applications.	1	1,2
CO3	Explain the fabrication techniques used to develop micro electro mechanical systems.	1,5	1,2
CO4	Apply material science principles to sensor design.	1	1,2
CO5	Identify the materials utilized in sensor designs.	1	1,2
CO6	Develop micro devices and microsystems by conceptualizing and designing them.	1, 3	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3		✓				
CO4			✓			
CO5		✓				
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	1	
CO2	3												3	1	
CO3	3				1								3	1	
CO4	1												3	1	
CO5	3												3	1	
CO6	3		1										3	1	3
Average	2.67		1										3	1	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Overview of MEMS and Microsystems: MEMS & Microsystems, typical products, Evolution, Microsystems and microelectronics, Multidisciplinary nature, Microsystems and miniaturization, Applications of Microsystems in automobile and other industry.

Working Principle of Microsystems: Biomedical and biosensors. Micro sensors: Acoustic, Chemical, Optical, Pressure, Thermal.

Unit-2

Materials for MEMS and Microsystems: Structure of silicon and other materials, Silicon wafer processing -Bulk micromachining and Surface micromachining, Wafer-bonding. Thin-film deposition, Lithography, wet etching and dry etching.

Unit-3

Micro Actuation: Using thermal forces, shape memory alloys, piezoelectric crystals and electrostatic forces.

MEMS with Micro Actuators: Microgrippers, micromotors, microvalves and micropumps, micro accelerometers, microfluidics.

Introduction to Scaling: Scaling in Geometry, Scaling in Rigid body dynamics, Scaling in Electrostatic forces, scaling in electromagnetic forces and scaling in fluid mechanics.

Unit-4

Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PVD-Sputtering, Deposition of Epitaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.

CASE STUDIES

1. Commercial MEMS Case Studies: The Impact of Materials, Processes and Designs.
2. Fabrication of MEMS devices - a scanning micro mirror case study- principle, design, and fabrication of a silicon-based scanning micromirror with a new type of action mechanism as an example of MEMS.
3. MEMS Manufacturing Testing: An Accelerometer Case Study
4. Introduction to Applications and Industries for Microelectromechanical Systems (MEMS) - MEMS fabricated combustible gas sensor.

TEXT BOOKS

1. Tai-Ran Hsu, "MEMS & Microsystems Design and Manufacture", Tata McGraw Hill Education, 2nd Edition, New Delhi. 2002
2. Chang Liu," Foundations of MEMS", Pearson Education Inc., 2012.

REFERENCE BOOKS

1. Vijay K Varadan, K. J. Vinoy, S. Gopalakrishnan, "Smart Material Systems and MEMS", Wiley, 2015.
2. The MEMS Handbook, Mohamed Gad-el-Hak, Taylor and Francis Publication, 2006.
3. James J Allen, "MEMS Design", Taylor and Francis Publication, 1st Edition, 2005.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/micro-and-nano-engineering
2. https://www.sciencedirect.com/topics/nursing-and-health-professions/microelectromechanical-system
3. https://www.memsjournal.com/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/117105082
2. https://nptel.ac.in/courses/108106165/

Course Title	Total Quality Management and Six Sigma			Course Type	Soft Core
Course Code	B20ERS715	Credits	3	Class	VII semester

Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The course offers fundamental aspects of quality, quality control and management. The course provides insights into basic approaches of total quality management (TQM), evolution of quality management and contributions of quality gurus to the development of TQM. Techniques and tools which Focus on customer satisfaction and their involvement in the TQM program are included .The course presents various tools and techniques which are widely used in continuous improvement (CI) and TQM implementation programs. Various quality management tools, six sigma methodology (DMAIC) and design for six sigma (DFSS) techniques are also elaborated in this course.

COURSE OBJECTIVES

1. To provide the knowledge of quality and its evolution
2. To introduce the basics of leadership and customer perception of quality
3. To impart the knowledge of quality tools
4. To attain the knowledge of six sigma and its methodology

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the principles of total quality management and to explain how these principles can be applied within quality management systems.	1,2	1,2,3
CO2	Explore the various dimensions of customer satisfaction and their involvement	1,2	1,2,3
CO3	Use appropriate process improvement techniques for measuring and improving quality control.	1,2	1,2,3
CO4	Select appropriate statistical techniques for improving processes and analyze the strategic issues in quality management.	1,2,5	1,2,3
CO5	Analyze and apply six sigma methodology for design optimization of process.	1,2,3,5	1,2,3
CO6	Use simulation tools to enhance the process capability.	1,2,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			✓			
CO2			✓			
CO3				✓		
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	1	1

CO2	3	2	1										3	1	1
CO3	3	3			1								3	1	1
CO4	3	1			1								3	1	1
CO5	3	2	1		1								3	1	1
CO6	3	3	1										3	1	1
Average	3	2.2	1		1								3	1	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Principles and Practices: Basic approach, gurus of TQM, TQM frame work, awareness, defining quality, historical review, obstacles, benefits of TQM.

Leadership: Definition, characteristics of quality leaders, leadership concepts, Deming philosophy, role of TQM leaders, implementation, strategic planning communication

Unit-2

Customer Satisfaction and Customer Involvement: Perception of quality, feedback using customer complaints, service quality, translating needs into Requirements, Kano model, customer retention. Employee involvement - Motivation, employee surveys, Empowerment teams, suggestion system, recognition and reward, gain sharing, performance appraisal

Unit-3

Continuous Process Improvement: Juran triology, improvement strategies, PDCA cycle, problem solving methods, Kaizen, 5S concepts, six sigma. Tool and Techniques - Statistical process control-7QC tools,
Benching marking, information technology, quality management systems, QFD, FMEA, product liability, Total productive maintenance. TQMEX model.

Unit-4

Quality Management Tools: Forced filed analysis, nominal group techniques, affinity diagram, interrelationship digraph, tree diagram, matrix diagram, process decision program chart and activity network diagram.

Design for Six Sigma: Introduction to DMAIC approach and DFSS, tools for concept development, design development, design optimization and design verification problems.

CASE STUDIES

1. Implementation of Total Quality management for an automobile industry.
2. Gillette's TQM Successfully Story
3. Implementation of Six Sigma - A successful journey in various firm.
4. Generic Electrics Six -Sigma Journey

Note: Student can do certification course on 6σ-yellow belt

TEXT BOOKS

1. Dale H.Bester field, “Total quality Management”, Pearson Education India, 5 Edition, 2019.
2. M.Zairi, “Total quality Management for Engineers”, McGraw-Hill’s, 3rd Edition, 1991.

REFERENCE BOOKS

1. Shoji shiba, Aln Graham, David Walden, “A new American TQM, four revolutions in Management”, Productivity Press, Orgeon, 1990.
2. Gopal K.Kanji and Mike Asher, “100 Methods for TQM”, Sage Publications, Inc., 1st Edition.
3. H.Lal, “Organizational Excellence through TQM” New age Publication.
4. Poornima M Charanth, Total Quality Management, Pearson Publication, 4th Edition, 2022.

JOURNALS/MAGAZINES

1. https://www.emerald.com/insight/publication/issn/0265-671X - International journal of quality and Reliability

Management

2. https://www.emerald.com/insight/publication/issn/2040-4166 ----internal journal of six sigma

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_mg03/preview
2. https://nptel.ac.in/courses/110104085

Course Title	Fluid Power Engineering				Course Type		Soft Core	
Course Code	B20ERS721	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The Fluid Power Engineering course is designed to equip delegates with the basic foundation knowledge and building blocks that underpin all hydraulic pneumatic systems. This course deals with the basic components and functions of hydraulic and pneumatic systems. Fluid power has the highest power density of all conventional power-transmission technologies. Learn the benefits and limitations of fluid power, analyze fluid power components and circuits, and design and simulate fluid power circuits for applications. Topics include standard symbols, pumps, control valves, control assemblies, actuators, maintenance procedures, and switching and control devices.

COURSE OBJECTIVES

1. To attain the knowledge of hydraulic and pneumatic systems.
2. To familiar with the power transmission in hydraulic cylinders and motors and solve the Problems.
3. To impart the knowledge on controlling components of hydraulics and pneumatics systems.
4. To understand the hydraulic and pneumatic circuits and interpret their applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Apply the concept of Pascal's law for designing of fluid power devices.	1,2	1,2
CO2	Identify and select the hydraulic and pneumatic components for the various applications	1,2	1,2
CO3	Design the hydraulic, pneumatic power circuits for the given applications and simulate using fluidSIM software.	1,2,3,5	1,2
CO4	Identify and select the suitable fluids for the fluid power applications.	1,2	1,2
CO5	Analyze the performance of fluid power components.	1,2	1,2
CO6	Use PLCs for controlling of fluid power devices.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1			✓			
CO2		✓				
CO3				✓		
CO4		✓				
CO5					✓	
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3	1	
CO2	3	3											3	1	
CO3	3	3	1		1								3	1	
CO4	3	2											3	1	
CO5	3	2											3	1	
CO6	3	2											3	1	
Average	**3**	**2.5**	**1**		**1**								**3**	**1**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Fluid Power: Pascal's law, Applications of Pascal's Law, Basics of Hydraulics, Structure of Hydraulic System- Numerical on Pascal's law. Advantages and Disadvantages of fluid power, Application of fluid power system

Hydraulic Pumps: Pumping theory, Gear pump, Vane Pump, Piston pump, construction and working of pumps, pump performance, Factors for selection of pumps, Numerical on calculation of volumetric displacements, eccentricity and efficiencies of hydraulic pumps.

Unit-2

Control Valves and Fluid Power Actuators: Control Valves-DCV: Check valve,3/2, 4/3, 5/3, 5/2, Solenoid operated DCV working, PRV: Pressure regulating and reducing valve, FCV: needle valve, Linear hydraulic actuators, Types of hydraulic cylinders, Single acting, Double acting, Special types of cylinders, Loading Mechanism, Cylinder Mounting, Cylinder load, speed and power, numerical.

Rotary Actuators: construction and working of motors, External Gear motor, Vane motor, Piston motor, Applications of Hydraulics Motors, Hydraulic motor performance, Numerical.

Unit-3

Hydraulic Circuits: Fluid Power Symbols, Single acting, Double acting, Regenerative, Double pump, Sequencing, Cylinder locking, Synchronizing, pump unloading circuit, counter balance circuit, Meter-in, Meter-out, Accumulators and Applications of Accumulators using circuits.

Demonstration: Hydraulics circuit design, simulation using FluidSIM software.

Maintenance of hydraulic Systems: Hydraulic oils, Desirable properties, Sealing Devices, Reservoirs System, Filters and strainers, Beta Ratio in filters, Problem caused by Gases in Hydraulic Fluids, Wear of moving parts to solid particle contamination, Temperature control, Trouble shooting.

Unit-4

Pneumatic Systems and Components: Pneumatic Components: Properties of air, types of Compressors, Filter, Regulator, and Lubricator Unit, Air control valves, Quick exhaust valves, and pneumatic actuators. Servo systems, Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics, Introduction to

fluidic devices, simple circuits, Introduction to programmable logic controllers (PLC), Applications of PLCs in Fluid power sectors, Pneumatic logic circuits by using OR & AND logic gates.

Demonstration: Pneumatics circuit design, simulation using FluidSIM software.

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Seventh Edition, Pearson Education, 2013.
2. Majumdar S.R, "Oil Hydraulics", Tata McGraw-Hill, New Delh, 2017

REFERENCE BOOKS

1. Majumdar S.R, "Pneumatic systems – Principles and Maintenance", Tata McGraw Hill, New Delhi, 2017.
2. James R. Daines, Martha J. Daines, "Fluid Power: Hydraulics and Pneumatics", Goodheart-Willcox; 3rd Edition, 2021.
3. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 2nd Edition, 1982.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/procedia engineering.
2. https://link.springer.com/article/10.1631/jzus.A1500042

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/ 112106300/
2. https://nptel.ac.in/courses/ 112105046/

Course Title	Tribology				Course Type		Soft Core	
Course Code	B20ERS722	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

Tribology deals with design of fluid containment systems like seals and gasket, Lubrication of surfaces in relative motion to achieve reduced friction and wear. The structure of the bearing and the nature of fluid flow determine the loads that can be supported. Modeling systems as hydrostatic squeeze film and Elasto-hydrodynamic lubrication will be studied as infinite and later finite structures. Gas (air) lubricated and rolling contact type motions with deformation at contact will be studied as special systems.

COURSE OBJECTIVES

1. To introduce tribology as an important aspect in design consideration in performance of machine components that are in relative motion.
2. To understand the importance of friction and wear in the process of designing components for functional applications.
3. To recognize the need of lubrication in machine components and bearings.
4. To analyze the mechanism of pressure development in fluid film in journal bearing.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Study the properties of Oil seals, Gaskets industrial tribology.	1	1,2
CO2	Analyze the friction and wear behavior in interacting surfaces.	1,2	1,2

CO3	Apply the principles of lubrication in designing of bearings.	1,2,3	1,2
CO4	Analyze the pressure of fluid film and estimate the load carrying capacity of journal bearing.	1,2	1,2
CO5	Analyze and interpret the power loss due to friction in Journal bearing.	1,2,4	1,2
CO6	Study the Interatomic Interactions in nano scale lubricants using Atomic Force Microscope.	1	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4				✓		
CO5		✓				
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												3	3	
CO2	3	2											3	3	
CO3	3	3	1										3	3	
CO4	3	3											3	3	
CO5	3	2		2									3	3	
CO6	3												3	2	
Average	2.8	2.5	1	2									3	2.8	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Introduction to tribology, History of tribology, Interdisciplinary approach, Economic benefits. Tribological Design of Oil seals, Gaskets.

Friction: Laws of friction - Stick-slip phenomenon, Friction characteristics of metals and non-metals.

Unit-2

Wear - Wear mechanisms – Interfacial wear and Chemical Wear-Wear measurements - Ferrography and oil analysis.

Lubrication & Bearings: Lubrication types, Regimes, Basic Modes of Lubrication, Properties of Lubricants. Types of bearings.

Unit-3

Hydrodynamics Lubrication: Fluid film in simple shear, Mechanism of pressure development in a convergent film, pressure induced, and velocity induced flows, Reynold's equation for fluid film lubrication, Load carrying capacity of slider bearing &Journal bearing Pressure development.

Unit-4

Lubrication in Bearings: Sommerfeld Number, Friction – Petroff's equation – Oil flow and Thermal equilibrium. Gas Lubricated Bearings.

Nanoscale Tribology: Interatomic Interactions, Atomic Force Microscope (AFM), Automotive Tribology.

CASE STUDIES

1. Study on Systematic oil analysis in late 1940s with the railways. The early applications were oriented toward avoiding catastrophic and costly failures of engines in operation and Success in rail engines.
2:.Study on Derailment of Train upon deformed bearing hub.
3. Study on Premature Bearing failures in Brick Clay mill.
4. Study on Jaw Crusher Machine Failure.

TEXT BOOKS

1. Gwidon W Stachowiak and Andrew W Batchelor, "Engineering Tribology", Butterworth-Heinemann. 2013.
2. K.C. Ludema, "Friction, Wear, Lubrication", CRC Press, 2010.

REFERENCE BOOKS

1. Majumdar.B.C, Introduction to Tribology of Bearings, Universal Books, 2010.
2. Bharat Bhushan, Introduction to Tribology, John Wiley & Sons, 2013.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/tribology-international
2. https://www.mdpi.com/journal/lubricants

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/112102015
2. https://onlinecourses.nptel.ac.in/noc20_mm12/preview

Course Title	Solar Energy Systems				Course Type		Soft Core	
Course Code	B20ERS723	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The course content is designed to provide comprehensive knowledge on solar radiation, fundamentals of the solar thermal and photovoltaic systems, the solar thermal collectors and their applications. It also deals with solar thermal energy storage devices, Photovoltaic systems, types, and their applications.

COURSE OBJECTIVES

1. To provide the basic knowledge on solar and earth geometry, the different devices used to measure the solar radiation.
2. To explain the classification, working of thermal energy storage devices and their applications.
3. To gain the knowledge of different available technologies to store the solar energy.
4. To summarize the types of photovoltaic systems, used to convert the solar energy into electric energy and their applications.
5. To design and analyze the Thermal and Photovoltaic system for different applications.

COURSE OUTCOMES (COs)

On completion of the course the student shall be able to:

CO	Course Outcomes	POs	PSOs

CO1	Explain about the solar geometry, construction and working of instruments used to measure solar radiation.	1	1
CO2	Identify different solar collector systems and select suitable solar collector system.	1	1
CO3	Explain the construction and working of thermal energy storage systems.	1	1
CO4	Demonstrate the knowledge on construction and working of solar PV cells.	1	1
CO5	Identify different types of PV system applications for stand-alone with and without battery storage.	1	1
CO6	Analyze the requirements, Interpret the data and design the sustainable, environmental friendly Thermal and PV systems for the society.	1,2,3,5,6,7	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		✓				
CO2		✓				
CO3		✓				
CO4		✓				
CO5		✓				
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3												3		
CO3	3												3		
CO4	3												3		
CO5	3												3		
CO6	3	3	2		1	2	3						3	2	2
Average	**3**	**3**	**2**		**1**	**2**	**3**						**3**	**2**	**2**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: - Solar radiation at the earth's surface, Sun and earth geometry, Solar constant, Solar angles, sunrise, sunset and day length, Instruments for measuring solar radiation and Sunshine, Simple Numerical on Solar radiation geometry

Unit-2

Solar Thermal Collectors: Classification of solar collectors, Flat plate collectors with plane reflectors, cylindrical parabolic collector, Compound parabolic collector (CPC), Paraboloid dish collector, Central receiver collector. Transmissivity of the cover system, Alternative to the conventional collector.

Thermal Energy Storage: Need for solar thermal energy storage, Sensible heat storage, Latent heat storage, Thermochemical storage.

Unit-3

Solar Photovoltaic System: Working principle of Photovoltaic system, Current voltage characteristics of a solar cell, Types of solar cells: Crystalline silicon solar cells, Thin-film solar cells, multifunctional solar cells, other solar cells, Losses in solar cells and solar modules, Photovoltaic modules in series and parallel

Unit-4

Photovoltaic system and its applications: Stand-alone system with and without battery storage and with AC and DC load, Grid connected, Concentrated photovoltaic systems, satellite power station.

Design of Solar Thermal and Photovoltaic: Design of solar flat plate collector system, Design of PV system for domestic applications.

Discussion on use of software for installation of Solar PV Cells, Flat plate collectors and other applications.

CASE STUDIES

1. Prepare a report on latest specifications and problems of solar water heaters to be implemented for a residential purpose for heating water.
2. Prepare a report on specifications and devices used for a solar roof top PV Systems for a residential purpose.
3. Prepare a report on power saving, money saved by using a solar roof top invertor.
4. Preparer a report on the power developed by solar power plant and problems faced.
5. Prepare a survey report on development of solar power plants in Karnataka.
6. Prepare a survey report on development of solar power plants in India.
7. Prepare a report on the specifications of devices used for measuring the solar energy.
8. Using solar PV software calculate the different parameters for solar panels.

TEXT BOOKS

1. S P Sukhatme and J K Nayak, “Solar Energy”, McGraw Hill Education (India) Private Limited, 4th Edition, 2017.
2. John A Duffie and William A Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, Inc., 4th edition April 2013

REFERENCE BOOKS

1. Martin A Green, “Solar cells: operating principles, technology, and system applications”, Prentice-Hall series in solid state in physical electronics, Longman Higher Education, 1st Edition, 1982.
2. Garg. H.P, Prakash.J, "Solar energy fundamentals and applications", Tata McGraw Hill publishing Co. Ltd, 1st Edition, 2017.
3. Yogi Goswami.D, Frank Kreith, Jan F.Kreider, "Principle of solar engineering", Taylor and Francis, 2nd Edition, 2000.
4. Chetan Singh Solanki, "Solar Photovoltaic technology and systems: A manual for Technicians, Trainers and Engineers", PHI Learning private limited, 1st Edition, 2013.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/solar-energy-materials-and-solar-cells
2. https://www.journals.elsevier.com/solar-energy

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/115103123
2. https://www.coursera.org/learn/photovoltaic-solar-energy
3. https://www.coursera.org/learn/solar-energy-basics
4. https://onlinecourses.nptel.ac.in/noc20_ee57

Course Title	**Autonomous Vehicles**				**Course Type**		**Soft Core**	
Course Code	**B20ERS724**	**Credits**	**3**		**Class**		**VII Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The goal of the course is to introduce students to the various technologies and systems used to implement advanced driver assistance systems. These systems have the overall impact of automating various driving functions, connecting the automobile to sources of information that assist with this task, and allowing the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants.

COURSE OBJECTIVES

1. Introduce the fundamental aspects of Autonomous Vehicles.
2. Gain Knowledge about the Sensing Technology and Algorithms applied in Autonomous vehicles.
3. Understand the Connectivity Aspects and the issues involved in driverless cars.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the evolution of Automotive Electronics and the operation of ECUs.	1,2	1,2
CO2	Compare the different type of sensing mechanisms involved in Autonomous Vehicles.	1,2	1,2
CO3	Discuss about the use of computer vision and learning algorithms in vehicles.	1,2	1,2
CO4	Summarize the aspects of connectivity fundamentals existing in a driverless car.	1,2	1,2
CO5	Identify the different levels of automation involved in an Autonomous Vehicle.	1,2	1,2
CO6	Outline the various controllers employed in vehicle actuation.	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4		√				
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1											1	1	
CO2	1	2											1	1	
CO3	2	2											1	2	
CO4	2	2											1	2	
CO5	2	2											1	2	
CO6	2	3											1	2	
Average	**1.8**	**2**											**1**	**1.6**	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit 1

Introduction: Evolution of Automotive Electronics, Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs -Infotainment, Body, Chassis, and Powertrain Electronics, Advanced Driver Assistance Systems, Autonomous Vehicles

Unit 2

Sensor Technology for Autonomous Vehicles: Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems, Camera Technology -Night Vision Technology, Use of Sensor Data Fusion, Kalman Filters

Unit 3

Computer Vision and Deep Learning for Autonomous Vehicles: Computer Vision Fundamentals -Advanced Computer Vision, Neural Networks for Image Processing, Tensor Flow, Overview of Deep Neural Networks, Convolutional Neural Networks Connectivity Fundamentals, DSRC (Direct Short Range Communication), Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Security Issues.

Unit 4

Autonomous Vehicle Technology Driverless Car Technology-Different Levels of Automation, Localization, Path Planning. Controllers to Actuate a Vehicle, PID Controllers, Model Predictive Controllers, ROS Framework, Technical Issues, Security Issues, Moral and Legal Issues.

TEXT BOOKS

1. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms and Implementation", Springer, 2011.
2. Williams. B. Ribbens: "Understanding Automotive Electronics", 7th Edition, Elsevier Inc., 2012.

REFERENCE BOOKS

1. Shaoshan Liu, Liyun Li, "Creating Autonomous Vehicle Systems", Morgan and Claypool Publishers, 2017.
2. Marcus Maurer, J.ChristianGerdes, "Autonomous Driving: Technical, Legal and Social Aspects" Springer, 2016.
3. Ronald.K.Jurgen, "Autonomous Vehicles for Safer Driving", SAE International, 2013.
4. James Anderson, KalraNidhi, Karlyn Stanly, "Autonomous Vehicle Technology: A Guide for Policymakers", Rand Co, 2014.
5. Lawrence. D. Burns, ChrostopherShulgan, "Autonomy – The quest to build the driverless car and how it will reshape our world", Harper Collins Publishers, 2018

JOURNALS/MAGAZINES

1. Journal of Autonomous Vehicles and Systems
2. International Journal of Vehicle Autonomous Systems

SWAYAM/NPTEL/MOOCs

1. https://www.mooc-list.com/course/introduction-self-driving-cars-coursera
2. https://www.mooc-list.com/course/decision-making-autonomous-systems-edx
3. https://www.mooc-list.com/course/visual-perception-self-driving-cars-coursera

<table>
<tr><td>Course Title</td><td colspan="4">Operation Research</td><td colspan="2">Course Type</td><td colspan="2">Soft core</td></tr>
<tr><td>Course Code</td><td>B20ERS725</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII semester</td></tr>
<tr><td rowspan="4">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
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<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
</table>

	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The course of operation Research focuses on optimization. Optimization problems arise in all walks of human activity –particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically solve problems in linear programming, transportation, Waiting lines, sequencing, Game Theory and subsequently educate the student to solve these problems with the help of the available methods.

COURSE OBJECTIVES

1. Learn Fundamentals of OR, Formulation of an LPP. And determine the optimal solution fora LPPProblem
2. Learn applications of LPP such as transportation problem, Assignment problem, travellingsalesman problem
3. Analyze the waiting line model for real world applications.
4. Determine the project completion time by using PERT and CPM.
5. Determine the scheduling of machines in the shop floor by using Johnson's algorithm.
6. Understand the conflict between the two players in a game and determine the best strategy for theplay.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Formulate & Analyze the different models of Operation research & their applications.	1,2,12	1,2
CO2	Solve transportation problem to determine optimal route and assignment for real time applications.	1,2,12	1,2
CO3	Design and develop a model to improve decision making and objective analysis of decision problems.	1,2,3,12	1,2
CO4	Interpret the characteristics of various waiting line problems	1,2,12	1,2
CO5	Determine optimal sequencing and best strategy of the play	1,2,12	1,2
CO6	Ascertain the optimization techniques to real life problems	1,2,12	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	**Bloom's Level**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		✓				
CO2				✓		
CO3				✓		
CO4				✓		
CO5				✓		
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2										1	3	3	
CO2	3	3										1	3	3	

CO3	3	2	3									1	3	3	
CO4	3	3										2	3	3	
CO5	3	3										2	3	3	
CO6	3	3			1							3	3	3	
Average	3	2.6	3		1							1.67	3	3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Operation Research: Definition, Scope of OR, OR Models, Characteristics and phases of OR. Advantages and limitation of OR. Mathematical formulation of LPP, Assumptions in LPP. Graphical solutions of LPP, Convex and non-convex sets.

Linear Programming Problem: Slack, surplus and artificial variables, Simplex method & BIG-M, Concept of duality, Special cases such as unbounded solution, multiple optimal solution, infeasible solution & degeneracy.

Unit-2

Formulation of Transportation Model: Determination of IBFS using different methods & optimality by modi (V-V) method. Balanced and unbalanced transportation Problem, Degeneracy in transportation problems and resolving degeneracy, maximization of transportation problem. Application of Transportation Problem.

Assignment Model: Hungarian Method, Formulation of the assignment model (Minimization and Maximization), Balanced and unbalanced model, travelling salesman problem.

Unit-3

Network Analysis – PERT & CPM Techniques: Project scheduling, Basic terminology used in project network, network construction, time estimates, determination of critical path and its durations, Floats , Variance under probabilistic models, prediction of project completion date.

Waiting Line Model: Queue system and characteristics of queuing models, Kendall's notation, classification of the queue. The M/m/1:∞/FCFS queuing system, Numerical

Unit-4

Game Theory: Introduction, Definition, strategy, Formulation of games, pay off matrix, Maximin and minimax criteria, Saddle point, Types of games. Solution of game with and without saddle point, Graphical solution of 2 X n game & M X 2 game. Dominance property for rectangular game i.e., M x N game.

Sequencing : Johnson's algorithm, Assumptions in sequencing, n jobs to 2 machines, n jobs on 3 machines, n jobs on m machines, 2 jobs on n machines, graphical solution priority rules, processing of n jobs through m machines.

CASE STUDIES

1. Develop a python programming for solve linear programming problem.
2. Formulation of the problem by using linear programming model for managing of waste in metropolitan cities.
3. Optimization of the optimal route and cost for connecting various cities in the state.
4. Analyzing the various characteristics of the queuing system in day to day service sector.
5. Application of network techniques for various manufacturing and service sector- A case study

TEXT BOOKS

1 Prem Kumar Gupta and D.S.Hira, "Problems in Operations Research", S.Chand Publication, New Delhi, 2021.

2.S.D.Sharma, "Operations Research", Kedar Nath Ram Nanth, New Delhi, 8th Revised Edition 2017

.**REFERENCE BOOKS**

1 Fredericks Hiller and Gerald J Liberman, "Introduction to Operation Research", Tata McGraw hill, Special Indian edition 9th Edition, 2017.

2. Taha.H.A, "Operation Research: An Introduction", Pearson Education Indian Edition, 2014.

3. A Ravindran, "Operation Research: Principles and Practice", John Wiley and Sons Ltd, 2nd Edition, 2004.
4. S Kalavathy, "Operation Research", Vikas Publishing house Pvt Ltd, 3rd Edition, 2009

JOURNALS/MAGAZINES

1. https://www.inderscience.com/jhome.php?jcode=ijor
2. https://www.springer.com/journal/12597

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/110106062
2. https://nptel.ac.in/courses/112106131

Course Title	**Internship**				**Course Type**		**Soft core**	
Course Code	**B20ERS726**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	3	3	3	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**0**	**39**	**50 %**	**50 %**

COURSE OVERVIEW

The internship in field of study is essential to successful outcomes after graduation. Classroom environment may involve only with discussion, debate, peer interaction, and shared learning experiences. But it is important to seek opportunities for a student to apply academic concepts according to industrial requirements.

COURSE OBJECTIVES

1. To gain a practice-oriented and 'hands-on' working experience in the real world and to enhance the student's learning experience.
2. To develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in real organizational setting.
3. To enhance operational, customer service, life-long knowledge and skills in a real world work environment.
4. To get pre-employment training opportunities and an opportunity for the company or organization to assess the performance of the student and to offer an employment opportunity after his/her graduation, if it deems fit.

.**COURSE OUTCOMES (COs)**

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Solve real life challenges in the workplace by analyzing work environment and conditions, and selecting appropriate skill sets acquired from the course.	1, 2	1, 2
CO2	Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job functions.	1,2,3	1, 2
CO3	Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement.	1, 2, 5, 6	1, 2
CO4	Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means.	9, 10, 11, 12	1, 2

CO5	Exhibit critical thinking and problem solving skills by analyzing underlying issue/s to challenges.	1, 2, 3,4	1, 2, 3
CO6	Exhibit professional ethics by displaying positive disposition during internship	7,8	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				✓		
CO2				✓		
CO3				✓		
CO4				✓		
CO5				✓		
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3	3	
CO2	3	3	3										3	3	
CO3	3	3			3	3							3	3	
CO4									3	3	2	2	3	3	
CO5	3	3	3	1									3	3	2
CO6							2	2					3	3	
Average	3	3	3	1	3	3	2	2	3	3	2	2	3	3	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Student should do internship for 21 days in one stretch or 15 days in two slot before the commencement of 7th semester classes. The internship can be completed during the summer or winter vacations.

Student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The student may contact Faculty Mentor taking guidance on how to make presentation and preparation of report. Student should prepare the final report on internship topic.

The Internship report will be evaluated on the basis of following criteria:

I. Originality.
II. Adequacy and purposeful write-up.
III. Organization, format, drawings, sketches, style, language etc.
IV. Variety and relevance of learning experience.
V. Practical applications, relationships with basic theory and concepts taught in the course.

Evaluation through Seminar Presentation, Assignments/Case Studies /Simulation and Viva-Voce:

The student expected to give a seminar / presentation and submit of case studies / assignment/ simulation whichever the faculty mentor expect.

The evaluation will be based on the following criteria:

I. Submission of Assignment/Case Studies/Simulation Solution relevance to Internship completed.
II. Quality of content presented.

III. Proper planning for presentation.
IV. Effectiveness of presentation.
V. Depth of knowledge and skills.
VI. Report Writing

TEXT BOOKS

1. C R Kothari, "Research Methodology- Methods and Techniques", New Age International, 2nd Edition, 2015.
2. A.K. Chitale, R.C. Gupta, "Product Design and Manufacturing", Prentice –Hall of India, Sixth Edition, 2013.

Course Title	**Electric and Hybrid Vehicles**				**Course Type**		**Open Elective**	
Course Code	**B20MEO701**	**Credits**	**3**		**Class**		**VII semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

This course is targeting students who wish to pursue research & development in industries or higher studies in the field of Electric and Hybrid Vehicles and upcoming market for retrofit of existing IC engine vehicles with electric motors. It also offers in depth knowledge about working of an Electric Vehicle by covering study of Vehicle fundamentals of EVs and its various components. The course gives an introductory level knowledge on working fundamentals of different electric motors, motor controllers, control techniques, electric vehicle drive train, regenerative braking and different types of hybrid vehicles.

COURSE OBJECTIVES

1. To provide the students with sufficient knowledge on series, parallel and complex hybrid architectures of automobile vehicles.
2. To enable the students to understand the concept of electric drive trains, hybrid architectures and hybrid power plant specifications.
3. To help the students to understand the concept of sizing the drive system, energy storage and their alternatives, energy management and control system.
4. To provide the knowledge of the various hybrid and load tracking architectures with knowledge on Hybrid power plant specifications.
5. To impart knowledge on various energy management and control strategies, energy storage systems like batteries and alternate energy storage systems like fuel cells.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Describe the systems of electric vehicles, hybrid electric vehicles and their relevance to society and environment.	1,6,7	1

CO2	Recognize different configurations of power trains used in hybrid vehicles and identify the hybrid load tracking architectures.	1	1
CO3	Illustrate the working of different types of electrical machines, motors and drive topologies.	1	1
CO4	Demonstrate the electric propulsion unit and Identify the communication protocols and technologies used in vehicle networks.	1	1
CO5	Analyze performance of battery based energy storage and problems associated with battery systems used in electric hybrid vehicles.	1, 2	1
CO6	Describe the characteristics of fuel cell technology.	1	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4			✓			
CO5		✓				
CO6		✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2	2						2		
CO2	3												3		
CO3	3												2		
CO4	3												3		
CO5	3	1											2		
CO6	2												3		
Average	**2.8**	**1**				**2**	**2**						**2.5**		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Sustainable Transportation, A Brief History of EHVs, Need of EHV technology, Architectures of EHVs, social and environmental importance of hybrid and electric vehicles, Challenges and Key Technology of EHVs.

EHV Fundamentals: Basics of vehicle performance, vehicle power source characterization, transmission characteristic and mathematical models to describe vehicle performance

Unit-2

Hybrid Electric Drive-trains: Basic Architecture of Hybrid Drive Trains, Energy Savings Potential of Hybrid Drivetrains, Hybrid drive train configurations- series configuration, Parallel configurations, Series-Parallel configurations and complex configurations, power flow control in hybrid drive-train topologies

Basic Architecture of Electric Drive Trains: Electric Vehicles drive train configurations, Introduction to various electric drive-train topologies, Electric Vehicle (EV) drivetrain Alternatives Based on Drivetrain Configuration, Electric Vehicle (EV) Drivetrain Alternatives Based on Power Source Configuration.

Unit-3

Electric Propulsion unit: Electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, introduction to Permanent Magnet Motors.

Control Systems for the EHV and EVs: In vehicle networks- CAN, Energy Management Strategies: Energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

Unit-4

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery Parameters, Different types of Battery used in EHVs, Battery based energy storage and its analysis, Problems associated with battery systems in EHVs, Temperature controlling methods, advanced battery technologies.

Fuel Cells: Fuel Cell Characteristics - Fuel Cell Types – Alkaline Fuel Cell - Proton Exchange Membrane - Direct Methanol Fuel Cell - Solid Oxide Fuel Cell- Hydrogen Storage Systems- Reformers - Fuel Cell EV - Super and Ultra Capacitors -Flywheels.

TEXT BOOKS

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", 4th Edition, CRC Press, 2003.
2. M. Ehsani, Y. Gao and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", 2nd Edition, CRC Press, London, 2010.
3. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley publications, 3rd Edition, 2003.

REFERENCE BOOKS

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 3rd edition, Wiley, 2003
2. Seth Leitman, "Build Your Own Electric Vehicle" McGraw-Hill, 2nd Edition, 2013.
3. Chris Mi, M A Masrur, D W Gao, "Hybrid Electric Vehicles – Principles and applications with practical perspectives", 4th edition, Wiley, 2011
4. C.C Chan, K.T Chau, "Modern Electric Vehicle Technology", Oxford University Press Inc., New York 2001

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/book/9780444535658/electric-and-hybrid-vehicles
2. https://www.scimagojr.com/journalsearch.php?q=11600153305&tip=sid

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/103/108103009/
2. https://www.edx.org/course/electric-cars-technology
3. https://www.classcentral.com/course/edx-hybrid-vehicles-10285

Course Title	**Design Lab**				**Course Type**		**Hard Core**	
Course Code	**B20ER0705**	**Credits**	**1**		**Class**		**VII Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

The course deals with the free and forced vibrations under un-damped and damped conditions for single degree of freedom mechanical systems. It also deals with the critical speed of a rotating shaft. This lab helps the manufacturing

sector in analyzing the vibration measurement and Noise Engineering. Also study the mode shapes of cantilever beam. The course further deals with experimental stress analysis.

COURSE OBJECTIVES

1. To enable the students to understand the theoretical principles of vibration and vibration analysis techniques for the practical solution of vibration problems.
2. To analyze the free and forced (harmonic, periodic, non-periodic) vibration analysis of single degree of freedom linear systems.
3. To enable the students to determine sound pressure level measurement in specified acoustic environment.
4. To predict stress levels using the concepts of Photo elasticity.
5. To analyze the parameters (Principal Stresses and Strains) using strain rosettes.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Estimate the natural frequency for longitudinal and torsional systems and demonstrate a physical understanding of damping as well as frequencies and mode shapes of engineered systems and record the results in the form of technical report.	1, 4, 9, 10	1, 2
CO2	Compute the natural frequency for forced vibration of a single degree of freedom of un-damped systems and record the results in the form of technical report.	1, 3, 9, 10	1, 2
CO3	Compute the critical speed of rotating shaft and record the results in the form of technical report.	1, 3, 9, 10	1, 2
CO4	Predict the vibration using measuring instruments and noise reduction techniques to real time engineering problems and record the results in the form of technical report.	1, 4, 6, 9, 10	1, 2
CO5	Justify the Photo elasticity principles for stress analysis and record the results in the form of technical report.	1, 2, 9, 10	1, 2
CO6	Determine Principal stresses and strains in members subjected to combined loading using strain rosettes, compare it with theoretical values and record the results in the form of technical report.	1, 2, 9, 10	1, 2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓				
CO2		✓				
CO3			✓	✓		
CO4	✓			✓	✓	
CO5		✓	✓			
CO6	✓	✓				

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			3					3	3			3	3	
CO2	2		3						3	3			3	3	
CO3	3		3						3	3			2	3	
CO4	3			3		3			3	3			3	2	

CO5	2	3							3	3			3	3	
CO6	3	3							3	3			2	3	
Average	**2.5**	**3**	**3**	**3**		**3**			**3**	**3**			**2.7**	**2.8**	

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional).
2. To study the forced damped vibration of spring mass system.
3. Determination of critical speed of a rotating shaft.
4. Vibration measurements by accelerometers, Laser Doppler Vibrometer, and u (μ-flown) probes.
5. Experimental Modal Analysis: Determination of Frequencies and mode shapes of cantilever. Beam.
6. Measurement of Noise.

Part-B

1. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
2. Determination of Fringe constant of photo elastic material using.
   a) Circular disc subjected to diametral compression.
   b) Pure bending specimen (four point bending).
3. Determination of stress concentration using Photo elasticity for rectangular plate with a hole under tension.
4. Determination of Pressure distribution in Journal bearing.

TEXT BOOKS

1. S. S. Rao, Mechanical Vibrations, Pearson Education Inc, 6th edition, 2016.
2. S. Graham Kelly, Schaum's outline Series, Fundamentals of Mechanical Vibrations, Tata McGraw Hill.
3. W. T. Thomson, Mechanical Vibrations, Pearson Education Inc, 5th edition, 2008.
4. Sadhu Singh, "Experimental Stress Analysis", Khanna Publisher New Delhi, 2009.
5. Srinath L.S., "Experimental stress Analysis", Tata McGraw Hill, New Delhi.

REFERENCE BOOKS

1. G. K.Grover, Mechanical Vibrations, Nem Chand and Bros.
2. W. T. Thomson, Theory of Vibration with Applications, Pearson Education Inc, 5th edition, 2008.
3. V. P. Singh, Mechanical Vibrations, Dhanpat Rai & Company, 3rd edition, 2006.
4. Jindal, "Experimental stress analysis", Pearson Publishers, 2018.
5. J.Srinivas, "Stress analysis-An introduction to Experimental Techniques", Narosa Publishers, 2015.

JOURNALS/MAGAZINES

1. Journal of Sound and Vibration
2. Journal of Vibration and Acoustics
3. Journal of Vibration Engineering & Technologies
4. https://www.inceusa.org/publications/noise-news-international
5. https://www.sciencedirect.com/topics/engineering/experimental-stress-analysis
6. https://link.springer.com/book/10.1007/978-3-319-06086-6

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112107212 (Introduction to Mechanical Vibration)
2. https://www.classcentral.com/course/swayam-sound-and-structural-vibration-58554
3. https://onlinecourses.nptel.ac.in/noc22_me34/preview (Sound and Structural Vibration)
4. https://onlinecourses.nptel.ac.in/noc21_me02/preview

5. https://nptel.ac.in/courses/112106068

Course Title	Computer Integrated Manufacturing Lab				Course Type		Hard Core	
Course Code	B20ER0706	Credits	1		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**1**	**2**	**2**	**0**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

The main purpose of this lab is to train the students industry ready and to attain employability skills with the CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes. Students will get acquainted about CNC Lathe part programming for Turning, Facing, Grooving, Step turning, Taper turning, Circular interpolation, Combination of few operations followed by CNC Mill Part programming. In addition part programming using Canned Cycles for Drilling, Peck drilling, Boring, Turning, Facing, Taper turning, Thread cutting and Simulation of Tool Path for different operations.

COURSE OBJECTIVES

1. To train the students with CNC part programming concepts
2. To generate manual part programming – CNC Turning, milling and drilling
3. To familiarize with the various operations to be performed with syntax format based on Fanuc controller.
4. To carry out the simulation /Dry run of the given profile with various operations involved in it.
5. To educate the students on Flexible Manufacturing System and Robot Programming
6. To demonstrate the concepts discussed in Computer Integrated Manufacturing course.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Understand the basic concept of machine programming languages – Manual Part programming and Computer assisted part programming.	1,2,5	1,2
CO2	Analyze the various operations involved in the profile with its syntax format for machining and document the results in the form of technical report.	1,2,5,9,10	1,2
CO3	Generate the part program for the given turning, drilling and Milling profile/part geometry and document the results in the form of technical report	1,2,5,9,10	1,2
CO4	Use Canned Cycles for Drilling, Peck drilling, Boring, Turning, Taper turning, Thread cutting operations and document the results in the form of technical report	1,2,5,9,10	1,2
CO5	Familiarized with the computer numerical control software and its ability to generate the cutter tool path as per given profile in the dry run and document the results in the form of technical report.	1,2,5,9,10	1,2
CO6	Analyze the various programming aspects based on turning and milling operations and also document the results in the form of technical report	1,2,5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				

CO2				✓		
CO3			✓			
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1								2	1	
CO2	2	3			3				2	2			2	2	
CO3	2	3			3				2	2			2	2	
CO4	2	3			3				2	2			2	2	
CO5	2	3			3				2	2			2	2	
CO6	3	2			1				1	1			2	1	
Average	**2.3**	**2.6**			**2.33**				**1.8**	**1.8**			**2**	**1.6**	

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Manual CNC part programming for turning and drilling parts. Selection and assignment of tools, correction of syntax and logical errors, and verification of tool path.
2. Simulation of Turning, Drilling operations. Typical simulations to be carried out using simulation packages like: Cadem CAMLab-Pro, Master- CAM with and without canned cycle programs.

Part-B

1. Simulation of milling operations. Typical simulations to be carried out using simulation packages like: Cadem, CAMLab-Pro, Master- CAM with and without canned cycle programs.
2. DEMO of Flexible Manufacturing system and robot programming

TEXT BOOKS

1. M.P.Groover & Emory W.Zimmer, "CAD/CAM, Computer Aided Design and Manufacturing", Pearson India, 2nd edition. 2007
2. Mikell P.Groover, "Automation, Production system & Computer Integrated Manufacturing", Pearson India, 2nd edition. 2007

REFERENCE BOOKS

1. Ibrahim Zeid, "CAD/CAM theory and practice", Tata McGraw hill. 2007.
2. P. Radha Krishnan, S. Subramanyan & V. Raju, "CAD/CAM/CIM", New Age international Publishers, 2nd edition. 2008.
3. P. Radha Krishnan, "Computer Numerical Control Machines and CAM", New Age international Publishers, 1st edition 2012.
4. P. N. Rao, "CAD/CAM Principles and applications", Tata McGraw hill.2010.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/Computer Aided Design
2. https://www.sciencedirect.com/journal/Advancements in CAD/CAM technology: Options for practical implementation

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112102102

2. https://nptel.ac.in/courses/112104289

8th Semester

Course Title	Total Quality Management and Six Sigma				Course Type		Open Elective	
Course Code	B20MEO801	Credits	3		Class		VIII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50 %**	**50 %**

COURSE OVERVIEW

The course offers fundamental aspects of quality, quality control and management. The course provides insights into basic approaches of total quality management (TQM), evolution of quality management and contributions of quality gurus to the development of TQM. Techniques and tools which Focus on customer satisfaction and their involvement in the TQM program are included .The course presents various tools and techniques which are widely used in continuous improvement (CI) and TQM implementation programs. Various quality management tools, six sigma methodology (DMAIC) and design for six sigma (DFSS) techniques are also elaborated in this course.

COURSE OBJECTIVES

1. To provide the knowledge of quality and its evolution
2. To introduce the basics of leadership and customer perception of quality
3. To impart the knowledge of quality tools
4. To attain the knowledge of six sigma and its methodology

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the principles of total quality management and to explain how these principles can be applied within quality management systems.	1,2	1,2,3
CO2	Explore the various dimensions of customer satisfaction and their involvement	1,2	1,2,3
CO3	Use appropriate process improvement techniques for measuring and improving quality control.	1,2	1,2,3
CO4	Select appropriate statistical techniques for improving processes and analyze the strategic issues in quality management.	1,2,5	1,2,3
CO5	Analyze and apply six sigma methodology for design optimization of process.	1,2,3,5	1,2,3
CO6	Use simulation tools to enhance the process capability.	1,2,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2			✓			
CO3				✓		
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	1	1
CO2	3	2	1										3	1	1
CO3	3	3			1								3	1	1
CO4	3	1			1								3	1	1
CO5	3	2	1		1								3	1	1
CO6	3	3	1										3	1	1
Average	**3**	**2.2**	**1**		**1**								**3**	**1**	**1**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Principles and Practices: Basic approach, gurus of TQM, TQM frame work, awareness, defining quality, historical review, obstacles, benefits of TQM.

Leadership: Definition, characteristics of quality leaders, leadership concepts, Deming philosophy, role of TQM leaders, implementation, strategic planning communication

Unit-2

Customer Satisfaction and Customer Involvement: Perception of quality, feedback using customer complaints, service quality, translating needs into Requirements, Kano model, customer retention. Employee involvement - Motivation, employee surveys, Empowerment teams, suggestion system, recognition and reward, gain sharing, performance appraisal

Unit-3

Continuous Process Improvement: Juran triology, improvement strategies, PDCA cycle, problem solving methods, Kaizen, 5S concepts, six sigma. Tool and Techniques - Statistical process control-7QC tools,
Benching marking, information technology, quality management systems, QFD, FMEA, product liability, Total productive maintenance. TQMEX model.

Unit-4

Quality Management Tools: Forced filed analysis, nominal group techniques, affinity diagram, interrelationship digraph, tree diagram, matrix diagram, process decision program chart and activity network diagram.

Design for Six Sigma: Introduction to DMAIC approach and DFSS, tools for concept development, design development, design optimization and design verification problems.

TEXT BOOKS

1. Dale H.Bester field, "Total quality Management", Pearson Education India, ISBN: 8129702606.

2. M.Zairi, “Total quality Management for Engineers”, 3rd Edition, McGraw-Hill’s, 1987.

REFERENCE BOOKS

1. Shoji shiba, Aln Graham, David Walden, “A new American TQM, four revolutions in Management”, Productivity Press, Orgeon, 1990.
2. Gopal K.Kanji and Mike Asher, “100 Methods for TQM”, Sage Publications, Inc., 1st Edition.
3. H.Lal, “Organizational Excellence through TQM” New age Publication.

JOURNALS/MAGAZINES

1. https://www.emerald.com/insight/publication/issn/0265-671X - International journal of quality and Reliability Management
2. https://www.emerald.com/insight/publication/issn/2040-4166 ----internal journal of six sigma

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_mg03/preview
2. https://nptel.ac.in/courses/110104085

Course Title	Major Project			Course Type	Hard Core
Course Code	B20ER0801	Credits	6	Class	VIII Semester
Course Structure	TLP	Credits	Contact Hours	Assessment in Weightage	
	Theory	0	0		
	Practice	6	18	IA	SEE
	Tutorial	0	0		
	Total	**6**	**18**	**50 %**	**50 %**

COURSE OVERVIEW

This course introduces the students to professional engineering practice by providing them with an opportunity to work on an open ended engineering problem. Typically, the students would apply knowledge gained from different courses and training, which they have studied in their curriculum using methods, tools and techniques to find solution to the stated problem. It also emphasizes the importance of life-long learning as a fundamental attribute of graduate engineers.

COURSE OBJECTIVES

1. To provide a definite circumstances, to apply the leanings from various courses of the program and solve problem related to society.
2. To develop a multidisciplinary approach for problem solving.
3. To provide an exposure to take up a real life research problem, product development, industrial problem and arrive at meaningful conclusions / product design / solution.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Articulate problem statements for real life problems with suitable assumptions and constraints.	1	1,2,3
CO2	Perform literature search and / or patent search in the area of interest.	2, 12	1,2,3
CO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs or understanding the social, environmental and in economic contexts.	3, 6, 7	1,2,3
CO4	Analyze data and reach a valid scientific conclusion or product or solution.	4	1,2,3

CO5	Apply appropriate techniques, resources, and modern engineering and IT tools to solve complex engineering activities as per ethical principles and norms of the engineering practice.	5, 8	1,2,3
CO6	Function effectively as a member or leader in diverse teams and in multidisciplinary settings.	9	1,2,3
CO7	Write effective reports, design documentation and make effective presentations.	10	1,2,3
CO8	Demonstrate knowledge and understanding of the engineering and management principles to manage projects.	11	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2				√		
CO3						√
CO4				√		
CO5					√	
CO6		√				
CO7				√		
CO8			√			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3										3	3	3	3
CO3			3			3	3						3	3	3
CO4				3									3	3	3
CO5					3			3					3	3	3
CO6									3				3	3	3
CO7										3			3	3	3
CO8											3		3	3	3
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Project may be a modelling, simulation, experimental & analysis, model/prototype design, fabrication of new equipment, analysis of data, software development, etc. or a combination of these.

The students have to make a project team consisting of two, three or four members. The project work should started in the beginning of seventh semester and to be completed before the end of eighth semester. Select the problems which will provide solution to an industry or in the society or any innovative ideas that benefit the society. The project team has to work for the solution or converting their ideas into product/ process and present the progress of the work as per university schedule. The group is expected to complete, literature review, problem definition, detailed project plan, methodology of work and estimated project cost, in seventh semester, and submit the same in the form of a report prepared as per the guidelines/format of the university (one report per group).

TEXT BOOKS

1. Biswajit Mallick, “Innovative Engineering Projects”, Entertinement Science and Technology Publication, Bhubaneswar, India, 1st Edition 2015.
2. C R Kothari, “Research Methodology- Methods and Techniques”, New Age International, 2nd Edition, 2015.
3. A.K. Chitale, R.C. Gupta, “Product Design and Manufacturing”, Prentice –Hall of India, Sixth Edition, 2013.

REFERENCE BOOKS

1. O. Molloy, S. Tilley and E. A. Warman, “Design for Manufacturing and Assembly: Concepts, Architectures and Implementation”, Springer. USA, 2012.
2. Boothroyd, G.Peter Dewhurst and Winston A, “Knight, Product Design for Manufacture and Assembly”, CRC Press, Taylor & Francis, Third Edition, 2010.
4. Navi Radjou, Jaideep Prabhu and Simone Ahuja, “JUGAAD Innovation: A Frugal and Flexible Approach to Innovation for the 21st Century”, Random house India, Noida, 2012.
5. Karl T. Ulrich and Steven D. Eppinger, “Product Design and Development”, McGraw-Hill, Sixth Edition, 2015.

JOURNALS/MAGAZINES

1. Global Innovative research Journal: https://freeprojectsforall.com/journal-publication/
2. International Journal of Project Management: https://www.journals.elsevier.com/international-journal-of-project-management

Registrar
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SCHOOL OF APPLIED SCIENCES

B.Sc. – MICROBIOLOGY, CHEMISTRY, GENETICS

HANDBOOK: 2021-24

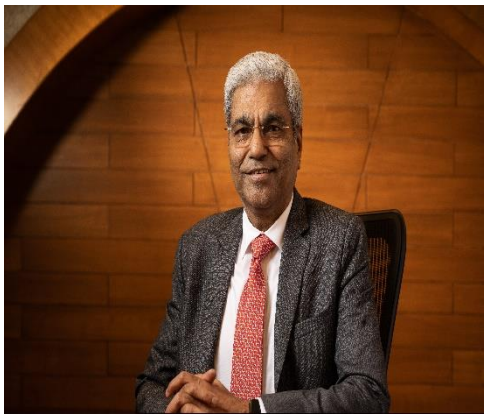
Rukmini Educational
Charitable Trust

CONTENTS

Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."

- Nelson Mandela.



There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is Power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju
The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

- **Dr. Dhanamjaya M**
  Vice Chancellor, REVA University.

Director's Message

Higher education across the globe is opening doors of its academic disciplines to the real-world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

Indian economy is experiencing an upward growth right from the beginning of 21st century necessitating well qualified science graduates to work as scientists, teachers, algorithm developers, computer programmers, professionals and often administrators. At present more than 400 million youth are below 18 years of age and government is committed to increase the GER to 30% by 2020, further necessitating a greater number of teachers and professors to work in schools and colleges. Research has also been given equal importance. Pivate sector and Corporates are also looking for smart science graduaes in a big way. The B.Sc. (CMG) degree program of REVA University is designed to prepare biotechnologist, biochemists, Microbiologist, genetists, scientists, teachers, professionals & administrators who are motivated, enthuastics & creative thinkers to meet the challenges of growing economy as well as to fulfill the growing aspirations of the youth.

The program has been developed with an emphasis on knowledge assimilation, application, national and international job market and its social relevance. Maximum number of courses are integrated with cross cutting issues, relevance to professional ethics, gender, human values, environment and sustainability. The curriculum caters to and has relevance to local, national, regional and global developmental needs. The outcome-based curriculum designed and followed imbibes required theoretical concepts and practical skills in the domain. By undergoing this program, you will develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge-based society.

This handy document containing brief information about B.Sc. (CMG) program, scheme of instruction and detailed course content will serve as a guiding path to you to move forward in a right direction.

I am sure you will enjoythe curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers' involvement and guidance. We will strive to provide all needed comfort andcongenial environment for your studies. I wish you and allstudents' pleasant stay in REVA and grand success in your career.

Prof.Shilpa BR

Deputy Director, SoAS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. Rukmini Educational Charitable Trust (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond Road Park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 11,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette dated 7th February, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well-planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 410 Scholars pursuing research leading to PhD in 18 disciplines. It has 800+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University

has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much-required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counselors and Placement Officers. The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student

exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreignuniversities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director I.I.Sc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is **'Life Time Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "**REVA Award of Excellence"** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA

but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and wonmedals and prizes in academic, cultural and sports activities are also recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honored with many more such honors and recognitions.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards.

Misson

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position

- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner.

ABOUT SCHOOL OF APPLIED SCIENCES

The School of Applied Sciences offers graduate and post graduate programs in Biotechnology, Biochemistry, Chemistry, Physics and Mathematics which are incredibly fascinating. It aims to attract talented youth and train them to acquire knowledge and skills useful to industrial sectors, research laboratories, and educational institutions. The school presently offers B.Sc. degree programs in Bio-Chemistry, Bio-Technology, Chemistry, Physics, Mathematics and B Sc with various combinations viz, Biotechnology, Biochemistry and Genetics, Physics Chemistry and Mathematics, Microbiology, Chemistry and Genetics, Mathematics, Statistics and Computer Science, and Bioinformatics, Statistics & Computer Science and also Post Graduate Diploma in Clinical Embryology and Artificial Reproductive Technology. The school also facilitates research leading to PhD in Biotechnology, Biochemistry, Physics, Chemistry, Mathematics, and related areas of study.

The School of Applied Sciences is shouldered by well qualified, experienced and highly committed faculty. The state-of-the-art infrastructure digital classrooms, well equipped laboratories, conference rooms and the serene academic atmosphere at REVA University will enhance the transfer as well as creation of knowledge. The school provides an interactive, collaborative peer tutoring environment that encourages students to break down complex problems and develop strategies for finding solutions across a variety of situations and disciplines. The school aims to develop a learning community of critical thinkers who serves as models of innovative problems solving in the university environment to enrich their academic and professional careers.

Vision

To nurture intellect, creativity, character and professionalism among students and impart contemporary knowledge in various branches of Chemical, Biological, Physical and Mathematical Sciences that are socially relevant and transform them to become global citizens.

Mission

- To achieve excellence in studies and research through pedagogy and support interface between industry and academia
- To create intellectual curiosity, academic excellence, and integrity through multidimensional exposure

- To establish state of the art laboratories to support research and innovation and promote mastery of science.
- To inculcate an ethical attitude and make students competitive to serve the society and nation.

BOS MEMBERS

Sl. No.	Panel Members
Chemistry	
1	**Dr. Sanjeevarayappa C.** Assistant Professor and Head Department of Chemistry GFGC, Yelahanka

Sl. No.	Panel Members
Microbiology	
1	**Dr. Mahesh M,** **Chief Executive Officer**, Azyme Biosciences Pvt. Ltd., Bengaluru, Karnataka, India
2	**Dr. Basavaraj Girennavar** Chairman and Managing Director, Criyagen Agri & Biotech Pvt. Ltd., Bengaluru,
3	**Dr. Latha P,** Chief Operating Officer, X-Cyton Pvt Ltd, Bengaluru.
4	**Dr. Pannuru Padmavathi,** Managing Director, DR Biosciences LLP, Bengaluru
5	**Dr. Pasupuleti Visweswara Rao** Associate Professor & Research Coordinator Department of Biomedical Sciences and Therapeutics Universiti Malaysia Sabah, Malaysia
6	**Dr. Mahesh Yandigeri,** Senior Scientist, Division of Genomic Resources, National Bureau of Agricultural Insect Resources (NBAIR), Hebbal, Bengaluru
7	**Dr. G.B. Manjunatha Reddy,** Scientist, ICAR - National Institute of Veterinary Epidemiology and Disease Informatics (ICAR – NIVEDI), Yelahanka, Bangalore

Sl. No.	Panel Members
	Genetics
1	**Dr. Harini BP** Professor, Center for Applied Genetics, Bangalore University, Bangalore.
2	**Dr. N. Vijaya Shankar** Senior Scientist, Aurigene Discovery Technology, Bengaluru
3	**Dr.S. Basavarajappa** Associate Prof in Zoology University, Mysore

B. Sc
(Microbiology, Chemistry, Genetics)

Programme Overview

B.Sc. Microbiology, Chemistry & Genetics at REVA University is a 3-year bachelor level course through six semesters. It is an arm of microbiology and chemistry that scientifically studies related to heredity, genes, and variations in living organisms. This combination familiarizes with the usage of living organisms in the field of medicine, genetics and chemical sciences. It is designed to aid the students to understand the importance of chemicals, microbiology and genetics to improve the quality of human life.

Programme Educational Objectives (PEOs)

PEO -1	Adopt strong foundation with skills, ethics, relevant training and education towards understanding life science.
PEO - 2	Apply appropriate tools and techniques for conducting scientific investigations to solve the problems in life science domain.
PEO – 3	Acquire higher degree of work in academics and research.
PEO – 4	Adapt lifelong learning with continuous improvement.

Programme Outcomes (POs)

1. Science knowledge: Apply the knowledge of life science for the solution of complex problems in various domains including healthcare considering public health & safety and the cultural societal & environmental concerns.

2. **Problem analysis**: Identify, formulate & analyse problems related to various domains of life sciences relevant to biotechnology, genetics and biochemistry.

3. **Conduct investigations of relevant problems**: Use basic knowledge including analysis and interpretation of data, and synthesis of the information to provide valid conclusions and also to carry out the research procedures.

4. **Modern tool usage: To** Create, select and apply appropriate techniques, resources and modern technology which in turn benefit the society.

5. Environment and sustainability: Understand and implement environmental friendly approaches in life sciences to support sustainable development.

6. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and norms in Life Sciences.

7. **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

8. **Communication**: Communicate effectively with the scientific community and with society at large. Be able to comprehend and document. Make effective presentations, and deduce clear instructions.

9. Project management and finance: Demonstrate knowledge and understanding of life sciences and management principles and apply these to one's own work, as a member and leader in a team.

10. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

After successful completion of the program, the graduates shall be able to

1. Develop knowledge and understanding of various subjects in Chemistry, Microbiology and Genetics.

2. Explain, design and analyse field related problems in the domains of Chemistry, Microbiology and Genetics.

3. Plan manufacturing process, handle instruments and test products in the field of Life Sciences.

Regulations – Bachelor Degree Programs
Academic Year 2021-22 Batch

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – Bachelor Degree Programs 2021-22 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following Bachelor Degree Programs of REVA University offered during 2021-22:

B Com (Industry Integrated)
B Com (Honors)
BBA (Industry Integrated)
BBA (Honors)
BBA (Entrepreneurship)
BA - Journalism, English, Psychology
BA - Tourism, History & Journalism
BA - Political Science, Economics & Journalism
BA - Performing Arts, English Psychology
BCA
BSc (Honours) Cloud Computing & Big Data
BSc in Physics, Chemistry, Maths
BSc in Maths, Statistics, Comp Sci.
BSc in Bioinformatics, Statistics, Computer Science
BSc in Biotechnology, Biochemistry, Genetics
BSc in Microbiology, Chemistry, Genetics
BSc in Physics, Maths, Computer Science

3. Duration and Medium of Instructions:

3.1 Duration: The Bachelor Degree program is of 6 Semesters duration. A candidate can avail a maximum of 12 semesters - 6 years as per double duration norm, in one stretch to complete the Bachelor Degree, including blank semesters, if any. Whenever a candidate opts for blank semester, s/he has to study the prevailing courses offered by the School

when s/he resumes his/her studies.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 Course: "Course" means a subject, either theory or practical or both, listed under a program; Example: "Microbiological techniques" in B.Sc. (CMG) program is an example of course to be studied under respective program.

Every course offered will have three components associated with the teaching-learning process of the course, namely:

L	**Lecture**
T	**Tutorial**
P	**Practice**

Where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands-on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much-required skill component.

4.2 Classification of Courses

Courses offered are classified as: Foundation Courses, Core Courses, Hard Core Courses, Soft Core Courses, Open Elective Courses, SEC, Project work/Dissertation

4.2.1 Foundation Course: The foundation Course is a mandatory course which should be completed successfully as a part of graduate degree program irrespective of the program of study

4.2.2 Hard Core Course (HC) simply core course: The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily

4.2.3 Soft Core Course (SC) (also known as Professional Elective Course)

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study

4.2.4 Open Elective Course (OE):

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course**

4.2.5 Project Work / Dissertation:

School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is considered to be equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project.

4.2.6 SEC: It is a mandatory course to equip students with skill sets required as per the industry expectation. Candidate will seek exposure through workshops and other certificate-based courses.

4.2.7 Mandatory Course (MC): A Mandatory course should be completed successfully as a part of graduate degree program irrespective of the program of study. It doesnot have credits but that the candidates have to complete compulsorily.

4.2.8 "Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to **Three Years Bachelor Degree** Programs (6 Semesters) is given below:

S. No.	Program	Duration	Eligibility
1	Bachelor of	6 Semesters	Pass in PUC/10+2 with minimum

	Commerce (Industry Integrated)	(3 years)	50% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
2	Bachelor of Commerce (Honours)		Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
3	Bachelor of Business Administration (Industry Integrated)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 50% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
4	Bachelor of Business Administration (Honours)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
5	Bachelor of Business Administration (Entrepreneurship)	6 Semesters (3 years)	
6	Bachelor of Arts in a) Journalism, English & Psychology (JEP) b) Political Science, Economics, Journalism (PEJ) c) Tourism, Journalism & History (TJH)	6 Semesters (3 years)	Pass in PUC /10+2 of any recognized Board / Council or any other qualification recognized as equivalent there to.
7	Bachelor of Arts in Performing Arts, English & Psychology	6 Semesters (3 years)	
8	Bachelor of Computer Applications	6 Semesters (3 years)	Pass in PUC/10+2 with at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council of any other qualification recognized as equivalent there to.
9	Bachelor of Science (Hons.) in Computer Science (with specialization in Cloud Computing	6 Semesters (3 years)	Pass in PUC/10+2 examination with Mathematics / Computer Science / Statistics as compulsory subject along with other subjects and obtained minimum 45% marks (40% in case of candidates

	& Big Data)		belonging to SC/ST category) in the above subjects taken together from any Board recognized by the respective State Government /Central Government/Union Territories or any other qualification recognized as equivalent thereto.
10	B Sc in a) Physics, Chemistry and Mathematics (PCM) b) Mathematics, Statistics and Computer Science (MStCs) c) Physics, Mathematics and Computer Science (PMCs)	6 Semesters (3 years)	Pass in PUC/10+2 with Mathematics as compulsory subjects and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as equivalent there to.
11	B Sc in a) Bioinformatics, Statistics & Computer Science (BCsSt) b) Biotechnology, Biochemistry, Genetics c) Microbiology, Chemistry & Genetics	6 Semesters (3 years)	Pass in PUC/10+2 with Biology as compulsory subject and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as equivalent there to.

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, University from time to time.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for IAs and final examination, evaluation and announcement of results.

6.3 The credit hours defined as below

In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester or a three hour

session of T/P amounts to 2 credits over a period of one Semester of 16 weeks for teaching-learning process.

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

For Example: The following table describes credit pattern

2: Credit Pattern					
Lectures (L)	**Tutorials (T)**	**Practice (P)**	**Credits (L:T:P)**	**Total Credits**	**Total C ontact Hours**
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course

7. Different C**ourses of Study**:

Different C**ourses of Study** are labeled as follows:

a. Foundation Course (FC)
b. Hard Core Course (HC)
c. Soft Core Course (SC)
d. Open Elective Course (OE)
e. Skill Enhancement Course (SEC)
f. Mandatory Course (MC)
g. Project Work / Dissertation: School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is considered to be equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project. These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

Registered candidates are required to earn the credits stated in the below table for the award of degree in the respective program:

Credits	**Programs**

120	**BSc in Physics, Chemistry, Maths, BSc in Maths, Statistics, Comp Sci., BSc in Bioinformatics, Statistics and Computer Science, BSc in Biotechnology, Biochemistry, Genetics, BSc in Microbiology, Chemistry and Genetics, and BSc in Physics, Maths, Computer Science**

The following courses are foundation courses and they are mandatory courses. Students registering for any of the programs mentioned in the table above are required to successfully complete the courses for the award of the degree.

1. Communicative English
2. Languages K / H / Additional English
3. Constitution of India and Professional Ethics
4. Environmental Science

8.2. The concerned BoS shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective and classify the courses as **Foundation Course (FC), Hard Core (HC), Soft Core (SC), Open Elective (OE) and Skill Enhance Course (SEC).**

8.3**.** The concerned BoS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

8.4. A candidate can enrol during each semester for credits as prescribed in the scheme of the program.

8.5 Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VI semester and complete successfully prescribed number of credits for the award of the degree for three year program in 6 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

8.6 Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree, a candidate can opt to complete a minimum of 18-20 extra credits either in the same discipline /subject or in different discipline / subject based on the eligibility criteria and in excess to prescribed number of credits for the award of 3-year degree in the registered program.

9 Assessment and Evaluation

9.1 The Scheme of Assessment will have two parts, namely;

i. Internal Assessment (IA); and
ii. Semester End Examination (SEE)

9.2 Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of for 3 year programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

9.3 The 50 marks of internal assessment shall comprise:

Internal Test	30 marks
Assignments / Seminars / Quizzes / Presentations / Case Studies etc.	20 marks

9.4 There shall be **two Internal Tests** conducted as per the schedule announced below. **The Students shall attend both the Tests compulsorily.**

- 1st test is conducted for 15 marks during **8th week** of the Semester;
- 2nd test is conducted for 15 marks during **16th week** of the of the Semester;
- Suitable number of Assignments/quizzes/presentations are set to assess the remaining 20 marks of IA at appropriate times during the semester

9.5 The coverage of syllabus for the said tests shall be as under:

- Question paper of the **1st test should be based on first 50% of the total syllabus**;
- Question paper of the **2nd test should be based on second 50% of the total syllabus**;

9.6 The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

9.7 A test paper is set for a maximum of 30 marks to be answered as per the pre-set time duration (1 hr / 1 hr 15 minutes / 1 hr 30 minutes). Test paper must be designed with School faculty members agreed pattern and students are assessed as per the instructions provided in the question paper. Questions must be set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document.

9.8 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by School specific Question Paper Scrutiny Committee formed by the respective School Head /Director to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

9.9 The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.10 Assignment/seminar/Project based learning/simulation-based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real-life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarise the answer from web or any other resources. An assignment / Quiz or combination thereof can be set for a maximum of 20 marks. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self-study.

9.11 Internal assessment marks must be decided well before the commencement of Semester End examinations

9.12 Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18^{th} and 19^{th} week of the semester and the entire course syllabus must be covered while setting the question paper.

9.13 Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have 3-4 sub questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students' outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

9.14 There shall be three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of

Examiners particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

9.15 There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

9.16 Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

9.17 There shall also be a **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the

School. **Program Assessment Committee (PAC)** shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

9.18 The report provided by the **Program Assessment Committee (PAC)** shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

9.19 During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

9.20 University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper

9.21 Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor

9.22 Online courses may be offered as per BACHELOR norms.
For online course assessment guidelines would be as follows:

1. If the assessment is done by the course provider, then the school can accept the marks awarded by the course provider and assign the grade as per REVA University norms.

2. If the assessment is not done by the course provider, then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain at the discretion of the school.

9.23 The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

9.24 Utilization of one or two credit online courses would be:

4-week online course – 1 credit – 15 hours
8-week online course / MOOC – 2 credits – 30 hours
12-week online course / MOOC – 3 credits – 45 hours

9.25 **Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

S	Type of Assessment	when	Syllabus Covered	Ma	Reduced to	Date By which the process must be completed
1	Test-1	During 8th week	First 50%	30	15	8th week
2	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 8th week (10 marks)				
3	Test -2	During 16th Week	Second 50%	30	15	16th Week
4	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 16th Week (10 marks)				
5	SEE	19/20th Week	100%	100	50	20th Week

Note: 1. Examination and Evaluation shall take place concurrently and Final Grades shall be announced as per the notification from COE.

2. Practical examination wherever applicable shall be conducted after 2nd test and beforsecond test for theory courses); the performance assessments of the mid-term test include performance in the conduction of exe semester end examination. The

calendar of practical examination shall be
decided by the respective School Boards and communicated well in advance to the Controller of Examination who will notify the same immediately

10 Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:
a) Knowledge of relevant processes;
b) Skills and operations involved;
c) Results / products including calculation and reporting.

10.1 The 50 marks meant for Internal Assessment (IA) of the performance in carrying out Practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting periment and write up about the experiment.	20 marks
	Total	**50 marks**

10.2 The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

i	Conducting of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

The duration for semester-end practical examination shall be decided by the concerned School Board.

10.3 For MOOC and other Online Courses assessment shall be decided by the BOS of the School.

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

All assessments must be done by the respective Schools as per the guidelines issued by the

Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

12. Requirements to Pass a Course:

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50, SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) which is compulsory.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below:

Marks, P	**Grade, G**	**Grade Point (GP=V x G)**	**Letter Grade**
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

a. Computation of SGPA and CGPA

The Following examples describe computation of Semester Grade Point Average (SGPA).

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : **SGPA (Si) = $\sum$(Ci x Gi) / $\sum$Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Examples on how SGPA and CGPA are computed

Example No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
	16			129

Thus, **SGPA = 129 ÷ 16 = 8.06**

Example No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
	20			141

Thus, **SGPA = 141 ÷ 20 = 7.05**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits for the respective programs are calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = ∑(Ci x Si) / ∑Ci**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example:
CGPA after Final Semester

Semester (ith)	**No. of Credits (Ci)**	**SGPA (Si)**	**Credits x SGPA (Ci X Si)**
1	20	6.83	20 x 6.83 = 136.6
2	19	7.29	19 x 7.29 = 138.51
3	21	8.11	21 x 8.11 = 170.31
4	20	7.40	20 x 7.40 = 148.00
5	22	8.29	22 x 8.29 = 182.38

6	18	8.58	18 x 8.58 = 154.44
Cumulative	**120**		**930.24**

Thus, **CGPA** = 930.24/120 = 7.75

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Example: CGPA Earned 7.75 x 10=77.5

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	**Grade (Numerical Index)**	**Letter Grade**	**Performance**	**FGP**
	G			**Qualitative Index**
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. **Provisional Grade Card**: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average (SGPA).**

b. **Final Grade Card:** Upon successful completion of three-year Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

14.1 All students must attend every lecture, tutorial and practical classes.

14.2 In case a student is on approved leave of absence (e g:- representing the University in

sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

14.3 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc., during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

15.1 In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and S/he shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

15.2 In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and s/he shall seek re-admission to such dropped semester.

16. Absence during Internal Test:

In case a student has been absent from an internal test due to the illness or other contingencies s/he may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), s/he can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. S/he can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her

submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if s/he is found guilty. The decision taken by the Grievance committee is final.

18. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances. Grievance committees will be formed by CoE in consultation with VC.

For every program there will be one grievance committee. The composition of the grievance committee is as follows: -

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

19. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

20. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

21. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters shall move to next semester of immediate succeeding year and final year of the study. However, s/he shall have to clear all courses of all semesters within the double duration, i.e., with six years of admission of the first semester failing which the student has to re-register to the entire program.

22. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. S/he can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

b. The answer scripts (in whatever form) for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

23. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Mapping of PEOS with Respect to Pos

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PS O1**	**PS O 2**	**PS O3**
PE01	√	√	√	√	√	√	√	√	√	√	√	√	√
PE02	√	√	√	√	√	√	√	√	√	√	√	√	√
PE03	√	√	√	√	√	√	√	√	√	√	√	√	√
PE04	√	√	√	√	√	√	√	√	√	√	√	√	√

CO PO MAPPING OF THE COURSES

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

B21AHK101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHH101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHA101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHE101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0101	**CO1**	2	1	1	2		2	1	1	1	3	2	1	2
	CO2	3	2	2	1	2		1		1	2	1	1	1
	CO3	3	2	2	1			1			2	1	1	2
	CO4	3	1	2	3	1	1	2	1	2	2	2	2	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0101	CO1	3	3	2	1			1			1	2	2	
	CO2	3	2	2	1			1			2	2	3	
	CO3	2	3	2	2		1				2	2	3	
	CO4	3	3	2	1							2	3	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0101	CO1	3	2	3		2	2				3	3	2	
	CO2	3									3	3		
	CO3	3	3	3			3				3	3	2	
	CO4	3	3	2			3		2		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS111	CO1	2	1	1	2		2	1	1		3	2	1	2
	CO2	1	2	2	1	2	1	1		1	2	1	1	1
	CO3	1	2	2	1			1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS112	CO1	2	1	1	2		2	1	1	1	3	2	1	

	CO2	1	2	2	1	2		1		2	2	1	1	1
	CO3	1	2	2	1	2	1	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21LSM101	CO1	3					3	2	2	2	1			1
	CO2	3	3	3			3	2	3		1			
	CO3	3	3	3	3	3	3	3	3		1			3
	CO4	3	3	3	3	3	3	3	3		1			3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0102	CO1	2	1	1	2			1	1		3	2	1	2
	CO2	1	2	2	1	1	2	1		2	2	1	1	1
	CO3	1	2	2	1			1			2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0102	CO1	3	2	3		2	2				3	3	2	
	CO2	3									3	3		
	CO3	3	3	3			3				3	3	2	
	CO4	3	3	2			3		2		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0102	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	
	CO3	1	2	2	1			1			2	1	1	
	CO4	1	1	2	2			2	1		2	2	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHK201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHH201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHA201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	CO1							2	3		3			
	CO2							2	3		3			

	CO3							2	3		3			
B21AHE201	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0201	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	2		1		1	2	1	1	1
	CO3	1	2	2	1			1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0201	CO1	3	3	2	3			2			1	2	2	
	CO2	3	3	3	2			1			2	2	3	
	CO3	3	2	2	2			2			1	2	3	
	CO4	3	2	1	2			2			3	3	3	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0201	CO1	3	3	3	3				3		3	3	2	
	CO2	3	3	3	3		2		2		3	3	2	2
	CO3	3	3						0		3	3	2	
	CO4	3	3			3			3		3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GNS111	CO1	3	3	3			2	3			3	3		
	CO2	3	3	3			2	3			3	2	3	
	CO3	3	3	3			2	2			3	0	3	
	CO4	3	3	3			2	2			3	2	3	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GNS112	CO1	3	3	3			3				3	3	3	3
	CO2	3	3	3	3		3	3			3	3	3	3
	CO3	3	3	3	3		3				3	3	2	
	CO4	3	3	3	3		3	3	3		3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21ASM201	CO1	1	2	1	1	1	2	3	1	1	1	1	2	1
	CO2	1	3	1	1	1	3	3	1	1	1	1	3	1
	CO3	2	3	2	1	3	3	3	1	1	1	2	3	2
	CO4	1	2	1	1	1	2	3	1	1	1	1	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0202	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	1
	CO3	1	2	2	1	1	2	1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0202	CO1	2	2	3	2	1		2			2	1	3	1
	CO2	3	3	3	3	1		2			3	2	2	2
	CO3	3	2	2	3			2			2	3	2	2

	CO4	2	3	2	2	1		2			3	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0202	CO1	3		3	3						3	3	2	3
	CO2	3	3								3	3	2	
	CO3	3				3					3	3		
	CO4	3	3			3					3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHK301	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHH301	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHA301	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0301	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1	2	2	1		1	2	1	1	1
	CO3	1	2	2	1	2	3	1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0301	CO1	1	2	1	1	1	1	1			1	2	2	
	CO2	2	2	1	1	1	1	1			1	2	2	
	CO3	1	2	1	2	2	2	2			1	1	1	
	CO4	2	1	1	2	1	2	2			1	1	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0301	CO1	3	3				3		3		3	3	2	
	CO2	3	3	3	3	3	3		3		3	3	3	
	CO3	3	3	3		3	3				3	3	2	
	CO4	3	3	3	3		3		3		3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS311	CO1	1	1	1	2						1	1	1	
	CO2	1	1	2	3						1	1	1	
	CO3	1	1	1	2						2	1	3	
	CO4	1	1	2	2						2	1	2	

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS312	**CO1**	2	1	1								1	1	
	CO2	2	1	1	1	1						1	1	
	CO3	2	1	1	1	1						1	1	
	CO4	2	1	1	1	1					1	1	1	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21ASO302	CO1	2	3	3	2	2	2	2	3	1	3	2	3	1
	CO2	2	3	3	2	2	1	2	1	1	3	2	2	3
	CO3	2	3	3	2	1	1	2	1	1	3	2	2	2
	CO4	2	3	3	2	1	1	2	1	1	3	2	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0302	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	2	2	1	1	1	2	1	1	1
	CO3	1	2	2	1	2		1	2	2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0302	CO1	1	2	1	1	1	1	1			1	2	1	1
	CO2	2	2	1	1	1	2	1			2	2	2	2
	CO3	1	2	1	2	2	2	1			1	1	1	1
	CO4	2	1	2	2	1	2	2			2	1	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0302	CO1	3	3	3	3			3	3	3	3	2	3	3
	CO2	3	3	3				3		3	3	2	3	3
	CO3	3	2	3	3			3		3	3	3	3	3
	CO4	3	3	3	3		3	3	3	3	3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHK401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHH401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHA401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3

B21MI0401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0401	CO1	1	2	1	1	1	1	1			1	2	1	
	CO2	2	2	1	1	1	2	1			1	2	2	
	CO3	1	2	1	2	1	2	1			1	1	1	
	CO4	2	1	1	2	1	1	2			1	1	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0401	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3				2				3	3		
	CO3	3	3	3	3	3	2				3	3	2	
	CO4	3	3	3			3	3	2		3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS411	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	1	1	1		2	2	1	1	1
	CO3	1	2	2	1	1	1	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS412	CO1	2	1	1	2	1	1	1	1	1	3	2	1	1
	CO2	1	2	2	1		2	1	2	2	2	1	1	1
	CO3	1	2	2	1	1	1	1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0402	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	2	1	1		2	2	1	1	1
	CO3	1	2	2	1	1	2	1		3	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0402	**CO1**	1	2	1	1	1	1	1			1	2	1	2
	CO2	2	2	1	1	1	2	1			1	2	2	
	CO3	1	2	1	2	1	2	1			1	1	1	1
	CO4	2	1	1	2	1	1	2			1	1	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0402	CO1	3	3			3	2				3	3	2	
	CO2	3	3			3					3	2	2	
	CO3	3	3			3					3	3		
	CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0501	CO1	2	1	1	2		1	1	1	2	3	2	1	2
	CO2	1	2	2	1	1	1	1		2	2	1	1	1

	CO3	1	2	2	1	2	2	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	3	2	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0501	CO1	2	1	1	1			1			2	1	2	
	CO2	3	2	2	1			1			2	2	2	
	CO3	2	1	1									2	
	CO4	2	1	1	1			1			1	2	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0501	CO1	3	3	3				3	3		3	3		2
	CO2	3	3	3	3		3	3	3		3	3		2
	CO3	3	3	3			2	2	2		3	3		2
	CO4	3	3	3	3	3	3	3	2	2	3	3		2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GNS511	CO1	3	3	3			3		3		3	3	2	
	CO2	3	3	3			3		3		3	3	3	2
	CO3	3	3	3	3		2				3	3	3	3
	CO4	3	3	3	3		3		3		3	3	3	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GNS512	CO1	3		3					3		3	3	3	
	CO2	3	3	3	3	2	2				3	3	3	
	CO3	3	3	3	3	3	3		3		3	3	3	
	CO4	3	3	3	3	3	3				3	3	3	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0502	CO1	2	1	1	2	1		1	1	1	3	2	1	1
	CO2	1	2	2	1	1	1	1		2	2	1	1	1
	CO3	1	2	2	1		2	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0502	CO1	1	2	2	1			2				3	1	2
	CO2	1	2	1	3			3				3	1	1
	CO3	1	2	2	2			2				3	1	1
	CO4	1	1	2	1			2			2	3	1	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0502	CO1	3	3	3			3				3	3	3	3
	CO2	3	3	3	3		3	3			3	3	3	
	CO3	3	3	3	3		3				3	3	2	3
	CO4	3	3	3	3		3	3	3		3	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0601	CO1	2	1	1	2	3	1	1	1		3	2	1	1
	CO2	1	2	2	1	2	2	1		1	2	1	1	1
	CO3	1	2	2	1	1	1	1		2	2	1	1	2

	CO4	1	1	2	2	1	1	2	1	1	2	2	2	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0601	CO1	2	2	2	1		1				1	0	1	
	CO2	3	2	1	1						2	1	1	
	CO3	2	1	2	2		1				2	2	1	
	CO4	2	3	1	2		1	1			2	1	1	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0601	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3	2							3	3	2	
	CO3	3	3	3		3	2				3	3	2	
	CO4	3	3	3	3	3	2				3	3	2	
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS611	CO1	3	2	2	1		2				1	2	3	2
	CO2	3	2	2	2		1	1				2	3	3
	CO3	2	3	2	1						2	2	3	2
	CO4	2	3	2	2			1			1	3	3	2
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS612	CO1	1		1	1						1	3	1	3
	CO2	1	2	2	1							1	1	2
	CO3	1		2	1						3	2	1	2
	CO4	1		1	2						2	3	3	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0602	CO1	2	1	1	2	1	2	1	1	2	3	2	1	2
	CO2	1	2	2	1	2	1	1		2	2	1	1	1
	CO3	1	2	2	1	1	1	1		3	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	1
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0602	CO1	3	3	3	3			2			2	3	2	3
	CO2	3	3	2	3			2			2	3	1	2
	CO3	3	3	2	3			2			2	3	2	2
	CO4	2	2	3	3			2			2	3	3	3
Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0602	CO1	3	3		3	3	2	3		3	3	3	2	
	CO2	3	3	3	3		3	3	2	3	3	3	2	
	CO3	3	3	3	3		3	3		3	3	2		
	CO4	3	3	3		3	3	3		2	3	3	2	

B. Sc – M C G
(Microbiology, Chemistry, Genetics)

Scheme of Instruction and Detailed Syllabus

(Effective from the Academic Year 2021-24)

Scheme of Instruction **Duration: 6 Semesters (3 Years)**

Sem	Course code	Title of the Course	HC/SC/SE/CC	Credit Pattern				
				L	T	P	Total	Hours
First	B21AHK101	Language – II: Kannada - I	CC	1	1	0	2	3
	B21AHH101	Language – II: Hindi - I						
	B21AHA101	Language – II:Additional English - I						
	B21AHE101	Communicative English – I	CC	1	1	0	2	3
	B21MI0101	Microbiological Methods	HC	2	1	0	3	4
	B21CH0101	Chemistry-I	HC	2	1	0	3	4
	B21GN0101	Classical Genetics	HC	2	1	0	3	4
	B21MIS111	Food Microbiology	SC	2	1	0	3	4
	B21MIS112	Extremophiles						
	B21LSM101	Constitution of India and Professional Ethics	FC	0	0	0	0	2
	B21MI0102	Microbiological Methods Lab	HC	0	0	1.5	1.5	3
	B21CH0102	Chemistry-I Lab	HC	0	0	1.5	1.5	3
	B21GN0102	Classical Genetics Lab	HC	0	0	1.5	1.5	3
		Total Credits		**10**	**6**	**4.5**	**20.5**	**33**
Second	B21AHK201	Language – II: Kannada - II	CC	1	1	0	2	3
	B21AHH201	Language – II: Hindi - II						
	B21AHA201	Language – II: Additional English - II						
	B21AHE201	Communicative English – II	CC	1	1	0	2	3
	B21MI0201	Bacteriology and Virology	HC	2	1	0	3	4
	B21CH0201	Chemistry-II	HC	2	1	0	3	4
	B21GN0201	Cytogenetics	HC	2	1	0	3	4

	B21GNS211	Analytical techniques in Genetics	SC	2	1	0	3	4
	B21GNS212	Forensic Biology						
	B21ASM201	Environmental Science	FC	0	0	0	0	2
	B21MI0202	Bacteriology and Virology Lab	HC	0	0	1.5	1.5	3
	B21CH0202	Chemistry-II Lab	HC	0	0	1.5	1.5	3
	B21GN0202	Cytogenetics Lab	HC	0	0	1.5	1.5	3
		Total Credits		**10**	**6**	**4.5**	**20.5**	**33**
Third	B21AHK301	Language – II: Kannada - III	CC	1	1	0	2	3
	B21AHH301	Language – II: Hindi - III						
	B21AHA301	Language – II: Additional English - II						
	B21MI0301	Chemistry-III	HC	2	1	0	3	4
	B21CH0301	Eukaryotic Microbiology	HC	2	1	0	3	4
	B21GN0301	Molecular Genetics	HC	2	1	0	3	4
	B21CHS311	Hetero Cyclic Chemistry & Chemistry of Natural Products	SC	2	1	0	3	4
	B21CHS312	Polymer Chemistry						
	B21ASO302	Open Elective – Health and Hygiene	OE	3	0	0	3	3
	B21MIM301	Skill Enhancement Program (Mandatory course)	SEC / MC	0	0	0	0	2
	B21MI0302	Chemistry-III Lab	HC	0	0	1.5	1.5	3
	B21CH0302	Eukaryotic Microbiology Lab	HC	0	0	1.5	1.5	3
	B21GN0302	Microbial Genetics Lab	HC	0	0	1.5	1.5	3
		Total Credits		**12**	**5**	**4.5**	**21.5**	**33**
Fourth	B21AHK401	Language – II: Kannada - IV	CC	1	1	0	2	3
	B21AHH401	Language – II: Hindi - IV						
	B21AHA401	Language – II: Additional English - IV						
	B21MI0401	Environmental Microbiology	HC	2	1	0	3	4
	B21CH0401	Chemistry-IV	HC	2	1	0	3	4
	B21GN0401	Developmental Genetics	HC	2	1	0	3	4
	B21MIS411	Aeromicrobiology & Aquatic Microbiology	SC	2	1	0	3	4
	B21MIS412	Immunity and Medical Microbiology						
	B21PTM401	Soft Skill Training (Mandatory course)	SEC	0	0	0	0	2
	B21CHM401	Skill Enhancement Program (Mandatory course)	SEC/ MC	0	0	0	0	2

	B21MI0402	Environmental Microbiology Lab	HC	0	0	1.5	1.5	3
	B21CH0402	Chemistry-IV Lab	HC	0	0	1.5	1.5	3
	B21GN0402	Developmental Genetics Lab	HC	0	0	1.5	1.5	3
		Total Credits		**9**	**5**	**4.5**	**18.5**	**32**
Fifth	B21MI0501	Microbial Physiology	HC	2	1	0	3	4
	B21CH0501	Chemistry-V	HC	2	1	0	3	4
	B21GN0501	Human Genetics	HC	2	1	0	3	4
	B21GNS511	Medical Genetics	SC	2	1	0	3	4
	B21GNS512	Applicative Genetics						
	B21SBON01	MOOC/SWAYAM	SEC	2	0	0	2	2
	B21GNM501	Skill Enhancement Program (Mandatory course)	SEC/ MC	0	0	0	0	2
	B21MI0502	Microbial Physiology Lab	HC	0	0	1.5	1.5	3
	B21CH0502	Chemistry-V Lab	HC	0	0	1.5	1.5	3
	B21GN0502	Human Genetics Lab	HC	0	0	1.5	1.5	3
		Total Credits		**10**	**4**	**4.5**	**18.5**	**29**
Sixth	B21MI0601	Agricultural Microbiology	HC	2	1	0	3	4
	B21CH0601	Chemistry-VI	HC	2	1	0	3	4
	B21GN0601	Evolutionary & Biometrical Genetics	HC	2	1	0	3	4
	B21CHS611	Chemistry of Bio Molecules	SC	2	1	0	3	4
	B21CHS612	Electro Analytical Chemistry						
	B21SE0601	Project	HC	0	0	4	4	8
	B21MI0602	Agricultural Microbiology Lab	HC	0	0	1.5	1.5	3
	B21CH0602	Chemistry-V Lab	HC	0	0	1.5	1.5	3
	B21GN0602	Evolutionary & Biometrical Genetics Lab	HC	0	0	1.5	1.5	3
		Total Credits		**8**	**4**	**8.5**	**20.5**	**33**
		Total Credits of all Semesters					**120**	**174**

Semester	Credit Pattern				
	L	T	P	Total	Hours
First	10	6	4.5	20.5	33
Second	10	6	4.5	20.5	33
Third	11	5	4.5	21.5	33
Fourth	11	5	4.5	18.5	32
Fifth	10	4	4.5	18.5	29
Sixth	8	4	7.5	20.5	33
Total	**60**	**30**	**30**	**120**	**174**

B. Sc –Microbiology, Chemistry, Genetics (MCG)
Detailed Syllabus
(Effective from Academic Year 2021)

FIRST SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHK101	**Language I: Kannada - I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

¨sÁµÉAiÀÄ£ÀÄß ªÀiÁvÀ£ÁqÀÄªÀ §gÉAiÀÄÄªÀ PË±À®å, ¸Á»vÀåzÀ §UÉÎ ¸ÀÆÜ®ªÁV ¥ÀjZÀ¬Ä¸ÀÄªÀ ªÀÄÆ®PÀ «zÁåyðUÀ¼À ªÀåQÛvÀé «PÁ¸À ºÁUÀÄ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ, ¥Àæ¸ÀÄÛvÀ ¸ÀAzÀ¨sÀðPÉÌ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸À®Ä ¥ÀoÀåªÀ£ÀÄß gÀÆ¦¸À¯ÁVzÉ. ¸Á»vÀå, PÀ¯É, ªÁtÂdå, DqÀ½vÁvÀäPÀ ªÀÄvÀÄ Û «eÁÕ£ÀzÀ «ZÁgÀUÀ½UÉ MvÀÛ£ÀÄß ¤ÃqÀ¯ÁVzÉ. EzÀÄ ªÉÆzÀ® JgÀqÀÄ ¸É«Ä¸ÀÖgï ªÀÄÆgÀÄ PÉærmïUÀ¼À£ÀÄß; ªÀÄÆgÀÄ ªÀÄvÀÄ Û £Á®Ì£ÉÃ ¸É«Ä¸ÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉÆA¢zÉ.

Pre-requisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå.
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy:

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß

ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀé «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

- ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
- CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
- ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èèlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

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Course Outcomes:

d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

- ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
- fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
- ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
- GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHK101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Content:

Unit I d£À¥ÀzÀ ªÀÄvÀÄÛ ¥ÁæaÃ£À PÁªÀå

7 Hrs

1. ¸ÀvÀåªÀAvÉ ºÀqÉzÀªÀé d£À¥ÀzÀ VÃvÉ
2. £É®QjªÉ£ÉAzÀÄ §UÉ«gÉ bÀ®QjªÉA gÀ£Àß

3. avÀæªÀÄ¥ÁvÉæ gÀªÀÄvÉ £Áj d£ÀÃ

Unit II ªÀÄzsÀåPÁ°Ã£À PÁªÀå

7 Hrs

1. C©ÞAiÀÄÄªÉÆªÉÄð PÁ®ªÀ±À¢A ªÀÄgÁåzÉAiÀÄA zÁAlzÉÃ....£ÁUÀZÀAzÀæ
2. ªÀZÀ£ÀUÀ¼ÀÄ §¸ÀªÀtÚ
3. wgÀÄ¤Ã®PÀAoÀgÀ gÀUÀ¼É ºÀjºÀgÀ

Unit III ¸ÀtÚ PÀxÉUÀ¼ÀÄ

6 Hrs

1. PÀ¯ÁärAiÀÄ PÉÆÃt ªÀiÁ¹Û
2. AiÀiÁgÀÆ CjAiÀÄzÀ «ÃgÀ PÀÄªÉA¥ÀÄ
3. ¸ÀªÀÄ¸ÉåAiÀÄ ªÀÄUÀÄ wæªÉÃtÂ

Unit IV £ÁlPÀ 6 Hrs

1. mÉÆ¼ÀÄîUÀnÖ n.¦. PÉÊ¯Á¸ÀA

¥ÀgÁªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ:

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., ZÁjwæPÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2008
3. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
4. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., PÀ£ÀßqÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2007
5. ºÀA¥À £ÁUÀgÁdAiÀÄå, ¸ÁAUÀvÀå PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
6. £ÁgÁAiÀÄt ¦.«, ZÀA¥ÀÆ PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
7. PÁ¼ÉÃUËqÀ £ÁUÀªÁgÀ, wæ¥À¢, gÀUÀ¼É ªÀÄvÀÄÛ eÁ£À¥ÀzÀ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
8. ¸ÀA. ¨É£ÀUÀ¯ï gÁªÀÄ gÁªï ªÀÄvÀÄÛ ¥Á£ÀåA ¸ÀÄAzÀgÀ ±Á¹ÛçÃ, ¥ÀÄgÁt £ÁªÀÄ ZÀÆqÁªÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥Àæ¸ÁgÁAUÀ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
9. qÁ. azÁ£ÀAzÀ ªÀÄÆwð, ªÀZÀ£À ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
10. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. ¸ÀªÀðdÕ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2012
11. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. CPÀÌ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 1997
12. ¸ÀA ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, £ÁUÀgÁd Q. gÀA. ªÀZÀ£À PÀªÀÄäl, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
13. £ÀgÀ¹AºÁZÁgï. r. J¯ï., ¥ÀA¥À ¨sÁgÀvÀ ¢Ã¦PÉ, ¥ÀæPÁ±ÀPÀgÀÄ r.«. PÉ ªÀÄÆwð ¥ÀæPÁ±À£À, ªÉÄÊ¸ÀÆgÀÄ. 2012

14. gÀAeÁ£ï zÀUÁð, ±ÀgÀtgÀ ¸ÀªÀÄUÀæ PÁæAw, ¥ÀæPÁ±ÀPÀgÀÄ. ¯ÉÆÃ»AiÀiÁ ¥ÀæPÁ±À£À, §¼Áîj. 2015
15. zÉÃ±À¥ÁAqÉ J¸ï.J¯ï. ¨ÉÃAzÉæ ±ÀjÃ¥sÀgÀ PÁªÁåAiÀiÁ£À, ¥ÀæPÁ±ÀPÀgÀÄ zÉÃ¹ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
16. ¸ÀA. ©. J¸ï. PÉÃ±ÀªÀgÁªï. PÉÊ¯Á¸ÀA PÀ£ÀßqÀ £ÁlPÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ CAQvÀ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2005
17. ±ÁªÀÄgÁAiÀÄ vÀ. ¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
18. ²ªÀgÀÄzÀæ¥Àà f. J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHH101	**Language I: Hindi - I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course description: अध्ययनवर्णन:

यहपाठ्यक्रमनौसिखिया,
अपनीभाषाकीक्षमताकाविकासकरनेहेतुतथाविभिन्नसाहित्यिकप्रक्रियाओंद्वारासमाज, संस्कृतिएवंजीवनकेमूल्योंकोसमझनेहेतुअभिकल्पितहै |

Prerequisites/Pre reading for the course: पूर्वापेक्षा:

- अध्येता, पी.यु.सीकेस्तरपरद्वितीयभाषाकेरूपमेंहिन्दीकाअध्ययनकरनाचाहिए |
- हिन्दीसाहित्यकेइतिहासकासंक्षिप्तज्ञानकीआवश्यकताहै |
- हिन्दीव्याकरणकाअवबोधनआवश्यकहै |
- अंग्रेज़ी – हिन्दीअनुवादसेसंबंधितजानकारीजरुरीहै |

c) Pedagogy:सिक्षशास्त्र:

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Objectives:पाठ्यक्रमउद्देश्य:

- संदर्भानुसारउचितभाषाकाप्रयोगकरनेकीदक्षताकोछात्रोंमेंउत्पन्नकरना |
- साहित्यकेमाध्यमसेसमाजएवंमानवीयमूल्योंकोसमझाकर, उनमूल्योंकीरक्षाहेतुप्रेरितकरना |
- छात्रोंमेंपुस्तकपठनएवंलेखनकीअकृतिमप्रवृत्तिस्थापितकरना |

- अध्येताओंमेंसाहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरना |

Course Outcomes:अधिगमपरिणाम:

अध्ययनकीसमाप्तिपरअध्येता –

- सामाजिकमूल्यएवंनैतिकजवाबदेहीकोस्वीकारकरसकताहै |
- साहित्यकीप्रासंगिकताकोजीवनमेंसमझनेकीदक्षतारखताहै |
- समाजमेंअंतर्निहितपद्धतियाँएवंविचारधाराओंकाव्याख्यानकरनेमेंसक्षमबनसकताहै |
- साहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरसकताहै |

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHH101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course content: अध्ययनविषयसूची /पाठ्यक्रम

इकाई–1 :कहानी,संस्मरण **7 hrs**

1.कहानी –नशा–प्रेमचंद

2.कहानी – सुखमयजीवन–चंद्रधरशर्मागुलेरी

3.संस्मरण – शरतकेसाथबितायाकुछसमय–अमृतलालनागर

इकाई–2:कहानी, आत्मकथा **6 hrs**

4.कहानी–मरनेसेपहले–भीष्मसाहनी

5.कहानी–लालहवेली–शिवानी

6. रेखाचित्र – घीसा – महादेवीवर्मा

इकाई–3:एकांकी, व्यंग्यरचना **7 hrs**

7.एकांकी – आवाजकानीलाम – धर्मवीरभारती

8.व्यंग्यरचना–भेड़ेऔरभेडियें–हरिशंकरपरसाई

इकाई–4:अनुवाद **6 hrs**

अनुवाद : अंग्रेज़ी–हिन्दी(शब्दएवंअनुच्छेद)

सूचना : प्रत्येकइकाई 25 अंककेलिएनिर्धारितहै |

d) Suggested Text Books and References

Text book/s: पाठ्यपुस्तक:

1. हिन्दीपाठ्यपुस्तक–रेवाविश्वविद्यालय|

References: सन्दर्भग्रन्थ:

1. सुबोधव्यवहारिकहिन्दी – डॉ. कुलदीपगुप्त
2. अभिनवव्यवहारिकहिन्दी – डॉ.परमानन्दगुप्त
3. हिन्दीसाहित्यकाइतिहास - डॉ. नागेन्द्र
4. आधुनिकहिन्दीसाहित्यकाइतिहास - डॉ. बच्चनसिंह
5. हिन्दीसाहित्यकानवीनइतिहास - डॉ. लालसाहबसिंह
6. शुद्धहिन्दीकैसेबोलेकैसेलिखे- पृथ्वीनाथपाण्डे
7. कार्यालयअनुवादनिदेशिका
8. संक्षेपणऔरपल्लवन - के.सी.भाटिया&तुमनसिंग

Course code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B21AHA101	**Language I: Additional English - I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This is a 2-credit course designed to help the learner gain competency in language through the introduction of various genres of literature. The course aims to inculcate a critical view among learners while sensitizing them to the contemporary issues around. It facilitates creative learning and helps to appreciate, assimilate and research on the various dimensions of society, culture and life.

Prerequisites: The student must possess fundamentals of language skills and be aware of social issues.

Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

Course Objectives:

- To develop linguistic prowess of the students.
- To appraise different genres of literature.
- To illustrate the fundamentals of creative language.
- To enhance consistent reading habits.

Course Outcome:

On completion of the course, learners will be able to:

- Demonstrate a thorough understanding of sensitive and critical social issues.
- Develop reading skills and a wide range of vocabulary.
- Critically analyze a piece of prose or poetry.

- Explain their opinion in a coherent and communicable manner.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHA101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Contents:

Unit-I: Values & Ethics **7 hrs**

Literature: Rabindranath Tagore - Where the Mind is Without Fear
Saki – The Lumber-room
William Shakespeare – Extract from Julius Caesar (Mark Antony's Speech)
Language: Vocabulary Building

Unit-II: Natural & Supernatural **6 hrs**

Literature: John Keats – La Belle Dame Sans Merci
Charles Dickens – The Signal Man
Hans Christian Anderson - The Fir Tree
Language: Collective Nouns

Unit-III: Travel & Adventure **7 hrs**

Literature: R.L. Stevenson – Travel
H.G. Wells – The Magic Shop
Jonathan Swift – Excerpt from Gulliver's Travels Book – I
Writing Skills: Travelogue

Unit-IV: Success Stories **6 hrs**

Literature: Emily Dickinson – Success is Counted Sweetest
Dr. Martin Luther King - I Have a Dream
Helen Keller – Excerpt from The Story of My Life
Writing Skills: Brochure & Leaflet

Reference Books:

- Tagore, Rabindranath. Gitanjali. Rupa Publications, 2002.
- Wordsworth, William. The Complete Works of William Wordsworth. Andesite Press, 2017.
- Munro, Hector Hugh. The Complete Works of Saki. Rupa Publications, 2000.
- Shakespeare, William. The Complete Works of William Shakespeare. Sagwan Press, 2015.

- Chindhade, Shirish. Five Indian English Poets: Nissim Ezekiel, A.K. Ramanujan, Arun Kolatkar, Dilip Chitre, R. Parthasarathy. Atlantic Publications, 2011.
- Dickens, Charles. The Signalman and Other Horrors: The Best Victorian Ghost Stories of Charles Dickens: Volume 2. Createspace Independent Publications, 2015.
- Anderson, Hans Christian. The Fir Tree. Dreamland Publications, 2011.
- Colvin, Sidney (ed). The Works of R. L. Stevenson. (Edinburgh Edition). British Library, Historical Prints Edition, 2011.
- Bishop, Elizabeth. Poems. Farrar, Straus and Giroux, 2011.
- Swift, Jonathan. Gulliver's Travels. Penguin, 2003.
- Dickinson, Emily. The Complete Poems of Emily Dickinson. Createspace Independent Publications, 2016.
- Brooke, Rupert. The Complete Poems of Rupert Brooke. Andesite Press, 2017.
- King, Martin Luther Jr. &James M. Washington. I Have a Dream: Writings And Speeches That Changed The World. Harper Collins, 1992.
- Keller, Helen. The Story of My Life. Fingerprint Publishing, 2016.
- Green, David. Contemporary English Grammar Structures and Composition. New Delhi: MacMillan Publishers, 2010.
- Thorpe, Edgar and Showick Thorpe. Basic Vocabulary. Pearson Education India, 2012.
- Leech, Geoffrey and Jan Svartvik. A Communicative Grammar of English. Longman, 2003.
- Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.

Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B21AHE101	**Communicative English – I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This 2-credit course focuses on improving the spoken and written communication of the learners. The course develops personal, inter-personal and group skills among learners. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The widespread reach of this course makes it highly practical and applicable.

Prerequisites: The student must have knowledge of intermediate English Grammar and LSRW skills.

Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.

Course Objectives:

- To enhance functional communication skills.
- To develop functional use of language in professional contexts.
- To utilize oral presentations in multiple contexts.
- To apply effective written skills in formal communication.

Course Outcomes:

After the completion of the course, students will be able to:

- Identify pressing issues relating to society, environment and media.
- Develop a process-oriented approach to writing.
- Apply the grammatical skills developed during the course aptly.
- Demonstrate a good command over language usage and refined interpersonal skills.

Mapping of Course Outcomes with programme Outcome

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHE101	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Contents:

Unit-I: Functional English **7 Hrs**

Remedial Grammar: Past Simple; Past Continuous; Irregular Verbs
Writing Skills: Paragraph Writing
Activities: Conversations; Leaving Phone Messages
Literature: Chief Seattle – The End of Leaving and Beginning of Survival

Unit-II: Interpersonal Skills **6 Hrs**

Remedial Grammar: Present Simple & Present Continuous; Activity & State Verbs
Writing Skills: Official Letters
Activities: Making Apologies; Invitations & Making Arrangements
Literature: Ruskin Bond – Tiger in the Tunnel

Unit-III- Multitasking Skills **7 Hrs**

Remedial Grammar: Present Perfect; For, Since & How Long; -ed & -ing adjectives; Prefix & Opposites of Adjectives
Writing Skills: Note Making
Activities: Agreeing & Disagreeing with Opinions
Literature: Jesse Owens - My Greatest Olympic Prize

Unit-IV: Communication Skills **6 Hrs**

Remedial Grammar: Collocations; Prepositions
Writing Skills: Precise Writing
Activities: Offers, Suggestions & Requests
Literature: Avijit Pathak – Onscreen Magic

Reference Books:

1. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
2. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
3. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
4. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. *Effective Technical Communication*. New Delhi: Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.

CourseCode	Microbiological Methods	Course Type	L	T	P	C	CH
B21MI0101		**HC**	**2**	**1**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

Students should have the knowledge of the microorganisms and able to distinguish between the prokaryotic and eukarytotic cells.

Course Objectives:

The objective of this Course is to:

1. Students will learn basic concepts and techniques of microbiology
2. Provide the students to understand the scope of microbiology
3. Provides the students to various characterisation of microorganisms
4. Students will learn the application of microbes in various fields of science.

Course Outcomes:

By the end of the course the student will be able to:

1. Understand the historical development and biology of microorganism in detail
2. Understand various methodologies for microbial enumeration and their characterisation
3. Learn the various culturing and microscopic as well as biochemical identification of microorganisms
4. Learn the various techniques and applications of microbiology in industries

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0101	CO1	2	1	1	2		2	1	1	1	3	2	1	2
	CO2	3	2	2	1	2		1		1	2	1	1	1
	CO3	3	2	2	1			1			2	1	1	2

	CO4	3	1	2	3	1	1	2	1	2	2	2	2	3

Course Content:

Unit-I Introduction to Microbiology **12 hrs**

Origin and historical development of microbiology, contribution of microbiologist- Leeuwenhoek, Robert Koch, Pasteur, Lister & Fleming, Kochs' postulates, biogenesis & abiogenesis theory, Microbiology as interdisciplinary science, importance and scope of microbiology.

Unit-II Microbial diversity **12 hrs**

Kingdom of classifications-five kingdom and domain classification, classification criteria in the microbes, Bergeys' classification, Binomial nomenclature, classification systems in different microbial classes and commission for the naming the organism. Nutritional classification of microbes and morphological classification of bacteria.

Unit-III Microbial culture and identification techniques **12 hrs**

Staining techniques in microbiology-simple, differential & structural; microbial medium & Sterilisation techniques-physical (Heat, Radiation and Filtration) and chemical (Classes of chemicals) sterilization techniques. Molecular methods of identification and classification of microbes.

Unit –IV Microbial Growth **12 hrs**

Nutritional basis for classification of microbes-phototrophs, autotrophs, heterotrophs, factors affecting growth, growth curve-phases & their importance, microbial isolation techniques-pour, streak & spread plating and enumeration of microbes-indirect & direct methods.

Reference

1. M J Pelzer Jr, ECS Chan, NR Krieg, Microbiology, TMH Publishing Co Ltd, 5th Edition, 2006.
2. Starrier, Ingraham and Wheeler, General Microbiology, McMillan Publisher, 5th Edition, 1998.
3. Atlas R.M. Microbiology: Fundamentals and applications 4th Edition, Singapore: Pearson Asia, 2000.
4. Prescott L.M, Harley T.P and Klein D.A. Microbiology, 9th Edition, WMC. Brown publishers, 2012.

CourseCode	**Chemistry-I**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B21CH0101		**HC**	**2**	**1**	**0**	**3**	**4**

Prerequisites:

Atomic models, fundamental particles of an atom, periodic table and its origin, hydrogen carbons and its classifications, states of matter.

Course objectives:

1. Provide brief descriptions of the accomplishments of Planck, Einstein, Rutherford, Rydberg, Bohr, de Broglie and Schrodinger; and how these contributed to understanding the structure of atom
2. Calculate the energy and wavelength of a given electronic transition in hydrogen atom.
3. Discuss the periodic properties of the elements, and their variations across the period and down the group.
4. Explain the preparation, properties and reactions of alkanes, alkens and alkynes.
5. Applications of various reagaents and reactions on organic synthesis.
6. Focuses on the Maxwell-Boltzmann distribution of molecular velocities.

Course Outcomes:

CO1: Formulate Rydberg equation to calculate all spectral lines of hydrogen atom.
CO2: Discuss the importance of atomic number in constructing periodic table.
CO3: Examine the role of reagents, named reactions and their applications in organic chemistry.
CO4: Utilize the concepts of different types of molecular velocities and establish the relationship between them.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0101	CO1	3	3	2	1			1			1	2	2	
	CO2	3	2	2	1			1			2	2	3	
	CO3	2	3	2	2		1				2	2	3	
	CO4	3	3	2	1							2	3	

Course Contents:

Unit-I: Atomic Structure **12 Hrs**

Fundamental particles of atoms, Bohr's theory and its limitations, Hydrogen atomic spectra, Derivation of expressions for radius and energy of hydrogen like atoms. Planck Quantization - Black body radiation, dual nature of electron, de Broglie's hypothesis.

Quantum Mechanics: Introduction, Heisenberg Uncertainty principle. wave functions, time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2. Application of Schrodinger wave equation: particle in one dimensional box. Quantum numbers, Shapes of s, p and d orbitals. Radial and angular parts of the hydrogenic wave functions and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals. Radial and angular nodes and their significance.

Electronic configuration, Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity and (n+l) rule.

Unit-II: Periodic Table and Periodicity **12 Hrs**

Introduction, Modern periodic law, Periodic classification of elements, Periodic properties and Causes:

i. Atomic radius: Definitions of covalent, metallic & van der Wall's radius; calculation of atomic radius from internuclear distance.
ii. Ionic radius: Definition, calculation by Pauling's method, Slater's rules.
iii. Ionization energy and electron affinity: Definitions, methods of determination.
iv. Electronegativity evaluation by Pauling's and Mullikan's methods.

Comparative study of groups 1, 2, 16 and 17. Halides, oxides and carbonates of alkali and alkaline earth metals. Hydrides of chalcogens and halogens.

General study of d and f block elements-Transition elements: electronic configuration, atomic and ionic radii, ionization energy, oxidation states, redox potentials, spectral and magnetic properties, catalytic activity, interstitial compound formation.

Unit-III Introduction to Organic Chemistry **12 Hrs**

Nomenclature (IUPAC) of bifunctional, aliphatic and aromatic compounds.

Alkanes: Methods of formation (corey-house reaction etc.,), physical and chemical properties. Halogenation, Nitration, Oxidation and Combustion reactions.

Alkenes: Preparation by wittig, Hoffmann's elimination. Mechanism of electrophilic addition, oxymercuration, reduction, hydroboration – oxidation and epoxidation. Chemical oxidation of alkene with $KMnO_4$ and OsO_4, ozonolysis. **Dienes:** Types, relative stabilities of dienes, conjugated dienes – 1,3 butadiene-structure, 1,2 and 1,4- addition reactions with H_2 and halogens, Diel's Alder reaction with an example.

Alkynes: Methods of preparation – Dehydrohalogenation, vicinal and gem dihalides, reactions of alkynes –Electrophilic additions with HCN, CH_3COOH and H_2O.

Alkyl halides: Isomerism and classification, nomenclature. Substitution reaction-S_N1, S_N2, with mechanism. Effect of substrate and nucleophiles. Nature of leaving group.

Relative reactivity of alkyl, allyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Reactive intermediates: Generation, stability of carbocations, carbanions, free radicals, nitrene, carbenes, benzynes and ylides.

Electronic effects (resonance, inductive, hyperconjugation) and steric effects and its applications (acid/base property).

Unit-IV Gaseous state **12 Hrs**

Maxwell-Boltzmann distribution of molecular velocities. Effect of temperature. Mean free path, collision frequency and collision number. Definition and expressions using SI units (no derivations). Boltzmann factor. Energy distribution as a function of temperature. Types of molecular velocities and relationships between them and numerical.

The critical phenomena – Andrew's experiments on CO_2, critical constants – Tc, Pc and Vc. Relation between Vander Waal's Constants 'a' and 'b' and critical constants Tc, Pc and Vc to be derived using isotherms of CO_2. Law of corresponding states and reduced equation of state.

Liquefaction of gases – Principle underlying liquefaction of gases – Joule Thomson effect, Joule Thomson coefficient, Inversion temperature, definitions and its relation between Van der Waal's constants ('a' and 'b').

Phase Rule: Definition of terms: Phase, components and degrees of freedom – Derivation of Gibbs phase rule. One component system: Water and Sulphur system, Reduced phase rule.
Two component system: Simple eutectic system: Pb–Ag system, KI–water system freezing mixtures. Thermal analysis and cooling curves. Compound formation with congruent melting point Zn–Mg, $FeCl_3$–Water system.

Suggested Text Books and References:

1. A. Bahl, and B.S. Bahl, Advanced Organic Chemistry, S. Chand, 2010.
2. A. Bahl, and B.S. Bahl, Advanced Physical Chemistry, S. Chand, 2010.
3. J.N. Gurtu and A. Gurtu, Advanced Physical Chemistry, Pragati Prakashan, Vol I, 4th Edition, 2017.
4. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Vishal Publishing Co., 33rd Edition, 2020.
5. P.A. Sykes, Guide book to Mechanism in Organic Chemistry, Orient Longman, New Delhi, 1988.
6. R.T. Morrison and R.N. Boyd, Organic Chemistry, Pearson, 2010.
7. B.H. Mahan, University Chemistry, Narosa, 3rd Edition, 1998.
8. J.D. Lee, Concise Inorganic Chemistry, Oxford University Press, 3rd Edition, 2008.
9. F.A. Cotton, G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry, Wiley, 3rd ed, 1995.

Course Code	Classical Genetics	Course Type	L	T	P	C	CH
B21GN0101		HC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of the cell types.
2. They should have prior idea about the classification of organisms.

Course Objectives:

The objective of this Course is to:

1. To explore the world of research using model organisms.
2. To understand the inheritance pattern of Mendelism
3. To analyze the different gene interactions and inheritance
4. To discuss the involvement of chromosomes in sex determination.

Course Outcomes:

By the end of the course the student will be able to:

1. Compare the different model organisms used for research and its significance.
2. List out the milestones in the evolution of genetics.

3. Outline the inheritance patterns of traits and the interaction of genes.
4. Illustrate the involvement of chromosomes in sex determination and the mechanisms involved in sex differentiation.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0101	CO1	3	2	3		2	2				3	3	2	
	CO2	3									3	3	0	
	CO3	3	3	3			3				3	3	2	
	CO4	3	3	2			3		2		3			

Course Content:

UNIT I Scope of Genetics **12 hrs**

Model organisms -Structure, life cycle, genetic and industrial applications)
Prokaryotes –Bacteriophage, TMV, *Escherichia coli*
Eukaryotes – *Coenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana,* Zebrafish, Rattus species,*Saccharomyces cerevisiae,Pichia pastoris*
History of Genetics – Pre- Mendelian genetic concepts: Preformation, Epigenesis, Inheritance of acquired characters and Mutation theory.

UNIT II Menedelian Genetics **12 hrs**

Biography of Mendel and his experiments on pea plants.
Principle of dominance.
Law of Segregation: Monohybrid cross, back cross and Test cross, Problems related.
Law of Independent Assortment: Dihybrid cross in pea plant, Back cross and Test cross.

UNIT III Multiple alleles & gene interactions **12 hrs**

Multiple Alleles: Definition, ABO blood groups and Rh factor in Human,
Gene Interactions
Inter allelic: -
Complementary gene interaction (9:7) Ex: *Lathyrus odoratus*
Supplementary gene interaction (9:3:4) Ex: Grain color in Maize.
Epistasis - Dominant Ex.: Fruit color in *Cucurbita pepo,* Recessive - Ex.: Coat color in *Mice.*
Non- Epistasis - Ex.: Comb pattern in Poultry. Related problems

UNIT IV Sex Determination **12 hrs**

Chromosome theory of Sex determination: XX- XY, XX-XO, ZZ-ZW, Genic Balance theory of Bridges, Intersexes and Super sexes in *Drosophila*, Y chromosome in sex determination of *Melandrium.*
Environment and sex determination; Hormonal control of Sex determination (Free martins).
Gynandromorphs.Sex differentiation. Dosage compensation.
Deviations from Mendelism: Incomplete inheritance and Co-dominance.
Related problems

Reference Books:

1. Biology: The Dynamic Science, 2nd Edition, Peter J. Russell, Paul E. Hertz. Beverly Mc Millan publications. 2012
2. Cell and Molecular Biology, 4th Edition, P.K. Gupta. 2014
3. Cytogenetics, 1st Edition, P.K. Gupta. 2013
4. Microbiology, 3rd Edition, P.D. Sharma. 2012.
5. Gardner/Simmons/Snustad. (2006). Principles of Genetics. 8th edition, John Wiley and sons.

CourseCode	Food Microbiology	Course Type	L	T	P	C	CH
B21MIS111		SC	2	1	0	3	4

Prerequisites/Pre reading for the course:

Students should have the basic knowledge microbial food products and spoilage.

Course Objectives:

The Objectives of this course is:

1. Understand the principles of microorganisms associated food and food products.
2. Recognize specific types of microbial spoilage during various food shelf-life stages.
3. Isolation, identification, and enumeration of the most common microorganisms found in specific food products.
4. Analyze different foods for presence of hazardous microorganisms using traditional and modern food microbiology technology.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS111	CO1	2	1	1	2		2	1	1		3	2	1	2
	CO2	1	2	2	1	2	1	1		1	2	1	1	1
	CO3	1	2	2	1			1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1

Course Outcomes:

By the end of the Course students will be able to:

1. Better understand the factors and sources of food contaminants
2. Describe the situations where improper food handling and storage may lead to the spoilage or contamination of food.
3. Identify desirable microorganisms and their effects in preservation and fermentation.
4. Develop the beneficial microbes in health and other allied food industries

Course Contents:

Unit I Food microbiology and fermented foods **12 hrs**

Definition, concepts and scope, Definition of fermentation, Microorganisms in food fermentation, production and importance of Single Cell Protein and probiotics, microorganisms involved in producing fermented foods such as bread, cheese and curd.

Unit II Food spoilage and preservation **12 hrs**

Food as a substrate for growth of microorganisms, sources of contamination, principles of spoilage, microbial spoilage of food and food preservation techniques. Microbial spoilage of food – Fruits, vegetables, meat, poultry, canned foods. Approaches and methods of food processing and food preservation-physical, chemical and biological methods (Chemicals, Antibiotics, Bacteriocins).

Unit III Microorganisms in Foods and methods for detection **12 hrs**

Fresh meat, Processed meat and poultry, Culture, Microscopic, and Sampling Method for detecting microbes, Physical, Chemical methods, Whole animal assays, Immunological methods. Mycotoxins, Aflatoxins Alternaria Toxins, Toxigenic Phytoplankton's and viruses.

Unit IV Applications of Food Microbiology **12 hrs**

Beneficial uses of microorganisms in Food Intestinal Beneficial Bacteria-Concept of Prebiotics and Probiotics, genetically modified foods. Biosensors in foods. Various applications in diary and food industries.

Reference

1. Food Microbiology, 2nd Edition By Adams
2. Modern Microbiology, James M. Jay
1. Fundamental Food Microbiology, Bibek Ray. CRC press
2. Norman G. M. and Robert B. G. 2006. Principles of Food Sanitation. Springer Science, Business Media. Inc.

Course Code	Extremophiles	Course Type	L	T	P	C	CH
B21MIS112		SC	2	1	0	3	4

Prerequisites/Pre reading for the course:

Students should have basis of microorganisms and their various adaptations to the various environments.

Course Objectives:

The Objectives of this course is:

1. Facilitate the students to understand microbes in extreme environments.
2. Impart the knowledge of thermophilic microbes and their importance.
3. Utilization of halophilic microbes and their applications.
4. Inculcate the knowledge to produce products from using extremophiles.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS112	CO1	2	1	1	2		2	1	1	1	3	2	1	
	CO2	1	2	2	1	2		1		2	2	1	1	1
	CO3	1	2	2	1	2	1	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	3

Course Outcomes:

By the end of the course the student will be able to

1. Acquire the knowledge of role of various microorganisms in extreme environment.
2. Identify the different of thermophiles and their molecular identification.
3. Inculcate the various halophiles and its applications
4. Impart the knowledge of energy production from microorganisms using extremophiles.

Course Contents:

Unit-I Microbes in extreme environmental conditions **12 hrs**

Microbial Diversity in extreme environment. Peculiar features of Archaea compared to bacteria. Identification of microbes in extreme environment.

Unit-II Thermophilic microbes **12 hrs**

Thermophiles-classes, extremely thermophilic archaebacteria, thermozymes, psychrophilespsychrophilic archael extremozymes, Molecular adaptation of extremophiles. Protein stability in extremophilic microbes.

Unit-III Halophilic Microbes **12 hrs**

Halophiles-osmoregulation, cellular adaptation, structural adaptation, molecular adaptation & Xerophiles. Radiation resistant bacteria-Deinococcus radiodurans.

Unit-IV Biotechnological applications of archaea. **12 hrs**

Bioelectronics from lipids of archaea. Space microbiology-introduction. Panspermia-definition, mechanisms proposed. Microbiological research in space environment.

Reference

1. Johri, B.N(2000)Extremophiles .Springer V erlag. , New York
2. Colwd , D.(1999) Microbial Diversity. Academic Press.
3. Kushner,D.J(2007)MIcrobial Life in Extreme Environments,.Academic Press.
4. Edward,C(1990) Microbiology of Extreme Environments. Open University Press.
5. Da Costa,M.S., Duarte,J.C & Williams,R.A.D(1989) Microbiology of Extreme Environments and its potential for Biotechnology. Elsiever Applied Science, London.
6. Heinrich,M.R (1976)Extreme Environment: Mechanism of Microbial Adaptation. Academic Press.
7. Thomas, D(1988) Thermophiles: General, Molecular and Applied Microbiology.WileyInterscience Publication.
8. Perry,J.J.,Staley,J(1997)Microbiology: Dynamics and Diversity .Saunders College Publishers.

Course Code	Indian Constitution &Professional Ethics	Course Type	L	T	P	C	CH
B21LSM101		FC	2	0	0	2	2

Course Objectives:

1. To provide and gain knowledge on Constitution ofIndia.
2. To know and understand about the Fundamental Rights, Duties and other Rights which is been given by ourlaw.
3. To prepare students in the understanding of Constitution perspective and make them face the world as a bonafidecitizen.
4. To attain knowledge about ethics and also know about professionalethics.
5. Explore ethical standards followed by differentcompanies.

Course Outcomes:

After completion of this course the students will be able to:

1. StrengthentheknowledgeonIndianconstitutionallawandmakethepracticalimplementation.
2. Understand the fundamental rights and humanrights.
3. Gettheknowledgetoexplainthedutiesandmoreimportantlypracticeitinarightway.
4. Adopt the habit of raising their voice against aunconstitutionality of any laws and upon anylegal discrimination as we have session of debates on Constitutionalvalidity.
   Get exposed about professional ethics and know about etiquettes aboutit.
5. Know about ethical standards of different companies which will increase their professional ability.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21LSM101	CO1	3					3	2	2	2	1			1
	CO2	3	3	3			3	2	3		1			
	CO3	3	3	3	3	3	3	3	3		1			3
	CO4	3	3	3	3	3	3	3	3		1			3

Course Content:

UNIT-I: 6 Hrs

Constitution of India: Making of Indian Constitution, features of Indian Constitution Preamble to the Constitution of India, Fundamental Rights under Part III; Rights to Equality, Right to Freedom, Right against Exploitation, Rights to Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Fundamental Duties of the Citizen, Significance and Characteristics. Elements of National Significance; National Flag, National Anthem, National Emblem.

UNIT -II: LegislatureandExecutive 6 Hrs

OrgansoftheGovernment; Legislature, Executive and Judiciary. Union and State Executives: President, Vice President, Prime Minister, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission.

UNIT-III:Judiciary 6 Hrs

Supreme Court of Indian, High Court, Right to Information Act 2005, Consumer Protection- Consumer Rights- Caveat Emptor and Caveat Venditor.

Unit-IV:ProfessionalEthics 6 Hrs

Definition Scope and need of Ethics for professional, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees. Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics.Best Ethical Companiesin India and Abroad; Corporate Social Responsibilities,Code of Conduct and Ethical Excellence.

Text Books:

1. M V Pylee, An introduction to Constitution ofIndia
2. M Govindarajan, S Natarajan, V S Senthil Kumar, EngineeringEthics.
3. Dr.Durga Das Basu, Introduction to constitution ofIndia

Course Code	Microbiological Methods Lab	Course Type	L	T	P	C	CH
B21MI0102		**HC**	**0**	**0**	**1.**	**1.**	**3**

Prerequisites/Pre reading for the course:

Requires theoretical knowledge of microbial culture medias and staining of bacteria for microscopy.

Course Objectives:

The objective of this course is to

1. Explore the various culturing aspects of microorganisms.
2. Famaliarise students with various staining procedures associated with microorganisms.
3. Expose the students with different methods of isolation and enumeration of microorganisms.
4. Provide various applications of microorganism in allied fields.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0102	CO1	2	1	1	2			1	1		3	2	1	2
	CO2	1	2	2	1	1	2	1		2	2	1	1	1
	CO3	1	2	2	1			1			2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1

Course Outcomes:

After completing the course, the student shall be able to:

1. Determine the various cultural aspects involved in microbiology.
2. Characterise the microorganism by the microscopic and biochemical procedures.
3. Derive the mathematical and graphical analysis of microbial growth.
4. Enumerate the microbial dynamics of various samples.

Course Contents:

1. Microbiological media preparation-NA, NB & MRBA
2. Sterilisation of medium and aseptic techniques
3. Isolation of MOs from air and soil
4. Pure culture methods-pour, spread & streak plate methods
5. Staining methods-simple, Gram, endospore and negative staining
6. Microbial growth curve-turbidimetric studies
7. Haemocytometer
8. MPN test

Reference

1. Microbiology Laboratory Manual: Cappuccino and Sherman
2. Prescott L.M, Harley T.P and Klein D.A. Microbiology, 9th Edition, WMC. Brown publishers, 2012

CourseCode	Chemistry Practical-I	Course Type	L	T	P	C	CH
B21CH0102		HC	0	0	1.5	1.5	3

Prerequisites:

Knowledge of chemicals, glasswares and instruments, systematic way of recording readings, basics of mathematics.

Course Objectives:

1. Provide basic knowledge of handling hazardous chemicals and safety precautions while performing experiments.
2. Hands on training about conduction of experiments independently.
3. Prepare the required solutions, using molarity and normality equations.
4. Apply suitable formule to obtain results, based on the results draw conclusions.

Course Outcomes:

CO1: Acquire the skill of handling glasswares, chemicals and instuments used in the laboratory.
CO2: Prepare the standard solutions and use the same for the estimation of requied from the given solution.
CO3: Build analytical skills such as recording the reading, interpretation of the date and drawing conclusions.
CO4: Estimate the amount of chlorine present in bleaching powder and COD in waste water.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21CH0102	CO1	3	2	3		2	2					3	2	3
	CO2	3										3		2
	CO3	3	3	3			3					3	2	
	CO4	3	3	2			3				2			

Course Contents:

1. Calibration of: (i) Pipette (ii) Burette (iii) Volumetric flask
2. Estimation of Carbonate and Bicarbonate in a given mixture using standard hydrochloric acid.
3. Estimation of potassium permanganate by using standard solution of oxalic acid present in the solution.
4. Determination of the percentage of available chlorine in the given sample of bleaching powder.
5. Estimation of ferrous and ferric iron in a given mixture using standard potassium dichromate solution
6. Estimation of COD of given waste water sample.

7. Estimation of total hardness of water.
8. Estimation of ammonium chloride using standard sodium hydroxide and standard hydrochloric acid solutions (back titration).
9. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's viscometer.
10. Determination of the density using specific gravity bottle and surface tension of a liquid using stalagmometer.
11. Effect surfactants on the surface Tension of water (Stock solution)

Suggested Text Books and References:

1. B.D. Khosla, V. C. Garg, A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
2. S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication, 2nd Edition, 2000.
3. Sunita Rattan, Experiments in Applied Chemistry, S.K. Kataria & Sons, 2nd edition 2008.
4. B.D. Khosla, V.C. Garg and A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
5. C.W. Garland, J.W. Nibler and D. P. Shoemaker, Experiments in Physical Chemistry, 1997.

Course Code	Classical Genetics Lab	Course Type	L	T	P	C	CH
B21GN0102		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Requires theoretical knowledge of chemicals and biotechniques.

Course Objectives:

The objective of this Course is to

1. Apply basic techniques in the organic laboratory for preparation, purification and Identification of organic compounds.
2. To develop the skills among students to understand the theory and practice of bio analytical techniques
3. To provide among students the scientific understanding of analytical techniques and detail interpretation of results.

Course Outcomes:

After completing the course, the student shall be able to:

1. Elucidate structures of unknown compounds using qualitative organic analysis.

2. Identify the amino acids given in the sample.
3. Identify the carbohydrates given in the sample.
4. To determine the extent of pollution in water.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21GN0102	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	
	CO3	1	2	2	1			1			2	1	1	
	CO4	1	1	2	2			2	1		2	2	2	

Course Contents:

1. Study of Model organisms and their genetic significance -
   Prokaryotes – Bacteriophage, TMV, *Escherichia coli*
2. Study of Model organisms and their genetic significance
   Eukaryotes – *Coenorhabditis elegans, Saccharomyces cerevisiae, Drosophila melanogaster, Arabidopsis thaliana*, Zebrafish.
3. Gram Staining – *Lactobacillus* and *E. coli*
4. Blood grouping.
5. Genetic problems on: Multiple alleles
6. Genetic problems on Gene Interactions (Complemetary/ Supplementary/ Dominant Epistasis gene interactions)
7. Study of Barr body in buccal epithelial cells.
8. Study of mitochondria using Janus green.

Reference Books:

1. Biology: The Dynamic Science, 2nd Edition, Peter J. Russell, Paul E. Hertz. Beverly Mc Millan publications. 2012
2. Cell and Molecular Biology, 4th Edition, P.K. Gupta. 2014
3. Cytogenetics, 1st Edition, P.K. Gupta. 2013
4. Microbiology, 3rd Edition, P.D. Sharma. 2012.
5. Gardner/Simmons/Snustad. (2006). Principles of Genetics. 8th edition, John Wiley and sons.

SECOND SEMESTER

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHK201	Language II: Kannada-II	FC	1	1	0	2	3

Course Overview:
¨sÁµÉAiÀÄ£ÀÄß ªÀiÁvÀ£ÁqÀÄªÀ §gÉAiÀÄÄªÀ PË±À®å, ¸Á»vÀåzÀ §UÉÎ ¸ÀÆÜ®ªÁV ¥ÀjZÀ¬Ä¸ÀÄªÀ ªÀÄÆ®PÀ «zÁåyðUÀ¼À ªÀåQÛvÀé «PÁ¸À ºÁUÀÄ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ, ¥Àæ¸ÀÄÛvÀ ¸ÀAzÀ¨sÀðPÉÌ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸À®Ä ¥ÀoÀåªÀ£ÀÄß gÀÆ¦¸À¯ÁVzÉ. ¸Á»vÀå, PÀ¯É, ªÁtÂdå, DqÀ½vÁvÀäPÀ ªÀÄvÀÄ Û «eÁÕ£ÀzÀ «ZÁgÀUÀ½UÉ MvÀÛ£ÀÄß ¤ÃqÀ¯ÁVzÉ. EzÀÄ ªÉÆzÀ® JgÀqÀÄ ¸É«Ä¸ÀÖgï ªÀÄÆgÀÄ PÉærmïUÀ¼À£ÀÄß; ªÀÄÆgÀÄ ªÀÄvÀÄ Û £Á®Ì£ÉÃ ¸É«Ä¸ÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉÆA¢zÉ.

Pre-requisites:
- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå.
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives:£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀ é «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.
- ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤n Ö£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
- CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
- ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°è lÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

- d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÄ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.
- ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, z sÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ, ¥Àj¸ÀgÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£À ºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨ sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.

- fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß Dz sÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
- GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.
- ¸ÀA±ÉÆÃzÀ£Á ªÀÄ£ÉÆÃ¨sÁªÀ ªÀÄvÀÄÛ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸ÀÄvÀÛzÉ.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHK201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Content:

Unit-I ªÀÄzsÀåPÁ°Ã£À PÁªÀå

7 Hrs

1. ZÀAzÀæªÀÄw «¯Á¥À gÁWÀªÁAPÀ
2. ºÀUÉUÀ¼À£ÀÄ »ArzÀ£ÀÄ ªÀÄ£ÀzÉÆ¼ÀUÉ PÀÄªÀiÁgÀªÁå¸À
3. UÉÆÃgÀPÀë ¥Àæ¸ÀAUÀ ZÁªÀÄgÀ¸À

Unit II ªÀÄzsÀåPÁ°Ã£À PÁªÀå

7 Hrs

1. wæ¥À¢UÀ¼ÀÄ ¸ÀªÀðdÕ
2. V½AiÀÄÄ ¥ÀAdgÀzÉÆ½®è ¥ÀÄgÀAzÀgÀ zÁ¸ÀgÀÄ
3. PÀgÉzÀÄ PÉÆlÖ£ÀÄ ±Á¥ÀªÀ£ÀÄ PÀ£ÀPÀzÁ¸ÀgÀÄ

Unit III ¯ÉÃR£ÀUÀ¼ÀÄ

6 Hrs

1. DvÀä²æÃUÁV ¤gÀAPÀÄ±ÀªÀÄwUÀ¼ÁV PÀÄªÉA¥ÀÄ
2. ªÀiÁ£À«ÃAiÀÄvÉ CAvÁgÀ¯Áè zÉÃªÀ£ÀÆgÀÄ ªÀÄºÁzÉÃªÀ
3. ¨sÀÆvÁ¬Ä ªÀÄÄ¤zÁ¼ÀÄ ªÀÄÄgÁj §¯Á è¼À

Unit IV ¥À æªÁ¸À PÀxÀ£À

6 Hrs

1. £À£ÉÆß¼ÀV£À ºÁqÀÄ PÀÆå¨Á (¸ÀAUÀæºÀ) f. J£ï. ªÉÆÃºÀ£ï

Reference Books:

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., ZÁjwæPÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2008
3. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
4. ¸ÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.J¯ï., PÀ£ÀßqÀ d£À¥ÀzÀ PÀxÀ£À PÁªÀåUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2007

5. £ÁgÁAiÀÄt ¦.«, ZÀA¥ÀÆ PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
6. PÁ¼ÉÃUËqÀ £ÁUÀªÁgÀ, wæ¥À¢, gÀUÀ¼É ªÀÄvÀÄÛ eÁ£À¥ÀzÀ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010 7. ¸ÀA. ¨É£ÀUÀ¯ï gÁªÀÄ gÁªï ªÀÄvÀÄÛ ¥Á£ÀåA ¸ÀÄAzÀgÀ ±Á¹ ÛçÃ, ¥ÀÄgÁt £ÁªÀÄ ZÀÆqÁªÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥Àæ¸ÁgÁAUÀ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
8. qÁ. azÁ£ÀAzÀ ªÀÄÆwð, ªÀZÀ£À ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
9. ¸ÀA ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, £ÁUÀgÁd Q.gÀA. ªÀZÀ£À PÀªÀÄäl, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
10. ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, µÀlà¢ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
11. ¸ÀA. ¸ÉÃvÀÄgÁªÀÄ gÁªï C.gÁ., ²æÃ ®QëöäÃ±À£À eÉÊ«Ä¤ ¨ sÁgÀvÀ(ªÀÄÆ®-vÁvÀàAiÀÄð-¸ÀavÀæ), ¥ÀæPÁ±ÀPÀgÀÄ PÁªÀÄzsÉÃ£ÀÄ ¥ÀÄ¸ÀÛPÀ ¨sÀªÀ£À, ¨ÉAUÀ¼ÀÆgÀÄ. 2010

Course Code	Course Title	Course Type	L	T	P	C	Hr/ Wk
B21AHH201	**Language – II: Hindi - II**	**FC**	**1**	**1**	**0**	**2**	**3**

Course description: अध्ययनवर्णन :

यहपाठ्यक्रमनौसिखिया,
अपनीभाषाकीक्षमताकाविकासकरनेहेतुतथाविभिन्नसाहित्यिकप्रक्रियाओंद्वारासमाज,
संस्कृतिएवंजीवनकेमूल्योंकोसमझनेहेतुअभिकल्पितहै |

Prerequisites/Pre reading for the course:

- अध्येता,पी.यु.सीकेस्तरपरद्वितीयभाषाकेरूपमेंहिन्दीकाअध्ययनकरनाचाहिए|
- हिन्दीसाहित्यकेइतिहासकासंक्षिप्तज्ञानकीआवश्यकताहै|
- हिन्दीव्याकरणकाअवबोधनआवश्यकहै|
- हिन्दी-अंग्रेजीअनुवादसेसंबंधितजानकारीजरुरीहै|

c) Pedagogy: सिक्षशास्त्र :

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Objectives: पाठ्यक्रमउद्देश्य:

- संदर्भानुसारउचितभाषाकाप्रयोगकरनेकीदक्षताकोछात्रोंमेंउत्पन्नकरना|
- साहित्यकेमाध्यमसेसमाजएवंमानवीयमूल्योंकोसमझाकर, उनमूल्योंकीरक्षाहेतुप्रेरितकरना|

- छात्रोंमेंपुस्तकपठनएवंलेखनकीअकृतिमप्रवृत्तिस्थापितकरना|
- अध्येताओंमेंसाहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरना|

Learning Outcomes: अधिगमपरिणाम:

अध्ययनकीसमाप्तिपरअध्येता –

- सामाजिकमूल्यएवंनैतिकजवाबदेहीकोस्वीकारकरसकताहै|
- साहित्यकीप्रासंगिकताकोजीवनमेंसमझनेकीदक्षतारखताहै|
- समाजमेंअंतर्निहितपद्दतियाँएवंविचारधाराओंकाव्याख्यानकरनेमेंसक्षमबनसकताहै|
- साहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरसकताहै|

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHH201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Content: अध्ययनविषयसूची /पाठ्यक्रम

इकाई – 1कविता: प्राचीनएवंआधुनिक **7 hrs**

1.कबीरकेदोहे

2.कविता –जलियाँवालाबागमेंबसंत- सुभद्राकुमारीचौहान

3.कविता –सुभाषकीमृत्युपर - धर्मवीरभारती

इकाई – 2कविता: प्राचीनएवंआधुनिक **6 hrs**

4.तुलसीदसकेपद

5.कविता – पाषाणी – नागार्जुन

6.कविता –चलनाहमाराकामहै-शिवमंगलसिंहसुमन

इकाई – 3कविता: प्राचीनएवंआधुनिक **7 hrs**

7.मीराबाईकेपद

8.कविता –मेरेसपनेबहुतनहींहैं-गिरिराजकुमारमाथुर

9.कविता – अभीनहोगामेराअंत – निराला

इकाई – 4 **6 hrs**

अनुवाद : शब्दएवंअनुच्छेद (हिन्दीसेअंग्रेज़ी)

सूचना : प्रत्येकइकाई 25 अंककेलिएनिर्धारितहै |

Suggested Text Books and References

Text book/s: पाठ्यपुस्तक :

1. हिन्दीपाठ्यपुस्तक–रेवाविश्वविद्यालय|

References:सन्दर्भग्रन्थ:

1. सुबोधव्यवहारिकहिन्दी – डॉ. कुलदीपगुप्त
2. अभिनवव्यवहारिकहिन्दी – डॉ.परमानन्दगुप्त
3. हिन्दीसाहित्यकाइतिहास - डॉ. नागेन्द्र
4. आधुनिकहिन्दीसाहित्यकाइतिहास - डॉ. बच्चनसिंह
5. हिन्दीसाहित्यकानवीनइतिहास - डॉ. लालसाहबसिंह
6. शुद्धहिन्दीकैसेबोलेकैसेलिखे- पृथ्वीनाथपाण्डे
7. संक्षेपणएवंपल्लवन

Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B21AHA201	**Language II: Additional English – II**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This is a 2-credit course designed to help the learner gain competency in language through an exploration to the various genres of literature. The syllabus is designed to encourage critical ability of the learner to guide them towards career opportunities. This course is intended to develop the capacity to appreciate and assess the various dimensions of society, culture and life.

Prerequisites: The student must possess fair knowledge of language and literature.
Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

Course Objectives:

- To assess ecological and environmental concerns through literature.
- To identify the inequal structures of power in society.
- To compare and relate the position of men and women in society.
- To interpret the representation of society in popular culture.

Course Outcome:

On completion of the course, learners will be able to:

- Demonstrate a thorough understanding of sensitive and critical ecological and environmental issues.
- Analyze the rigid structure of center and margin in our society.
- Criticize the subordinate position of women in society.
- Justify the depiction of society in popular culture.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHA201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Contents:

Unit-I: Ecology & Environment **7 hrs**

Literature: Toru Dutt - Casuarina Tree
Gordon J.L. Ramen – Daffodils No More
C.V. Raman – Water – The Elixir of Life
Language: Degrees of Comparison

Unit-II: Voices from the Margin **6 hrs**

Literature: Tadeusz Rozewicz – Pigtail
Jyoti Lanjewar – Mother
Harriet Jacobs – Excerpt from Incidents in the Life of a Slave Girl
Language: Prefix and Suffix

Unit-III: Women & Society **7 hrs**

Literature: Kamala Das – An Introduction
Rabindranath Tagore – The Exercise Book
Jamaica Kincaid – Girl
Writing Skills: Dialogue Writing

nit-IV: Popular Culture **6 hrs**

Literature: Rudyard Kipling – The Absent-minded Beggar
Sir Arthur Conan Doyle – The Adventure of Lion's Mane
Aldous Huxley – The Beauty Industry
Writing Skills: Story Writing

Reference Books:

- Agrawal, K.A. *Toru Dutt the Pioneer Spirit of Indian English Poetry - A Critical Study*. Atlantic Publications, 2009.
- Latham, Edward Connery (ed). *The Poetry of Robert Frost*. Holt Paperbacks, 2002.
- Gale, Cengage Learning. *A Study Guide for Tomas Rivera's The Harvest*. Gale, Study Guides, 2017.
- Basu, Tejan Kumar. *The Life and Times of C.V. Ram*an. Prabhat Prakashan, 2016.
- Rozewicz, Tadeusz. *New Poems*. Archipelago, 2007.
- Manohar, Murli. *Critical Essays on Dalit Literature*. Atlantic Publishers, 2013.

- Hansda, Sowvendra Shekhar. *The Adivasi Will Not Dance: Stories*. Speaking Tiger Publishing Private Limited, 2017.
- Jacobs, Harriet. *Incidents in the Life of a Slave Girl*. Createspace Independent Publication, 2014.
- Das, Kamala. *Selected Poems*. Penguin Books India, 2014.
- Tagore, Rabindranath. *Selected Short Stories of Rabindranath Tagore*. Maple Press, 2012.
- Gale, Cengage Learning. *A Study Guide for Jamaica Kincaid's Girl*. Gale, Study Guides, 2017.
- Kipling, Rudyard. *The Absent-Minded Beggar*. Hardpress Publishing, 2013.
- Doyle, Arthur Conan. *The Hound of the Baskervilles*. General Press, 2017.
- Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt Ltd., 1988.
- Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.
- Samson, T. (ed.) *Innovate with English.* Cambridge University Press, 2010.
- Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHE201	**Communicative English – II**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This 2-credit course focuses on enhancing written proficiency required for professional enhancement. It also polishes the spoken skills of the learners to make them effective and confident presenters. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The practical components discussed in this course enable a fruitful transition from academia to the industry of their choice.

Prerequisites: The student must possess functional knowledge of LSRW skills.
Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.

Course Objectives:

- To build skills essential for corporate communication.
- To enhance context specific language skills.
- To discover the creative linguistic potential through language and literature.
- To develop communication skills necessary for employability.

Course Outcomes:

After the completion of the course, students will be able to:

- Apply acquired skills to communicate effectively in a corporate scenario.
- Demonstrate command over rhetoric of language.
- Develop critical and creative thinking through assimilated language skills.
- Utilize the communication skills learnt to match industry standards.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHE201	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Contents:

Unit-I: Language Acquisition **7 Hrs**

Remedial Grammar: Questions& Negatives; Questions Tags
Writing Skills: Email Writing
Activities: Group Discussions
Literature: Alphonse Daudet - The Last Lesson

Unit-II: Persuasive Skills **6 Hrs**

Remedial Grammar: Past Simple & Past Perfect
Writing Skills: Report Writing
Activities: Book & Movie Reviews
Literature: Lord Alfred Tennyson – Ulysses

Unit-III: Cognitive Skills **7 Hrs**

Remedial Grammar: Present & Past Passive; Conditionals
Writing Skills: Creative Writing
Activities: Role Plays
Literature: O. Henry – The Gift of the Magi

Unit-IV: Employability Skills **6 Hrs**

Remedial Grammar: Reported Speech; Idioms
Writing Skills: Cover Letter & CV
Activities: Exchanging Information
Literature: Saki – The Open Window

Reference Books:

1. Bansal, R.K. and J.B. Harrison. *Spoken English*. Orient Blackswan, 2013.
2. Raman, Meenakshi and Sangeeta Sharma. *Technical Communication*. Oxford University Press, 2015.
3. Thorpe, Edgar and Showick Thorpe. *Objective English*. Pearson Education, 2013.
4. Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt Ltd., 1988.
5. Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.
6. Samson, T. (ed.) *Innovate with English*. Cambridge University Press, 2010.
7. Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.

8. Goodale, Malcolm. *Professional Presentation*. Cambridge University Press, 2013.

Course Code	Bacteriology and Virology	Course Type	L	T	P	C	CH
B21MI0201		HC	2	1	0	3	4

Prerequisites/Pre reading for the course:

Students should have the knowledge of prokaryotic microbes and viruses

Course Objectives:

1. Provide the detailed information of bacteriology and its function.
2. Derive the mathematical hypothesis of bacterial growth dynamics.
3. Provide fundamentals of viruses and its host interactions.
4. Provides various techniques of culturing and characterisation of virus.
5.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0201	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	2		1		1	2	1	1	1
	CO3	1	2	2	1			1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	2

Course Outcomes:

After the end of the sourse students will be able to:

1. Strengthen the knowledge of the morphological details and classification of bacteria
2. Exploit of bacterial growth phases and kinetics involved in growth
3. Explore the biology of virus, phage and their host interactions
4. Explain the various characterisation and identification of virulent viruses

Course Contents

Unit-I Bacteriological studies **12 hrs**

Brief history of bacteriology, general characteristics of bacterium, classification of bacteria based on the morphology, flagella and nutritional aspects, ultrastructure of bacterial cells-cell wall composition, cell membrane, flagella, cell surface appendages, genomes & extra chromosomal DNA and functions of bacterial structure.

Unit II Bacterial growth kinetics **12 hrs**

Different phases of growth curve-lag, log, stationary, death phases and kinetics, measurement of growth curve, calculation of generation time, reproduction in bacteria-binary fission & its mechanism.

Unit III Virology **12 hrs**

Brief history of virology, general characteristics, classification by various methods such as nature of genetic materials, complexities & envelop and their importance, life cycle of bacteriophage (lambda, T4, M13), animal virus (Polio, hepatitis, HIV) and plant virus (TMV, CaMV) importance and scope of virology.

Unit IV Virus culturing techniques **12 hrs**

Isolation of virus-different techniques, various methods of culturing-in vitro, in vivo & animal models; different detection methods in the virology-naked, effects & various molecular techniques. Add a note on viriods & prions and their disease caused.

References

1. Prescott L.M, Harley T.P and Klein D.A. Microbiology, 9th Edition, WMC. Brown publishers, 2012
2. Stanier Pub; Ingraham and Wheeler. General Microbiology (1998), 5th edition. McMillan Publisher, 1998
3. Atlas R.M. Microbiology: Fundamentals and applications 4thEdition, Singapore : Pearson Education Asia, 2000
4. Cann A J, Princples of Molecular Virology, Academic Press Oxford UK 2012

Course Code	Chemistry-II	Course Type	L	T	P	C	CH
B21CH0201		HC	2	1	0	3	4

Prerequisites:

Knowledge of atomic structure, electronic configuration, valence electrons, sigma and pi bond, types of reactions, isomerism, properties of liquid and liquid mixtures.

Course Objectives:

1. Understand various interactions in liquid mixtures and their effect on mixture properties.
2. Study the effect of temperature on the behavior of miscible and immiscible liquids.
3. Acquire the concept of fractional distillation, its principles and applications.
4. Fundamental concepts of chemical bonding, Ionic bonding, Covalent Bonding etc.
5. Brief the concepts of binary mixtures, laws of miscibility, fractional distillation etc.
6. Defie the concepts of vapour pressure, elevation of boiling points, cryoscopic constant, isotonic solutions, plasmolysis etc.

Course Outcomes:

CO1: Apply Fajans rules and determine the percentage covalent character of an ionic compound.
CO2: Categorise the oraganic cyclic compounds into aromatic, non-aromatic and anti-aromatic character.
CO3: Draw conclusions form the properties of the solute and solvents and their interactions.
CO4: Interpret the analytical data and solve problems related to basics of analytical chemistry.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0201	CO1	3	3	2	3			2			1	2	2	
	CO2	3	3	3	2			1			2	2	3	
	CO3	3	2	2	2			2			1	2	3	
	CO4	3	2	1	2			2			3	3	3	

Course Contents:

Unit – I: Chemical Bonding **12 Hrs**

Ionic Bonding: Lattice energy and solvation energy. Born-Landé equation, Born-Haber cycle and its applications. Polarization, polarizing power and polarizability. Fajan's rules, percentage ionic character in covalent compounds, dipole moments. Ionic solids; structure of NaCl and CsCl.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. AXE method. Concept of resonance and resonating structures in various inorganic compounds (CO_3^{2-}, SO_3^{2-}, O_3, HN_3, CH_2N_2, N_2O).

MO Approach: Rules for the LCAO method. Molecular orbital diagram for He_2^+, Be_2, N_2, O_2, O_2^{2-}, O_2^+, CO and NO (bond order, stability and magnetic properties to be discussed).

Metallic bond: Band theory, electrical conductance of metals, semiconductors (n- and p-type), Insulators and Superconductors. **Hydrogen bonding:** Types and conditions. Hydrogen bonding in HF, H_2O, NH_3.

UNIT-II **12 Hrs**

Aromaticity-Huckel's rule, aromatic, anti-aromatic and non-aromatic character. Aromaticity in benzenoids, (benzene, naphthalene, anthracene and phenanthrene) and non-benzenoid compounds (cyclopropenyl, cyclopentadienyl, cycloheptadienyl system).

Aromatic electrophilic substitution reactions – Arenium mechanism, reactivity and orientation effects in benzene substituents- electron donating groups (-CH_3, -Cl, and -OH groups) and electron withdrawing groups (-NO_2, and –SO_3H groups). Friedel-craft alkylation and acylation.

Aromatic nucleophilic substitution *via* benzyne intermediate, mechanism with evidences for the formation of benzyne by trapping with anthracene, Birch reduction.

Amines: Classification. Preparation of alkyl and aryl amines-reductive amination of carbonyl compounds, Gabriel phthalimide synthesis. Basicity of amines in aqueous solution: Inductive,

resonance, steric and solvation effects on the basicity of amines. Reaction of amines as nucleophiles –Methylation, quaternary salts, Hoffmann elimination with mechanism. Distinguishing reactions
of 1^0, 2^0 and 3^0 amines. Diazotization and synthetic applications of diazonium salts. Sandmeyer's reaction. (conversion to chlorobenzene, bromobenzene and benzonitrile), hydrolysis, reduction (to phenyl hydrazine and aniline), coupling reactions to give azo dyes (*p*-hydroxy azobenzene and 1-phenylazo-2-naphthol).

UNIT-III **12 Hrs**

Liquid mixtures: Classification, Raoult's law, Henry's law and its limitations.

Completely miscible liquids: Ideal and non- ideal solutions. Vapor pressure – composition diagrams for ideal and non-ideal solutions. Principle of distillation of binary miscible liquids**:** Konowaloff's rule, Azeotropic mixtures.

Partially miscible liquids: Critical solution temperature (CST) – types – phenol-water system, triethylamine-water system. Effect of addition of non-volatile solute on CST.

Immiscible liquids: Steam distillation.

Colligative Properties: Relation between relative lowering of vapour pressure and molar mass (to be derived). Determination of relative molar mass of solute by Ostwald-Walker's dynamic method. Elevation of boiling point and its relation to lowering of vapour pressure and molar mass (to be derived, problems to be worked out). Ebullioscopic constant of the solvent and its relation to the boiling point (only equation). Determination of molar mass of the solute by Walker-Lumsden method. Depression in freezing point and its relation to lowering of vapour pressure and molar mass (to be derived, problems to be worked out). Cryoscopic constant and its relation to the melting point (equation). Determination of molar mass of a non-volatile solute by Beckmann's method (problems to be worked out).

Semi permeable membrane – natural and artificial, preparation of copper ferrocyanide membrane by Morse-Frazer method. Definition of osmosis, osmotic pressure, determination of osmotic pressure by Berkley-Hartley's method. Determination of molar mass from osmotic pressure measurements (relation to be derived, problems to be worked out), isotonic solutions.

UNIT-IV **12 Hrs**

Analytical Chemistry:

Principles of qualitative and quantitative analysis; acid-base, oxidation-reduction and complexometric titrations using EDTA; precipitation reactions; use of organic reagents in inorganic analysis.

Indicator – Definitions, types (acid-base, redox, adsorption indicators), examples for each type. Theory of indicators – Oswald's theory and Quinonoid theory – indicator constant – action of phenolphthalein and methyl orange in acid-base solutions – pH titration curves for strong acid vs strong base, weak acid vs strong base, weak base vs strong acid, choice of indicators in these types of titrations – colour change and pH range.

Statistical treatment of results of quantitative analysis: Classification of errors, accuracy, precision, minimization of errors (calibration of apparatus, running of blank determination, running parallel determination to be mentioned), significant figures and computation, mean and standard deviation (explanation with an example), distribution of random errors (explanation with the help of curve), reliability of results (F-test and t-test).

References:

1. R.L. Madan, Chemistry for Degree Students, S. Chand, 1st Edition, 2011.
2. A. Bahl, and B.S. Bahl, Advanced Organic Chemistry, S. Chand, 2010.
3. A. Bahl, and B.S. Bahl, Advanced Physical Chemistry, S. Chand, 2010.
4. J.N. Gurtu and A. Gurtu, Advanced Physical Chemistry, Pragati Prakashan, Vol I, 4th Edition, 2017.
5. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Vishal Publishing Co., 33rd Edition, 2020.
6. P.A. Sykes, Guide book to Mechanism in Organic Chemistry, Orient Longman, New Delhi, 1988.
7. R.T. Morrison and R.N. Boyd, Organic Chemistry, Pearson, 2010.
8. B.H. Mahan, University Chemistry, Narosa, 3rd Edition, 1998.
9. J.D. Lee, Concise Inorganic Chemistry, Oxford University Press, 3rd Edition, 2008.
10. F.A. Cotton, G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry, Wiley, 3rd ed, 1995.

Course Code	Cytogenetics	Course Type	L	T	P	C	CH
B21GN0201		**HC**	**2**	**1**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of cell organelles.
2. They should have idea about cell cycle.

Course Objectives:

The objective of this Course is to

1. To equip with the knowledge of microscopy.
2. To explore cell biology and its characteristics.
3. To define the structure and organization of eukaryotic chromosomes.
4. To study the mechanism of linkage and recombination.

Course Outcomes:

After the end of the Course students will be able to:

1. Describe the structure and organization of eukaryotic chromosomes.
2. Diagnose the syndromes depending on karyotypic data.
3. Understand the mechanism of linkage and recombination.
4. Explain the inheritance followed by non-nuclear genes

Mapping of Course Outcomes with programme Outcomes

Course Code		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0201	CO1	3	3	3	3				3		3	3	2	

	CO2	3	3	3	3		2		2		3	3	2	2
	CO3	3	3								3	3	2	
	CO4	3	3			3			3		3	3	2	

Course Contents:

UNIT I **12 hrs**

Microscopy: Magnification, Resolving power, Principles and Applications of Simple, Compound, Stereozoom, Phase contrast, Fluorescent and Electron microscopes, confocal microscopy.

Cell organelles: Ultrastructure, Chemical composition and Functions of Cytoplasmic organelles: Plasma membrane, Endoplasmic reticulum, Ribosomes, Lysosomes, Golgi bodies andNucleus. Cell cycle and cell division. Apoptosis (extrinsic and intrinsic mechanisms). Chromosome theory of inheritance.

UNIT II **12 hrs**

Eukaryotic Chromosome: Macro-molecular organization. Primary and Secondary constriction, Sat-bodies, Telomeres, Heterochromatin and Euchromatin and its significance.

Ultra structure of Chromosome - Histones, DNA, Nucleosome model, solenoid, scaffold, domains.

Special types of Chromosomes: Structure and Significance of: Polytene Chromosome - Salivary gland chromosome in *Drosophila*, Lampbrush chromosome in amphibian Oocyte. B Chromosome.

UNIT III **12 hrs**

Linkage: Definition of Linkage, Coupling and Repulsion hypothesis, Linkage group- *Drosophila*, maize and man, Types of linkage-complete linkage and incomplete linkage, Factors affecting linkage- distance between genes, age, temperature, radiation, sex, chemicals and nutrition, Significance of linkage.

Crossing over: Crossing over- definition and types of crossing over: Germinal and Somatic crossing over. Crossing over in *Drosophila.* Cytological basis of crossing over: Stern's experiments in *Drosophila*, Creighton and McClintock experiment in maize. Mechanism of crossing over: Chiasma type theory, Breakage first theory, Contact first theory, Strain or torsion theory. Molecular mechanism of crossing over - Holliday model, Interference and coincidence, Steps in Construction of genetic map *(Drosophila).*

UNIT IV **12hrs**

Sex linkage: Definition of sex linkage; Sex linkage in Drosophila. Sex linked genes in poultry, moths and man. Sex linked inheritance in man (Colour-blindness, Haemophilia).

Meiotic behavior of chromosome and non - disjunction. Bridge's theory of non-disjunction. Attached X-chromosome.

Extra Chromosomal Inheritance / Cytoplasmic Inheritance: Characteristic features of Cytoplasmic Inheritance. Maternal effect inheritance. Structure and organization of

Mitochondria and Chloroplast Inheritance of: Mitochondrial DNA, Chloroplast DNA, Kappa articles in *Paramecium*, Sigma factor in *Drosophila*, Shell coiling in snail. Cytoplasmic Male Sterility (CMS) in maize.

Reference Books:

1. Cytogenetics, Plant Breeding and evolution by U. Sinha and Sunita Sinha, Vikas Publishing House Private, Limited, 1998.
2. Cytology, Genetics and Molecular Biology by P. K. Gupta (2002), Rastogi publications.
3. Elements of Genetics by Phundan Singh, Kalyani Publishers. 2009.
4. Genetic Maps, 6th edition by O'Brien, S (1993) Book 3: Lower Eukaryotes. Book 4: Nonhuman Vertebrates. Book 5: The Human maps. Book 6: Plants. Cold Spring Harbor Lab press New York.
5. Genetics, 2nd Edition, by Weaver, R.F. and Hendrick, P.W. (1992). W.C. Brown.
6. Instant notes in Genetics by P. C. Winter, G.I. Hickey and H. L. Fletcher (2003) Viva Books Pvt.Ltd.
7. Principles of Genetics by E. J. Gardener, M. J. Simmons and D.P. Snustad. J. Wiley and Sons pubs (1998).

CourseCode	Analytical techniques in Genetics	Course Type	L	T	P	C	CH
B21GNS111		SC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have the basic knowledge of biomolecules.
2. They should know the basics of physical and chemical analysis techniques.

Course Objectives:

The Objectives of this course is:

1. To emphasis on the techniques and technologies used in genetics and molecular biology.
2. To understand the different methods used for analysis of biomolecules.
3. To interpret the presence of metabolite.
4. To outline the protocol used for different analysis

Course Outcomes:

By the end of the Course students will be able to:

1. Visualize the microscopic images and document them effectively.
2. Blueprint the techniques used to detect proteins and DNA.
3. Understand the techniques of spectroscopy and computational biology.
4. Interpret the presence of metabolite using chromatographic techniques.

Mapping of Course Outcomes with program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GNS111	CO1	3	3	3			2	3			3	3		
	CO2	3	3	3			2	3			3	2	3	
	CO3	3	3	3			2	2			3		3	
	CO4	3	3	3			2	2			3	2	3	

Course Contents:

Unit-I **12 hrs**

Microscopy: Light Microscopy-Introduction, Geometrical optics, Image formation, Magnification and Resolution, Lens aberrations, Distortion of image and curvature of field; Types of microscopes-Compound, Bright field and dark field, Fluorescence, Polarized, Stereo, their basic principles, working and applications; Electron Microscopy-Introduction, Historical review, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Theory and basic principles, Instrumentation, applications. FISH – Fluorescence In situ Hybridization and FACS – Fluorescence Activated Cell Sorter

Unit -II **12 hrs**

Chromosome banding - Principles and techniques of nucleic acid hybridization and cot curves; Sequencing of nucleic acids; Southern, Northern and Western blotting techniques; Protein sequencing, Polymerase chain reaction (PCR), Real Time-PCR, Methods for measuring nucleic acid and protein interaction. Electrophoresis: Principle, procedure and application of- Agarose, PAGE, SDS-PAGE, Pulse field electrophoresis, Paper cellulose acetate and High voltage electrophoresis; Isoelectric focusing (IEF).

Unit -III **12 hrs**

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy; Structure determination using X-ray diffraction and NMR analysis using light scattering; Different types of mass spectrometry and surface plasma resonance methods; Computation methods; Nucleic method and protein sequence databases, data mining method for sequence searches, motif analysis and prediction.

Unit -IV **12 hrs**

Principle and applications of gel filtration, ion exchange & affinity chromatography; Thin layer chromatography; Gas chromatography; GLC; High pressure liquid chromatography (HPLC), Fast protein liquid chromatography (FPLC); Ultracentrifugation (Velocity and buoyant density). Radioactivity, detection and measurement, construction and use of scintillation counters, Autoradiography, preparation of labelled compounds. Applications in biological sciences, use of non-radioactive compounds.

References:

- Molecular cloning A Laboratory Manual 3rdedition Vol. 1, 2, 3-Sambrook and Russell, Churchill press 20072.
- Principles and Techniques of Biochemistry and Molecular Biology (2010)-Edited by Keith Wilson and John Walker, Sixth Edition, Cambridge University Press.
- Chromosome Structural analysis (1999) -A Practical Approach (Ed.) W.A. Bickmore, Oxford University Press5. The AGT Cytogenetics Lab Manual (1997) 3rded. -, Barch, Knutsen and Spurbeck, Lippincott Raven publications.
- Techniques in lifesciences D. B. Tembhare; Himalaya publishing house
- Principles of Gene Manipulation and Genomics; S B Primrose and R M Twyman; seventh edition; Blackwell publishing.

Course Code	Forensic Biology	Course Type	L	T	P	C	CH
B21GNS112		SC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have Critical thinking capacity.
2. They should have knowledge of crime scene.

Course Objectives:

The Objectives of this course is:

1. To teach the methodology involved in forensic investigation**.**
2. To understand and utilize the facilities available at forensic laboratories.
3. To document and analyze the crime scene.
4. To analyze the biological andentomological evidences for interpretation.

Course Outcomes:

By the end of the Course students will be able to:

1. Outline the protocol of forensic science investigation.
2. Involve in forensic investigation.
3. Categorize the evidences and analyze them.
4. Explore the significance of different biological evidences and their significance in interpretation.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GNS112	CO1	3	3	3			3				3	3	3	3
	CO2	3	3	3	3		3	3			3	3	3	3

	CO3	3	3	3	3		3				3	3	2	
	CO4	3	3	3	3		3	3	3		3	3	3	3

Course Contents:

UNIT-1 **12 Hrs**

Introduction: Scope and future prospects of forensic sciences - Forensic science Laboratories – CFSL & SFSL

Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene. Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes. Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes.

Crime Scene Evidence - Classification of crime scene evidence - physical and trace evidence. Locard principle. Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence. Chain of custody. Reconstruction of crime scene.

UNIT-II **12Hrs**

Biological Evidence

Nature and importance of biological evidence. Types and identification of microbial organisms of forensic significance. Identification of wood, leaves, pollens and juices as botanical evidence. Diatomsand their forensic significance. Dermatoglyphics. Wildlife Forensics - Fundamentals of wildlife forensic. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Forensic entomology - Insects of forensic importance. Collection of entomological evidence during death investigations.

UNIT-III **12 Hrs**

Forensic Serology

Forensic characterization of bloodstains. Typing of dried stains. Blood enzymes and proteins. Composition, functions and forensic significance of saliva, sweat, semen, milk and urine. Tests for their identifications.

Bloodstain Pattern Analysis - Bloodstain characteristics. Impact bloodstain patterns. Cast off bloodstain patterns. Projected bloodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis.

UNIT IV Genetic Marker Analysis **12 Hrs**

Cellular antigens. ABO blood groups. Extracellular proteins and intracellular enzymes. Significance of genetic marker typing data. Sexual assault investigations. Principles of heredity. Genetics of paternity. DNA markers in forensics. DNA testing in disputed paternity. Missing body cases. Reference populations and databases.

Reference Books:

1. Richard Saferstein, 2001, Criminalistic: An Introduction to Forensic Science. 7th edition Prentice-Hall, New Jersey.
2. Evidence in Civil and Criminal cases, IV edition, Foundation Press, Westbury, New York.
3. James, S.H. and Nordby J.J. Forensic Science: An introduction to Scientific and investigative techniques, CRC Press, USA, 2003.
4. Chowdhri, S., Forensic Biology B.P.R. &D, Govt. ofIndia.
5. Najjar and NacWillim, 1978. Forensic Authropology.
6. Byrd, J.H. and Cartner, J.L., 2001. Forensic Entomology, CRC Press, LIC.
7. Robertson, J., 1999. Forensic Examination of Hair. Taylor & Forensic.
8. Cammins, H. and Middle C., 1961. Fingerprints Palms and Soles. Dover Publications.

Course Code	Environmental Science	L	T	P	C
B21ASM201		2	0	0	2

Prerequisites:

Basic knowledge of Environmental Science studied at higher secondary & school level.

Course Objectives:

1. Discuss Foster clear awareness and concern about economic, social, political and ecological interdependence in urban and ruralarea
2. Influence the new patterns of behaviors of individuals, groups and society as a whole towards theenvironment
3. List the knowledge values, attitudes, commitment and skills needed to protect and improve the environment
4. Elaborate the evaluation of the environmental measures and educationprograms.

Course Outcomes:

On successful completion of this course, the student will be able to:

1. Adapt the environmental conditions and protectit
2. Estimate the role of individual, government and NGO in environmentalprotection.
3. Interpret the new renewable energy resources with high efficiency throughactive research.
4. Analyze the ecological imbalances and protectit.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	CO1	1	2	1	1	1	2	3	1	1	1	1	2	1

B21ASM201	CO2	1	3	1	1	1	3	3	1	1	1	1	3	1
	CO3	2	3	2	1	3	3	3	1	1	1	2	3	2
	CO4	1	2	1	1	1	2	3	1	1	1	1	2	1

Course Contents:

Unit-I **6 Hrs**

Multidisciplinary Nature of Environmental Studies: Introduction to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection – Role of Government-Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Initiative and Role of Non-government organizations in India andworld.

Self study: Need for public awareness on the environment, Gaia Hypothesis.

Unit-II **6 Hrs**

Environmental pollution, degradation & Waste management:

Environmental Pollution – Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile Pollution-Causes, Effects & control measures.

Self study: Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes.

Environmental degradation – Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.

Solid Waste management – Municipal solid waste, Biomedical waste, Industrial solid waste and Electronic waste (E-Waste).

Self study: Disaster management, early warning systems-bio indicators for Tsunami and other naturaldisasters.

Unit-III **6Hrs**

Energy & Natural resources:

Energy – Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source ofenergy.

Self study: Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nucleardisaster.

Natural resources –water resource (Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance), Mineral resources (Types of minerals, Methods of mining & impacts of mining activities), Forest wealth (Importance's,

Deforestation-Causes, effects and controllingmeasures)
Self study: Hydrology & modern methods adopted for mining activities.

Unit-IV **6Hrs**

Ecology and ecosystem:
Ecology-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem-Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. Biogeochemical cycles and its environmental significance – Carbon, nitrogen and phosphorus cycle, Energy flow in ecosystem, food chains –types, food web& Ecological Pyramids.
Self study: Need for balanced ecosystem and restoration of degraded ecosystems.

Reference Books

1. "Environmental Studies", by R.J. Ranjit Daniels and Jagadish Krishnaswamy,(2017), Wiley India Private Ltd., New Delhi, Co-authored &Customised by Dr. M. S. Reddy & Chandrashekar, REVA University.
2. "Environmental Studies", by R.J. Ranjit Daniels and JagadishKrishnaswamy, (2009), Wiley India Private Ltd., NewDelhi.
3. "Environmental Studies" by Benny Joseph, Tata McGraw – Hill Publishing Company Limited.
4. Environmental Studies by Dr. S. M. Prakash, Elite Publishers Mangalore,2007
5. RajagopalanR.2005,"EnvironmentalStudies–fromCrisistocure",OxfordUniversityPress.
6. Environmental Science by Arvind walia, Kalyani Publications,2009.
7. Environmental Studies by AnilkumarDey and ArnabkumarDey.

CourseCode	Bacteriology & Virology Lab	Course Type	L	T	P	C	CH
B21MI0202		HC	0	0	1.5	1.5	3

Course Objectives:

1. Provides working skills to handle various techniques for isolation of bacteria and viruses
2. Provides the various enumeration methods for bacteria and phages
3. Analyse different biochemical techniques to identify bacteria.
4. Quantify the microorganisms present in the given samples.

Course Outcomes:

After the end of the course students will be able to:

1. Explore various sampling techniques and restoration for bacterial and viral specimens
2. Learn the handle the bacteria and viruses in laboratory

3. Exploit biochemical and molecular techniques to identify, characterise and phylogenetic analysis of bacteria and viruses.
4. Determine the microbial load in the various sample.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO2	PSO3
B21MI0202	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	1
	CO3	1	2	2	1	1	2	1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1

Course Contents

1. Sampling of bacteria- baiting, enrichment and selective isolation
2. Microscopic identification of bacteria
3. Selective identification of bacteria
4. Direct cell count and estimation of microbes
5. Biochemical identification of bacteria
6. Phylogenetic identification of bacteria
7. Isolation of bacteriophage
8. Plaque forming assay

References

1. Stanier Pub; Ingraham and Wheeler. General Microbiology (1998), 5th edition. McMillan Publisher, 1998
2. Atlas R.M. Microbiology: Fundamentals and applications 4thEdition, Singapore : Pearson Education Asia, 2000
3. Cann A J, Princples of Molecular Virology, Academic Press Oxford UK 2012
4. Wagner EK, Hewlett MJ, Bloom DC, Camerini D Basic Virology 3rd edition. Blackwell publishing. Malden USA 2008

CourseCode	**Chemistry – II Practicals**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B21CH0202		**HC**	**0**	**0**	**1.5**	**1.5**	**3**

Prerequisites:

Knowledge of physical properties, functional groups, solubility chart, elements and chemical reactions,

Course Objectives:

1. Obtain skill of handling strong acids and reagents used for functional group anlysis.
2. Perform independently detection of elements, solubility of the compound, functional group analysis and preparation of suitable solid derivative.
3. Perform the distinguishing test between aldehyde and ketone using Schif's reagent.
4. Prepare some organic compounds and purification using recrystallization technique.

Course Outcomes:

CO1: Acquire knowledge of steps involved in organic functional group analysis.
CO2: Test for elements such as sulfur, nitrogen and halogens using sodium fusion extract.
CO3: Determine the physical constants of both compound and its derivative using melting point apparatus.
CO4: Setup organic reactions, isolation and purification of organic compounds.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0202	CO1	2	2	3	2	1		2			2	1	3	1
	CO2	3	3	3	3	1		2			3	2	2	2
	CO3	3	2	2	3			2			2	3	2	2
	CO4	2	3	2	2	1		2			3	2	2	2

Course Contents:

Part 1: Qualitative analysis of mono functional organic compounds through functional group analysis. Determination of physical constant. Preparation of suitable solid derivative of the following class.

1. Acids,
2. Alcohols,
3. Aldehydes,
4. Amide,
5. Amine,
6. Halogenated hydrocarbons,
7. Hydrocarbons,
8. Ketones,
9. Nitro compounds,
10. Phenols.

Part 2: Organic preparations: Recrystallisation and determination of melting point and its importance may be mentioned

1. Acetylation: Preparation of acetanilide from aniline
2. Oxidation: Preparation of benzoin acid from benzaldehyde
3. Nitration: Preparation of m-dinitrobenzene from benzene
4. Esterification: Preparation of methyl benzoate from benzoic acid.

References:

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Pandey, O.P., Bajpai D. N. & Giri S. *Practical Chemistry, Revised Edition*, (For BSc. I, II, III Year Students of All Indian Universities) S. Chand Company Pvt Limited, 2014.
4. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

CourseCode	Cytogenetics Lab	Course Type	L	T	P	C	CH
B21GN0202		**HC**	**0**	**0**	**1.5**	**1.5**	**3**

Course Objectives:

1. To enable students to handle the microscopes.
2. To familiarize the cell division processes.
3. To learn the culturing of *Drosophila*
4. To study the structure of chromosomes.

Course Outcomes:

After the end of the Course students will be able to:

1. Handle the microscopes and observe the live and fixed specimens.
2. Understand the stages of meiosis and mitosis.
3. Culture and maintain the *Drosophila* in laboratory.
4. Familiarize the structure of polytene chromomsomes.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0202	CO1	3		3	3						3	3	2	3
	CO2	3	3								3	3	2	
	CO3	3				3					3	3		
	CO4	3	3			3					3	3	2	

Course Contents

1. Microscopy: Handling of Dissection& Simple Microscope.
2. Stereozoom and Compound Microscopes.
3. Temporary squash preparation of onion root tips for mitosis.
4.. Temporary squash preparation of onion flower buds for meiosis.
5. Culturing and Handling of *Drosophila*:

a) Media Preparation
b) Cleaning and Sterilization of bottles
c) Handling of *Drosophila*

6. Morphology and Sexual dimorphism
7. Salivary gland Chromosome-
   Dissection of Salivary glands and Preparation of Polytene chromosome.
8. Problems on:
   a. Sex linkage
   b. Genetic map

Reference Books:

1. Cytogenetics, Plant Breeding and evolution by U. Sinha and Sunita Sinha, Vikas Publishing House Private, Limited, 1998.
2. Cytology, Genetics and Molecular Biology by P. K. Gupta (2002), Rastogi publications.
3. Elements of Genetics by Phundan Singh, Kalyani Publishers. 2009.
4. Genetic Maps, 6th edition by O'Brien, S (1993) Book 3: Lower Eukaryotes. Book 4: Nonhuman Vertebrates. Book 5: The Human maps. Book 6: Plants. Cold Spring Harbor Lab press New York.
5. Genetics, 2nd Edition, by Weaver, R.F. and Hendrick, P.W. (1992). W.C. Brown.
6. Instant notes in Genetics by P. C. Winter, G.I. Hickey and H.L. Fletcher (2003) Viva Books Pvt.Ltd.
7. Principles of Genetics by E.J. Gardener, M.J. Simmons and D.P. Snustad.J. Wiley and Sons pubs (1998).

THIRD SEMESTER

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHK301	**Language III: Kannada - III**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

¨sÁµÉAiÀÄ£ÀÄß ªÀiÁvÀ£ÁqÀÄªÀ §gÉAiÀÄÄªÀ PË±À®å, ¸Á»vÀåzÀ §UÉÎ ¸ÀÆÜ®ªÁV ¥ÀjZÀ¬Ä¸ÀÄªÀ ªÀÄÄÆ®PÀ «zÁåyðUÀ¼À ªÀåQÛvÀé «PÁ¸À ºÁUÀÄ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ, ¥Àæ¸ÀÄÛvÀ ¸ÀAzÀ¨sÀðPÉÌ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸À®Ä ¥ÀoÀåªÀ£ÀÄß gÀÆ¦¸À¯ÁVzÉ. ¸Á»vÀå, PÀ¯É, ªÁtÂdå, DqÀ½vÁvÀäPÀ ªÀÄvÀÄ Û «eÁÕ£ÀzÀ «ZÁgÀUÀ½UÉ MvÀÛ£ÀÄß ¤ÃqÀ¯ÁVzÉ. EzÀÄ ªÉÆzÀ® JgÀqÀÄ ¸É«Ä¸ÀÖgï ªÀÄÆgÀÄ PÉærmïUÀ¼À£ÀÄß; ªÀÄÆgÀÄ ªÀÄvÀÄ Û £Á®Ì£ÉÃ ¸É«Ä¸ÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉÆA¢zÉ.

Pre-requisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy:

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÄÀaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀ é «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

- ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§Az sÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤n Ö£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
- CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨ sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
- ¸Ààz sÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°è lÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

- ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ, ¥Àj¸ÀgÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£À ºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨ sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
- fÃªÀ£ÀzÀ°è §gÀÄªÀ C© ü¥ÁæAiÀÄ ¨ÉÃz sÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
- GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.
- ¸ÀA±ÉÆÃzÀ£Á ªÀÄ£ÉÆÃ¨ sÁªÀ ªÀÄvÀÄÛ ¸Ààz sÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸ÀÄvÀÛzÉ.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHK301	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			

	CO4							2	3		3			

Course Content:

Unit I £ÀªÉÇÃzÀAiÀÄ PÀ«vÉUÀ¼ÀÄ

7 Hrs

1. ¨É¼ÀUÀÄ zÀ.gÁ. ¨ÉÃAzÉæ
2. PÀ°Ì PÀÄªÉA¥ÀÄ
3. PÀ£Àßqï ¥ÀzÀUÉÆ¼ï f. ¦. gÁdgÀvÀßA

Unit II £ÀªÉÇÃzÀAiÀÄ ºÁUÀÄ £ÀªÀå PÀ«vÉUÀ¼ÀÄ

7 Hrs

1. CªÀzsÀÆvÀ ¸ÀÄ.gÀA.JPÀÄÌAr
2. ªÀÄ£É¬ÄAzÀ ªÀÄ£ÉUÉ PÉ.J¸ï.£À
3. £À£Àß ºÀtvÉ f.J¸ï.J¸ï.

Unit III ¸ÀtÚ PÀxÉUÀ¼ÀÄ

6 Hrs

1. zÁ½ £ÀqÉzÁªÀ CuÁ Ú CªÀÄgÉÃ±À £ÀÄUÀqÉÆÃtÂ
2. PÉÆ£ÉAiÀÄ VgÁQ ¤gÀAd£À
3. ªÀiÁ¤ÃlgÏ vÉÃd¹ é

Unit IV £ÁlPÀ 6 Hrs

1. «ÄÃrAiÀiÁ (¸ÀAUÀæºÀ) AiÀÄÄj¦rÃ¸ï C£ÀÄªÁzÀ: PÉ. ªÀÄgÀÄ¼À ¹zÀÞ¥À

¥ÀgÁªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ :

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014
3. qÁ. CgÀ«AzÀ ªÀiÁ®UÀwÛ, ¸Á»vÀå ¸ÀA¸Àløw ªÀÄvÀÄÛ zÀ°vÀ ¥ÀæeÉÕ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÀßqÀ ¸Á»vÀå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2014
4. qÁ. F.J¸ï. DªÀÄÆgÀ, PÀ£ÀßqÀ PÀxÀ£À ¸Á»vÀå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
5. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, zsÁgÀªÁqÀ. 2009
6. ¸ÀA. ©.J¸ï. PÉÃ±ÀªÀgÁªï. PÉÊ¯Á¸ÀA PÀ£ÀßqÀ £ÁlPÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ CAQvÀ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2005
7. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
8. DzsÀÄ¤PÀ PÀ£ÀßqÀ PÁªÀå ¨sÁUÀ-2, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2004
9. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHH301	**Language-III: Hindi - III**	**FC**	**1**	**1**	**0**	**2**	**3**

Course description: अध्ययनवर्णन :

यहपाठ्यक्रमनौसिखिया,

अपनीभाषाकीक्षमताकाविकासकरनेहेतुतथाविभिन्नसाहित्यिकप्रक्रियाओंद्वारासमाज, संस्कृतिएवंजीवनकेमूल्योंकोसमझनेहेतुअभिकल्पितहै |

Prerequisites/Pre reading for the course:पूर्वापेक्षा:

- अध्येताको, हिन्दीनाटकसाहित्यकासंक्षिप्तज्ञानआवश्यकहै |
- हिन्दीसाहित्यकेइतिहासकासंक्षिप्तज्ञानकीआवश्यकताहै |
- हिन्दीव्याकरणकाअवबोधनआवश्यकहै |
- मीडियालेखनकीबुनियादीजानकारीचाहिए |
- अंग्रेज़ी – हिन्दीअनुवादसेसंबंधितजानकारीजरुरीहै|

c) Pedagogy:सिक्षशास्त्र :

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives: पाठ्यक्रमउद्देश्य:

- संदर्भानुसारउचितभाषाकाप्रयोगकरनेकीदक्षताकोछात्रोंमेंउत्पन्नकरना|
- साहित्यकेमाध्यमसेसमाजएवंमानवीयमूल्योंकोसमझाकर, उनमूल्योंकीरक्षाहेतुप्रेरितकरना|
- छात्रोंमेंपुस्तकपठनएवंलेखनकीअकृतिमप्रवृत्तिस्थापितकरना|
- अध्येताओंमेंसाहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरना|

Course Outcomes :अधिगमपरिणाम:

अध्ययनकीसमाप्तिपरअध्येता –

- सामाजिकमूल्यएवंनैतिकजवाबदेहीकोस्वीकारकरसकताहै|
- साहित्यकीप्रासंगिकताकोजीवनमेंसमझनेकीदक्षतारखताहै|
- समाजमेंअंतर्निहितपद्दतियाँएवंविचारधाराओंकाव्याख्यानकरनेमेंसक्षमबनसकताहै|
- साहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरसकताहै|

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
B21AHH301	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course content

इकाई–1:नाटक**:** एकऔरद्रोणाचार्य– डॉ**.**शंकरशेष **7 hrs**

लेखकपरिचय

प्रथमदृश्य

द्वितीयदृश्य

इकाई–2 :नाटक**:** एकऔरद्रोणाचार्य **7 hrs**

तृतीयदृश्य

चतुर्थदृश्य

इकाई–3:नाटक**:**एकऔरद्रोणाचार्य **6 hrs**

पंचमदृश्य

छठादृश्य

इकाई–4: 6 hrs

अनुवाद : अंग्रेजी - हिन्दी-समाचारपत्रसंबंध

सूचना : प्रत्येकइकाई 25 अंककेलिएनिर्धारितहै |

Suggested Text Books and References

Text book/s:पाठ्यपुस्तक :

1. एकऔरद्रोणाचार्य – डॉ. शंकरशेष

References:सन्दर्भग्रन्थ:

1. मीडियालेखनएवंजनसंचार – डॉ.संजीवकुमार
2. .हिन्दीसाहित्यकाइतिहास - डॉ. नागेन्द्र

3. आधुनिकहिन्दीसाहित्यकाइतिहास - डॉ. बच्चनसिंह
4. हिन्दीसाहित्यकानवीनइतिहास - डॉ. लालसाहबसिंह
5. शुद्धहिन्दीकैसेबोलेकैसेलिखे- पृथ्वीनाथपाण्डे
6. कार्यालयअनुवादनिदेशिका
7. मीडियाविमर्श – रामशरणजोशी
8. संस्कृति– जनसंचारऔरबाजार ,नन्दभरद्वाज

Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B21AHA301	**Language III: Additional English - III**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This 2-credit course allows the learners to explore the various socio-political aspects represented in literature. The concepts discussed in the course provide learning exposure to real life scenarios. The course is designed to develop critical thinking ability among learners, through the socio-political aspects discussed in literature. Thus, the aim is to produce responsible and sensitive individuals.

Prerequisites: The student must possess fair knowledge of language, literature and society.

Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

Course Objectives:

- To outline the global and local concerns of gender and identity.
- To identify the complexities of human emotions through literature.
- To assess the struggles of human survival throughout history.
- To compare and contrast between the various dimensions of childhood.

Course Outcome:
On completion of the course, learners will be able to:

- Evaluate the pressing gender issues within our society.
- Criticize human actions through a humane and tolerant approach.
- Perceive the human conflicts with an empathetic perspective.
- Disprove the assumption of a privileged childhood.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	CO1							2	3		3			

B21AHA301	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Contents:

Unit-I: Gender & Identity **7 hrs**

Anne Sexton – Consorting with Angels
Eugene Field – The Doll's Wooing
Vijay Dan Detha – Double Life
Charlotte Perkins Gilman – The Yellow Wallpaper

Unit-II: Love & Romance **6 hrs**

Alfred Noyes – The Highway Man
William Shakespeare – Sonnet 116
Frank Richard Stockton – The Lady or the Tiger?
Oscar Wilde – The Nightingale and the Rose

Unit-III: War & Trauma **7 hrs**

Lord Alfred Tennyson – The Charge of the Light Brigade
Taufiq Rafat – The Medal
Guy de Maupassant – Two Friends
Sadaat Hasan Manto – Toba Tek Singh

Unit-IV: Children's Literature **6 hrs**

William Blake – The Chimney Sweeper
D.H. Lawrence – Discord in Childhood
Anna Sewell – The Black Beauty (Extract)
Rudyard Kipling – The Jungle Book (Extract)

Reference Books:

- Sexton, Anne. *The Complete Poems*. Houghton Mifflin, 1999.
- Namjoshi, Suniti. *Feminist Fables*. Spinifex Press, 1998.
- Vanita, Ruth & Saleem Kidwai (ed.) *Same Sex Love in India*. Penguin India, 2008.
- Gilman, Charlotte Perkins. *The Yellow Wallpaper*. Rockland Press, 2017.
- Gale, Cengage Learning. *A Study Guide for Alfred Noyes's "The Highwayman"*. Gale, Study Guides, 2017. (Kindle Edition Available)
- Shakespeare, William. *Poems and Sonnets of William Shakespeare*. Cosimo Classics, 2007.
- Stockton, Frank Richard. *The Lady, or the Tiger?* Createspace Independent Publications, 2017.

- Wilde, Oscar. *The Collected Works of Oscar Wilde*. Wordsworth Editions Ltd., 1997.
- Tennyson, Lord Alfred. *The Complete Works of Alfred Tennyson*. Forgotten Books, 2017.
- Blake, William Erdman, David V. (ed.). *The Complete Poetry and Prose* (Newly revised ed.). Anchor Books, (1988).
- Maupassant, Guy de. *Guy de Maupassant-The Complete Short Stories*. Projapati, 2015.
- Manto, Sadaat Hasan. *Manto: Selected Short Stories*. RHI, 2012.
- Ricks, Christopher. *Metaphysical Poetry*. Penguin, 2006.
- Sewell, Anna. *The Black Beauty*. Maple Press, 2014.
- Kipling, Rudyard. *The Jungle Book*. Amazing Reads, 2018.

Course Code	Eukaryotic Microbiology	Course Type	L	T	P	C	CH
B21MI0301		**HC**	**2**	**1**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

Students should have the knowledge of prokaryotes and eukaryotes

Course Objectives:

1. Provides the information on the basis of eukaryotic microorganisms
2. Strengthen the knowledge of biology of fungal kingdom
3. Familiarise the morphological and biological characteristics of algal kingdom
4. Understand the parasites and their disease related to protozoans.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0301	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1	2	2	1		1	2	1	1	1
	CO3	1	2	2	1	2	3	1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	1

Course Outcomes:

After the end of the course students will be able to

1. Learn eukaryotic microorganisms and their characteristics
2. Gain the knowledge about the fungal kingdoms and their applications
3. Strengthen their knowledge of algae and its nutritional importance's
4. Understand the host-parasite interactions and its virulence factors

Course Contents:

Unit I Eukaryotic microbes **12 hrs**

Eukaryotic microorganisms – Major differences between prokaryotes & eukaryotes, Classification and major differences among eukaryotic microbes (Fungi, Algae, Protozoa) general characteristics and significance of eukaryotic microbes

Unit II Mycology **12 hrs**

Fungal characteristics, growth, reproduction, life cycle, classification & importance. Study of thallus structure, reproduction and life cycle of the following fungi - *Pythium, Rhizopus, Saccharomyces, Aspergillus, Penicillium, Fusarium and Agaricus*. Major applications of fungi in various fields

Unit III Phycology **12 hrs**

Algae characteristics, structures, growth, reproduction, life cycle, classification & importance. Study of thallus structure, reproduction and life cycle of the following: Cyanobacteria, Chlorella, Scenedesmus, Spirogyra, Diatoms and Gracilaria. Major applications of algae in the various fields

Unit-IV Parasitology **12 hrs**

Evolution and the parasite-host relationship and its significant & parasites of humans Introduction, structure and reproduction of –. Important diseases caused by protozoans – malaria & trichomoniasis.

References

1. Microbiological Techniques (2005) Aneja.
2. Introductory Mycology by Alexopoulos CJ, Mims CW and Blackwell M. (2012) 3rd Ed., John Wiley and Sons.
3. Sumbali G. (2005). The Fungi. 2nd edition. Narosa Publishing India House
4. Webster J and Weber (2000). Introduction to Fungi. 3rd edition. Cambridge University Press.
5. Lee RE. (1999). Phycology. 4th edition. Cambridge Press
6. Barasanti L and Guaaltieri P. (2006). Algae: Anatomy Biochemistry and Biotechnology. Taylor and Francis Group, New York
7. Kumar HD. Introductory Phycology (2007) 2nd Ed., Affiliated East Western Press.

Course Code	Chemistry–III	Course Type	L	T	P	C	CH
B21CH0301		HC	3	0	0	3	4

Prerequisites:

Knowledge of chemical bonding, periodic table, stereochemistry, thermodynamics.

Course Objectives:

1. Learn the structure and bonding in following compounds of Boron, Carbon, Nitrogen, Sulphur and halogens.

2. Understand the classification of the following topics Alkyl halides, aryl halides, alcohols, phenols, carbonyl comounds
3. Explore the fundamental knowledge about electrolytes, common ion effect, ionization constant and salt hydrolysis.
4. Develop the knowledge about various laws of thermodynamics, heat capacity, bond energy, carnot cycle etc

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1: Illustrate the nature of bonding in metal carbonyls, boron, halogens and its properties, identify different functional groups.

CO2: Understand the nomenclature, different reactions and its mechanism of various named reactions.

CO3: Classify the electrolytes based on Debye Huckle theory and discussing about asymmetric effect and electrophoretic effect, etc.

CO4: Conclude the limitations and postulates of various thermodynamic laws, working of carnot cycle.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0301	CO1	1	2	1	1	1	1	1			1	2	2	
	CO2	2	2	1	1	1	1	1			1	2	2	
	CO3	1	2	1	2	2	2	2			1	1	1	
	CO4	2	1	1	2	1	2	2			1	1	2	

Course Contents:

Unit-I: **12 Hrs**

Chemistry of Non-Metals:

Boron: Compounds of boron – diborane, BF_3, Borazole, and boric acid, preparation, structure and uses.

Carbon: Fullerenes – production, structure of C_{60} and $C_{70.}$ CNT, Fullerenes, molecular sieves.

Silicon: Structure of silica. Silicates – types and structure with one example for each type.

Nitrogen: Preparation, properties, structure and applications of hydrazine, hydroxyl amine.

Sulphur: Preparation, properties, structures and applications of thionyl chloride, sulphuryl chloride.

Halogens: Bleaching powder – preparation, properties and structure.

Pseudo halogens: Preparation, properties and structure of cyanogen and thiocyanogen.

Interhalogens: Preparation, properties and structure of ClF_3 and IF_7.

Lanthanides and Actinides: Electronic configuration, atomic and ionic sizes, lanthanide contraction and its consequences. Oxidation states, spectral and magnetic properties, comparison

of oxidation states, complex formation and magnetic properties of d and f block elements. Ion exchange method for separation of Lanthanides.

Unit-II: **12 Hrs**

Alcohols: Definition and classification, oxidation reaction (CrO_3, Jones reagent, PCC) reduction reaction, glycols, glycerols, and thiols.

Phenols: Definition, classification with examples, acidity of phenols, effect of substituents on acidity of phenols. Mechanism of Reimer-Tiemann reaction and Kolbe reaction. Industrial applications of phenols (as drug).

Carboxylic acids: Definition, Classification with examples. Homologation of carboxylic acid - Arndt-Eistert reaction.

Carbonyl Compounds: Distinguish between aldehydes and ketones – oxidation ($K_2Cr_2O_7$) and reduction (H_2Pt, $LiAlH_4$) method. Mechanism of aldol condensation (Ex: acetaldehyde), Perkins reaction, Cannizzaro reaction, Michael-addition reaction, Wittig reaction, Claisen condensation, Knoevenagel reaction.

Tautomerism and Enolates: Keto-Enol tautomerism. Acidity of alpha-hydrogen atoms in aldehydes, ketones and active methylene compounds (example diethyl malonate and ethyl acetoacetate). Preparation of (from acetic acid) and synthetic applications of diethyl malonate. Preparation of - butanoic acid, Adipic acid, cinnamic acid and butanone. Preparation and applications of ethyl acetoacetate.

Ethers: Williamson ether synthesis, reactions – cleavage and auto-oxidation, estimation of number of methoxy groups by Ziesel's method. Cyclic and crown ethers.

Unit-III: **12 Hrs**

Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).

Salt hydrolysis - calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson-Hasselbalch equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts –applications of solubility product principle. Qualitative treatment of acid –base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Unit-IV: **12 Hrs**

Basic Thermodynamics: Definition of thermodynamic terms: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work. Zeroth Law of thermodynamics, First law of thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule – Thomson coefficient for ideal

gas and real gas: and inversion temperature. Temperature dependence of enthalpy, Kirchhoff's equation. Bond energies and applications of bond energies.

Second Law of Thermodynamics: Limitations of First Law of Thermodynamics – need for II Law of thermodynamics, spontaneous, non-spontaneous and equilibrium processes , different ways of stating II Law, heat engine (example) Carnot cycle, efficiency of Carnot cycle(derivation), concept of entropy – definition and physical significances of entropy – criteria of spontaneity in terms of entropy change, statements of II law in terms of entropy (numerical problems to be worked out on entropy and efficiency of Carnot engine).

Suggested Text Books:

1. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, S. Chand, 2010.
2. A. Bahl and B.S. Bahl, Advanced Physical Chemistry, S. Chand, 2010.
3. J.N. Gurtu and Aayushi Gurtu, Undergraduate Physical Chemistry, Vol I, Vol II and Vol III Pragati Prakashan.
4. Puri, Sharma and Kalia, Principles of Inorganic Chemistry, Milestone Publications & Distributors, 33rdEdition, 2018.
5. S.P. Banerjee, Advanced Inorganic Chemistry, Books and Allied (p) Ltd, 2ndEdition, 2017.
6. N.N. Greenwood and A. Earnshaw, Chemistry of the Elements, Pergamon Press, 2ndEdition, 1989.
7. P.A. Sykes, Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).

Course Code	Molecular Genetics	Course Type	L	T	P	C	CH
B21GN0301		HC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of DNA structure and chromosomes.
2. They should know the concept of central dogma of molecular biology.

Course Objectives:

The objective of this Course is:

1. To study the discovery and structure of the genetic material.
2. To understand the processes of gene expression and gene regulation.
3. To facilitate students to understand the concept of microbial genetics.
4. To investigate the causes of genetic diseases.

Course Outcomes:

After the end of the Course students will be able to

1. Understand the characteristics of nucleic acids.
2. Illustrate the processes of gene expression and various stages of gene regulation.
3. Understand the inheritance pattern in bacteria.

4. Associate the mutations linked with several disorders.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0301	CO1	3	3				3		3		3	3	2	
	CO2	3	3	3	3	3	3		3		3	3	3	
	CO3	3	3	3		3	3		0		3	3	2	
	CO4	3	3	3	3		3		3		3	3	2	

Course Contents:

UNIT I **12 hrs**

a.Chemical Basis of Heredity:

DNA as genetic material- Experiments of Griffith; Avery, Mc Leod and Mc Carty; Hershey and Chase. RNA as genetic material- Experiment of Fraenkel and Singer.

Nucleic acids:

Molecular structure of DNA, Chargaff's rule, Forms of DNA- A, B and Z forms.

RNA types and structure – mRna, tRna (clover leaf model), rRNA, and other types and their significance Ribozymes **DNA Replication:** Meselson and Stahl Experiment.

DNA Replication in prokaryotes – Initiation, Continuous and discontinuous synthesis, Events at the replication fork, Termination, Enzymology of DNA replication. Rolling circle replication. DNA Replication in eukaryotes.

UNIT II **12 hrs**

Gene expression:

Transcription: Prokaryotes and eukaryotesinitiation, elongation and termination (rho-dependent and rho- independent).

Post transcriptional modifications: methylation, polyadenylation, RNA splicing.

Translation: Prokaryotes and eukaryotes, Genetic code and its properties; process of translation- Initiation, elongation and termination. Post-translational modifications of proteins.

Protein sorting

UNIT III **12 hrs**

Gene regulation:

Concept of operon, Inducible operon – Lac operon – structure and mechanism, Catabolite repression. Repressible operon – Tryptophan operon – structure and mechanism.

Epigenetic Regulation of GeneExpression: Overview of epigenetic regulation; Chromatin remodelling and gene expression; Histone modifications and gene expression; Small RNA based epigenetic regulation; Propagation of epigenetic regulation (genome imprinting).

UNIT IV **12 hrs**

Mutations:

Introduction and Types of Gene mutations – Base substitution (Transition and transversion), Frame shift mutation, insertion, deletion, missense, nonsense, reverse, suppressor and lethal mutations). Pleiotropy- definition and examples.
Mutagens – Physical (ionizing and non- ionizing radiations) and chemical (Base analogs, Alkylating agents, Acridine dyes, Deaminating agents, Hydroxylating agents, Tobacco carcinogens); Oncogenic Viruses.
DNA repair mechanisms (Mismatch repair, photoreactivation, excision and SOS repair).
Mutation as raw material for evolution. Beneficial effects of mutation.

References Books:

1. Advanced Genetics by G.S. Miglani. 2002.
2. Advanced Molecular Biology by Twyman R.M (1998) Viva Books Ltd.
3. Cell Biology and Molecular Biology by EDP Robertis and EMF Robertis, Saunder College. 1980.
4. Genes- IX, 9th Ed., Benjamin Lewin. Jones and Bartlett Publishers, 2008.
5. Genetics – Analysis of Genes and genomes – VII edition – Daniel L. Hartl and Elizabeth W. Jones. 2011.
6. Genetics – from genes to genomics – Leland Hartwell, Leroy Hood, Charles (Chip) Aquadro, Michael L. Goldberg, Maria Papaconstantinou, Fischer, Janice, Jim Karagiannis. McGraw-Hill Education, 2017.
7. Genomes by T.A. Brown (2002) Viva Books.
8. Instant Notes in Molecular Biology by P.C. Turneretal (2002) Viva Books.
9. Molecular cell Biology, 2nd edition by Darnell.J, H. Lodish and D. Baltimore (1990), Scientific American Books, New York.
10. Molecular Genetics by D.N. Bharadwaj. Kalyani, 2008

Course Code	Hetero Cyclic Chemistry & Chemistry of Natural Products	Course Type	L	T	P	C	CH
B21CHS311		SC	3	0	0	3	4

Prerequisites:

Knowledge of hydrocarbons, heteroatoms like S, N, and O, biomolecules like carbohydrates, proteins, vitamins.

Course Objectives:

1. Explain the fundamental concept of structure, bonding and properties in heterocyclic compound.
2. Discuss the structural elucidation of certain organic compounds.
3. Illustrate the chemical route synthesis of some biomolecules (carbohydrates) and natural product.
4. Explain the basic concept of amino acids, types of amino acids and peptides.

Course Outcomes:

1. Analyze the different types, reactivity and aromatic character of heterocyclic compounds
2. Predict the structure and chemical route synthesis of some organic compounds.
3. Classify the different types of aminoacids and their synthesis.
4. Discuss the topics include chemical strategy used to elucidate natural product pathways.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS311	CO1	1	1	1	2						1	1	1	
	CO2	1	1	2	3						1	1	1	
	CO3	1	1	1	2						2	1	3	
	CO4	1	1	2	2						2	1	2	

Course Contents:

UNIT-I **12 hrs**

Heterocyclic Compounds: Introduction, Nomenclature and classifications, five membered ring compounds with single hetero atom (Ex: pyrrole, furan and thiophene), aromatic character and preparation from 1, 4-di carbonyl compounds, Paul Knorr synthesis. Properties: Acidic character of pyrrole –electrophilic substitution at 2, 5 positions, (nitration, sulphonation and halogenation). Diels-Alder reactions of furan. Pyridine: Structure, basicity, aromaticity-comparison with pyrrole, preparation and properties, reactivity towards nucleophilic substitution reaction.

UNIT-II **12 hrs**

Terpenoids: Occurrence, classification and isoprene rule. Structural elucidation and synthesis of citral. Structures of limonene, menthol, α-terpineol, camphor, β carotene and their uses.

Alkaloids: Introduction, classification and general characteristics. Structural elucidation and synthesis of nicotine. Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine.

Steroids: Introduction, classification, synthesis of cholesterol.

UNIT-III **12 hrs**

Carbohydrates: Introduction, Definition, classification based on composition with examples-reducing and non-reducing sugars.

Monosaccharides

Structural elucidation of glucose in detail – evidence for cyclic structure of glucose (aldehyde test and mutarotation) determination of ring size (methylation, hydrolysis and oxidation reactions) pyranose structures (Haworth and chair conformational formulae) Fischer and Haworth structures of fructose and galactose.

Conversion reactions – 1. Kiliani's synthesis 2. Wohl's degradation.

Disaccharides: Glycosidic bond, structural formulae of maltose and lactose (Haworth structure).

Nucleic Acids

Purine and pyrimidine bases. Structure of nucleosides and nucleotides. Methods of formation of internucleotide bonds (DCC, phosphotriester approach). Biological importance of DNA and RNAs. Protein-nucleic acid interaction chromatin and viral nuclear capsid.

UNIT-IV **12 hrs**

Amino acids and proteins:

Introduction, classification- Natural and un-natural amino acids, examples.

Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

Reference Books:

1. R.K. Bansal, Heterocyclic Chemistry, Tata Mcgraw Hill Publications.
2. M.K. Jain, A Text book of Organic Chemistry, S. Chand & Company.
3. Bhal and Bhal, A Text book of Organic Chemistry, S. Chand & Company.
4. P.L. Soni, A Text book of Organic Chemistry, S. Chand & Company.
5. R.K. Bansal, Laboratory Manual of Organic Chemistry, New Age Publications.
6. Jayaraman, Laboratory Manual of Organic Chemistry, S. Chand & Company.
7. A. Goel, Chemistry of Natural products, Publishing House, Meerut.
8. K.K. Sharma, Organic Chemistry, Shobhanlal & Nagan Company.
9. Ashuthosh Kar, Medicinal Chemistry, Tata Mcgraw Hill Publications.

Course Code	Polymer Chemistry	Course Type	L	T	P	C	CH
B21CHS312		SC	3	0	0	3	4

Prerequisites:

Knowledge of momomers, polymers, rubbers, cellulose, inorganic polymers, polymer processing.

Course Objectives:

1. To realize the importance of monomer concept in polymers.
2. Enhance the knowledge foundation concepts of synthesis of various polymeric compounds.
3. Expertize basic concepts in Biopolymers and their fundamental importance.
4. Understand reaction kinetics, theory and relevant applications of the polymers.

Course Outcomes:

1. Assimilate the appreciate the foundation knowledge of polymer concepts, importance of polymers and molecular weight of the polymeric compounds.
2. Design and apply the knowledge of synthesis, applications of polymeric compounds.
3. Realization of polymerization foundation in various processes.
4. Increase knowledge on biopolymer, synthesis and application.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS312	CO1	2	1	1								1	1	
	CO2	2	1	1	1	1						1	1	
	CO3	2	1	1	1	1						1	1	
	CO4	2	1	1	1	1					1	1	1	

Course Contents:

UNIT-I **12hrs**

Introduction to polymer Science

History of macromolecular science. Concept of macromolecules. Degree of polymerization, Concept of molecular mass, polydispersity, number average and weight average, viscosity average molecular weight, molecular weight distribution in linear polymers (step growth and chain polymers), Nomenclature of polymers. Basic concepts in polymer science. Different ways in classification of polymers depending on – The origin (natural, Semisynthetic, synthetic etc.), The structure (linear, branched, network, hyperbranched, dendrimer.), The type of atom in the main chain (homochain, hetercohain).

The formation (condensation, addition). Homopolymers, copolymers. The behaviour on application of heat and pressure (thermoplastic andThermosetting). The form and application (plastics, fiber. elastomers and resin). Stereochemistry of polymers, Introduction to two types of polymerization Reactions viz. condensation and addition polymerization (without detailed mechanism and derivations), Monomer structure and polymerizability.

Concept of functionality. Writing the structure of the polymer formed for a given monomer and its classification. Raw materials for monomers with specific example viz. acrylonitrile, vinyl, chloride, methyl methacrylate, isoprene, styrene, hexamethylene diamine and adipic acid, caprolactum, ethylene glycol and their Polymerization reactions.

UNIT-II

12hrs

Inorganic polymers: Definition – examples, general properties, comparison with organic polymers,

Silicones: Definition, nomenclature, preparation (linear, cross- linked and cyclic). Factors affecting the nature of silicon polymers, properties (chemical and thermal stabilities, chemical

properties) uses of silicon polymers, silicon fluids/oils – uses, silicon elastomers – rubbers, silicon resins (preparation and uses). Synthesis, structural aspects and applications of siloxanes. Borazines, phosphazenes, and polysulphates.

UNIT-III **12 hrs**

Kinetics and Mechanism of Chain Polymerization Processes:

Chain reaction (Addition) polymerization, Free radical addition polymerization mechanism of vinyl polymerization, generation of free radicals, initiation, propagation, termination, chain transfer inhibition of retardation, configuration of monomer units in vinyl polymer chains.
Kinetics of free radical addition polymerization – experimental determination of rate constants, derivations for rate expressions and expressions for kinetic chain length and hence degree of polymerization. Thermodynamics of free radical polymerization, effect of temp and pressure, enthalpies, entropies, free energies, activation energies polymerization. Ionic and coordination chain (addition) polymerization common features of two types of ionic polymerization, Mechanism of cationic polymerization, expressions for overall rate of polymerization and the number average degree of polymerization. Mechanism of anionic, polymerization, expressions for overall rate of polymerization and the average degree of polymerization.

UNIT-IV **12 hrs**

Biopolymer Interactions
Synthesis of Biopolymers, Forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interaction. Multiple equilibria and various types of binding processes in biological system. Hydrogen ion titration curve. Thermodynamics of biopolymers. Vant's Hoff's law of osmotic pressure, Theory of osmotic pressure and semipermiability. Behaviour of cells and molecular weight determination from osmotic pressure measurements. Significance of osmosis in biology. Problem solving.
TRANSPORT OF IONS: Ion transport through cell membrane, irreversible thermodynamic treatment of membranetransport.
BIOSENSORS: Definition, types, sensors for environmental, medical, food safety and biosecurity applications.

Reference Books:

1. F.W. Billmeyer, Jr. Textbook of polymer science, Wiley- Interscience, N.Y. 1971.
2. R. Seymour, Introduction to polymer chemistry, Wiley –Interscience, 1981.
3. D.D. Deshpande, Physical chemistry of Macromolecules, Vishal publications,1985.
4. P.J. Flory, Principles of polymer chemistry, Singer, 2015.
5. V.R. Gowarikar, Polymer Science, Publisher: John Wiley and Sons Ltd, 2012.
6. G. Odian, Principles of polymerization, Wiley – Interscience, 1981.
7. G. Odian, Principles of polymerization, Wiley – Interscience, 1981.
8. K.J. Saunders, Organic polymer chemistry, Chapman and Hall, London,1973.
9. R.B. Seymour, G. S. Kirshenbaum, High performance polymers, their origin and development, Elservie, 2012.
10. P.W. Morgen, Condensation polymers by interfacial and solution methods, Interscience publishers, 2010.

11. T.L. Richardson, Industrial plastics: Theory applications, Chapman and Hall, London,2000.
12. R.W. Lenz, Organic chemistry of synthetic high polymers, Interscience publisher, 2004.

Course Code	Eukaryotic Microbiology Lab	Course Type	L	T	P	C	C
B21MI0302		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Students should have the knowledge of algae, fungi and protozoans

Course Objective:

1. Practical exposure to culture the fungi and with various growth media
2. Explore various isolation techniques for fungi and algae
3. Culturing aspects of industrially important fungi and algae
4. Various staining techniques for parasites.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0302	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	2	2	1	1	1	2	1	1	1
	CO3	1	2	2	1	2		1	2	2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	2

Course Outcomes:

By the end of the course the student will be able to:

1. Handle the preparation of growth media and various culturing techniques for fungi and algae
2. Explore the techniques for isolation and identification of specific fungi and algae
3. Explore Biological applications of fungi and algae
4. Identify the virulent parasites and their diseases caused

Course Contents

1. Preparation of medium for fungi-MRBA, PDA & SDA
2. Isolation and identification of Saprophytic fungi
3. Isolation and identification of Endophytic fungi
4. Isolation and identification of plant pathogenic fungi
5. Medium for algae-Basal medium, BG11 & Bristol medium

6. Isolation of Algae & its identification
7. Culturing of microalgae spirulina and SCP estimation
8. Staining of plasmodium and others

References

1. Aneja (2007) Microbiological Techniques
2. Barasanti L and Guaaltieri P (2006). Algae: Anatomy Biochemistry and Biotechnology. Taylor and Francis Group, New York.

Course Code	Chemistry Practical-III	Course Type	L	T	P	C	CH
B21CH0302		HC	0	0	1.5	1.5	3

Prerequisites:

Knowledge of anions and cations, qualitative and quantitative analysis.

Course Objectives:

1. This course is intended to provide basic skills in qualitative analysis at the semi-micro scale.
2. It also emphasizes the importance of organized and systematic approach in carrying out experiments.
3. It also helps in developing analytical reasoning, critical thinking, questioning etc.

Course Outcomes:

1. Identify the indivisual anions and cat ions in a compound.
2. Apply the knowledge in determining the strength of analyte.
3. Interprete the involvement of intermediate ions while estimating particular group.
4. Solve the reactions involved related to intermediates and product formation during analysis

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0302	CO1	1	2	1	1	1	1	1			1	2	1	1
	CO2	2	2	1	1	1	2	1			2	2	2	2
	CO3	1	2	1	2	2	2	1			1	1	1	1
	CO4	2	1	2	2	1	2	2			2	1	2	2

Course Contents:

Part 1: Systematic semi-micro qualitative analysis of inorganic salt mixture containing two cations and two anions (Minimum 10 mixtures to be analysed).
Anions: HCO_3^-, CO_3^{2-}, SO_3^-, Cl^-, Br^-, NO_3^-, BO_3^{3-}, SO_4^{2-} and PO_4^{3-}
Cations: Pb^{2+}, Bi^{3+}, Cd^{2+}, Al^{3+}, Fe^{3+}, Fe^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, K^+, Na^+ and NH_4^+.
Note:

1. Mixture requiring elimination of phosphate and borate should not be given
2. Combination like Cl^- and Br^-, NO^{3-} and Br^- shall be avoided.
3. Salts that yield double decomposition shall be avoided (like $CaSO_4$, $BaSO_4$, $FeSO_4$).
4. The combination of two cations in the mixture should to different groups. However, combination like Mg^{2+} and NH_4^+ and Na^+ and NH_4^+ can be given.

Part-2: Inorganic preparation

a. Preparation of Chloropentaminecobalt (III) chloride
b. Preparation of Cuprammoniumsulphate
c. Preparation of Ferric alum
d. Preparation of ferrous oxalate
e. Preparation of Prussian blue (ferri ferrocyanide)

Reference Books: Practicals

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
2. Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla. Pearson Education, 2002.

Course Code	Molecular Genetics Lab	Course Type	L	T	P	C	CH
B21GN0302		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of centrifugation.
2. They should know the concept of quantification methods.

Course Objective:

The objective of this Course is:

1. To facilitate students to extract DNA and analyze them.
2. To characterize DNA and proteins using electrophoresis.
3. To understand the mechanism of mutations.

Course Outcomes:

After the end of the Course students will be able to

1. Extract and estimate the DNA from different sources.
2. Estimate the DNA and RNA using standard protocols.
3. Characterize DNA and proteins using agarose gel electrophoresis and SDS PAGE.
4. Analyse the genetic disorders.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0302	CO1	3	3	3	3			3	3		3	3	2	3
	CO2	3	3	3				3			3	3	2	3
	CO3	3	2	3	3			3			3	3	3	3
	CO4	3	3	3	3		3	3	3		3	3	3	3

Course Contents

1. Genomic DNA isolation in plants – Cauliflower, Coconut endosperm
2. DNA isolation in bacteria
3. DNA isolation in animal – liver
4. Estimation of DNA by Diphenyl amine method
5. Estimation of RNA by Orcinol method
6. Agarose gel electrophoresis
7. SDS PAGE – Poly Acrylamide Gel Electrophoresis
8. Study of mutations:
   Sickle cell Anaemia- Mis – sense mutation.
   Thalassemia – frame shift mutation.
   Identification of point mutation types based on the given representation.

Reference Books:

1. Advanced Genetics by G.S. Miglani. 2002.
2. Advanced Molecular Biology by Twyman R.M (1998) Viva Books Ltd.
3. Cell Biology and Molecular Biology by EDP Robertis and EMF Robertis, Saunder College. 1980.
4. Genes- IX, 9th Ed., Benjamin Lewin. Jones and Bartlett Publishers, 2008.
5. Genetics – Analysis of Genes and genomes – VII edition – Daniel L. Hartl and Elizabeth W. Jones. 2011.
6. Genetics – from genes to genomics – Leland Hartwell, Leroy Hood, Charles (Chip) Aquadro, Michael L. Goldberg, Maria Papaconstantinou, Fischer, Janice, Jim Karagiannis. McGraw-Hill Education, 2017.
7. Genomes by T.A. Brown (2002) Viva Books.
8. Instant Notes in Molecular Biology by P.C. Turneretal (2002) Viva Books.
9. Molecular cell Biology, 2nd edition by Darnell.J, H. Lodish and D. Baltimore (1990), Scientific American Books, New York.

10. Molecular Genetics by D.N. Bharadwaj. Kalyani, 2008

FOURTH SEMESTER

Course code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHK401	**Language IV: Kannada - IV**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Overview:

¨sÁµÉAiÀÄ£ÀÄß ªÀiÁvÀ£ÁqÀÄªÀ §gÉAiÀÄÄªÀ PË±À®å, ¸Á»vÀåzÀ §UÉÎ ¸ÀÆÜ®ªÁV ¥ÀjZÀ¬Ä¸ÀÄªÀ ªÀÄÄÆ®PÀ «zÁåyðUÀ¼À ªÀåQÛvÀé «PÁ¸À ºÁUÀÄ ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ, ¥Àæ¸ÀÄÛvÀ ¸ÀAzÀ¨sÀðPÉÌ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸À®Ä ¥ÀoÀåªÀ£ÀÄß gÀÆ¦¸À¯ÁVzÉ. ¸Á»vÀå, PÀ¯É, ªÁtÂdå, DqÀ½vÁvÀäPÀ ªÀÄvÀÄ Û «eÁÕ£ÀzÀ «ZÁgÀUÀ½UÉ MvÀÛ£ÀÄß ¤ÃqÀ¯ÁVzÉ. EzÀÄ ªÉÆzÀ® JgÀqÀÄ ¸É«Ä¸ÀÖgï ªÀÄÄgÀÄ PÉærmïUÀ¼À£ÀÄß; ªÀÄÄgÀÄ ªÀÄvÀÄ Û £Á®Ì£ÉÃ ¸É«Ä¸ÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉÆA¢zÉ.

Pre0requisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉUÉ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀÆªÀð ²PÀëtzÀ°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÉÆzÀ®£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÄÌ ªÀiÁrPÉÆAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©ügÀÄaAiÀÄ£ÀÄß ªÀÄÆr¸À¯ÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉÆvÉUÉ ªÀåQÛvÀ é «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀ¯ÁUÀÄvÀÛzÉ.

- ¨ sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§Az sÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤n Ö£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
- CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨ sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÅzÀÄ UÀÄjAiÀiÁVzÉ
- ¸Ààz sÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°è lÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

d£À¥ÀzÀ, ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

- ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, z sÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ, ¥Àj¸ÀgÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£À ºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨ sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
- fÃªÀ£ÀzÀ°è §gÀÄªÀ C© ü¥ÁæAiÀÄ ¨ÉÃz sÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß Dz sÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
- GvÀÛªÀÄ ¸ÀAªÀºÀ£À PÀ¯ÉAiÀÄ£ÀÄß ¨É¼É¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß FqÉÃj¸ÀÄvÀÛzÉ.
- ¸ÀA±ÉÆÃzÀ£Á ªÀÄ£ÉÆÃ¨ sÁªÀ ªÀÄvÀÄÛ ¸Àaz sÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß ¸ÀdÄÓUÉÆ½¸ÀÄvÀÛzÉ.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHK401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Content:

Unit I £ÀªÀå0¹ÛçÃªÁ¢ PÀ«vÉUÀ¼ÀÄ
7 Hrs

1. §Ä¢ÞªÀAvÀjUÉ PÀ£À¸ÀÄ ©zÀÝgÉ J.PÉ.gÁªÀÄ£ÀÄd£ï

2. PÀÄjUÀ¼ÀÄ ¸Ágï PÀÄjUÀ¼ÀÄ PÉ.J¸ï.¤¸Ágï CºÀªÀÄzï

3. CPÀÌ ºÉÃ½zÀÄÝ ¸À. GµÁ

Unit II zÀ°vÀ0§AqÁAiÀÄ
7 Hrs

1. £À£Àß PÀªÀ£ÀUÀ¼À°è ºÀÄqÀÄPÀ¢gÀÄ £À£Àß ZÀA¥Á

2. zÀ°vÀgÀÄ §gÀÄªÀgÀÄ zÁj©r ¹zÀÞ°AUÀAiÀÄå

3. PÀlÖqÀzÀ PÉ®¸ÀUÁgÀgÀÄ JZï J¸ï ²ªÀ¥ÀæPÁ±À

Unit III ¯ÉÃR£ÀUÀ¼ÀÄ
6 Hrs

1. ºÀ¹gÀÄ ºÉÆ¸ÀPÀÄªÀ UÀtÂUÀ¼ÀÄ AiÀÄ® è¥Àà gÉrØ

2. eÁUÀwÃPÀgÀtzÀ »£Éß¯ÉAiÀÄ°è UÁA¢üÃfAiÀÄ ¥Àæ¸ÀÄÛvÀvÉ ¹. £ÁUÀtÚ

3. ZÁªÁðPÀgÀÄ: MAzÀÄ n¥ÀàtÂ ¦ J£ï gÀAUÀ£ï

Unit IV PÁzÀA§j 6
Hrs

1. ¸ÀA¸ÁÌgÀ (DAiÀÄÝ¨sÁUÀ) AiÀÄÄ.Dgï. C£ÀAvÀªÀÄÆwð

Reference Books:

1. ªÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2014
2. ¹ÃªÀiÁwÃvÀ PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ ¸ÀA¥ÀÄl 1,2,3,4,5 ªÀÄvÀÄÛ 6, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2014 3. qÁ. CgÀ«AzÀ ªÀiÁ®UÀwÛ, ¸Á»vÀå ¸ÀA¸ÀÌøw ªÀÄvÀÄÛ zÀ°vÀ ¥ÀæeÉÕ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÀßqÀ ¸Á»vÀå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2014
4. qÁ. F.J¸ï. DªÀÄÆgÀ, PÀ£ÀßqÀ PÀxÀ£À ¸Á»vÀå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
5. zÉÃ±À¥ÁAqÉ J¸ï.J¯ï., ¨ÉÃAzÉæ ±ÀjÃ¥ sÀgÀ PÁªÁåAiÀiÁ£À, ¥ÀæPÁ±ÀPÀgÀÄ zÉÃ¹ ¥ÀÄ¸ÀÛPÀ, ¨ÉAUÀ¼ÀÆgÀÄ. 2013
6. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, z sÁgÀªÁqÀ. 2009
7. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ 02014
8. ¸ÀA. qÁ! ¹. Dgï. ZÀAzÀæ±ÉÃRgï, ªÀÄÄAzÁ¼ÀÄvÀ£ÀzÀ ®PÀëtUÀ¼À£ÀÄß ¨É¼É¹PÉÆ¼ÀÄîªÀÅzÀÄ ºÉÃUÉ?, ¥ÀæPÁ±ÀPÀgÀÄ £ÀªÀPÀ£ÁðlPÀ ¥À© èPÉÃµÀ£ï ì ¥ÉæöÊªÉmï°«ÄmÉqï. 2010
9. Dz sÀÄ¤PÀ PÀ£ÀßqÀ PÁªÀå ¨ sÁUÀ02, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2004
10. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 201

Course Code	Course Title	Course Type	L	T	P	C	Hrs.
B21AHH401	**Language – IV: Hindi - IV**	**FC**	**1**	**1**	**0**	**2**	**3**

Course description: अध्ययनवर्णन :

यहपाठ्यक्रमनौसिखिया,

अपनीभाषाकीक्षमताकाविकासकरनेहेतुतथाविभिन्नसाहित्यिकप्रक्रियाओंद्वारासमाज, संस्कृतिएवंजीवनकेमूल्योंकोसमझनेहेतुअभिकल्पितहै |

Objectives: पाठ्यक्रमउद्देश्य:

- संदर्भानुसारउचितभाषाकाप्रयोगकरनेकीदक्षताकोछात्रोंमेंउत्पन्नकरना |
- साहित्यकेमाध्यमसेसमाजएवंमानवीयमूल्योंकोसमझाकर, उनमूल्योंकीरक्षाहेतुप्रेरितकरना |
- छात्रोंमेंपुस्तकपठनएवंलेखनकीअकृतिमप्रवृत्तिस्थापितकरना |
- अध्येताओंमेंसाहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरना |

Learning Outcomes :**अधिगमपरिणाम:**

अध्ययनकीसमाप्तिपरअध्येता –

- सामाजिकमूल्यएवंनैतिकजवाबदेहीकोस्वीकारकरसकताहै |
- साहित्यकीप्रासंगिकताकोजीवनमेंसमझनेकीदक्षतारखताहै |
- समाजमेंअंतर्निहितपद्दतियाँएवंविचारधाराओंकाव्याख्यानकरनेमेंसक्षमबनसकताहै |
- साहित्यकेमाध्यमसेप्रभावीएवंकुशलसंचारकाविकासकरसकताहै |

c) Pedagogy:सिक्षशास्त्र :

1. Direct method
2. ICT and Digital support
3. Collaborative and Cooperative learning
4. Flipped Classroom

Prerequisites/Pre reading for the course:पूर्वापेक्षा:

- अध्येताको,हिन्दीखंडकाव्यकासंक्षिप्तज्ञानआवश्यकहै |
- हिन्दीसाहित्यकेइतिहासकासंक्षिप्तज्ञानकीआवश्यकताहै |
- हिन्दीव्याकरणकाअवबोधनआवश्यकहै |

- **Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHH401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Content:अध्ययनविषयसूची / पाठ्यक्रम

इकाई–1:खंड0काव्य – नहुष – मैथिलीशरणगुप्त **7 hrs**

कविपरिचय

काव्यपरिचय

शचीसर्ग

नहुषसर्ग

इकाई–2:खंड0काव्य – नहुष – मैथिलीशरणगुप्त **7 hrs**

उर्वशीसर्ग

स्वर्गभोगसर्ग

इकाई–3:खंड0काव्य – नहुष – मैथिलीशरणगुप्त **6 hrs**

सन्देशसर्ग

मंत्रणासर्ग

पतनसर्ग

इकाई–4: **6 hrs**

सिनिमारिव्यू :

सूपर 30, मिशनमंगल, थप्पड़,आर्टिकल 15

सूचना : प्रत्येकइकाई 25 अंककेलिएनिर्धारितहै |

d) Suggested Text Books and References

Text book/s: पाठ्यपुस्तक:

1. खंड0काव्य – नहुष – मैथिलीशरणगुप्त

References: सन्दर्भग्रन्थ:

1. रस – छंद – अलंकर0 कृष्णदेवशर्मा&सुरेशअग्रवाल
2. हिन्दीसाहित्यकाइतिहास 0 डॉ. नागेन्द्र
3. आधुनिकहिन्दीसाहित्यकाइतिहास 0 डॉ. बच्चनसिंह
4. हिन्दीसाहित्यकानवीनइतिहास 0 डॉ. लालसाहबसिंह
5. शुद्धहिन्दीकैसेबोलेकैसेलिखे0 पृथ्वीनाथपाण्डे
6. मीडियाविमर्श – रामशरणजोशी

Course Code	Course Tittle	Course Type	L	T	P	C	Hrs./Wk.
B21AHA401	**Language IV: Additional English -IV**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This 20credit course helps the learner explore various socio0cultural issues through literature. The course provides insight on matters like education and culture that are pertinent in the contemporary society. The course also offers multi0dimensional perspective in the genres of literature and contributes for language enrichment.

Prerequisites: The student must possess fair knowledge of language, literature, culture and society.

Pedagogy: Collaborative Method, Flipped Classroom, Blended Learning

Course Objectives:

- To infer the myths from the contemporary perspective.
- To outline the idea of family represented in literature.
- To interpret horror and suspense as a genre of literature.
- To assess the impact of education in building a society.

Course Outcome:

On completion of the course, learners will be able to:

- Examine the relevance of myths and mythology.
- Demonstrate family values and ethics essential to live in the society.
- Analyze horror and suspense as a significant genre of literature.
- Evaluate the applicability of academic contribution in building a society.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHA401	CO1							2	3		3			
	CO2							2	3		3			
	CO3							2	3		3			
	CO4							2	3		3			

Course Contents:

Unit I: Myths & Mythology **6 hrs**

John W. May – Narcissus
W.B. Yeats – The Second Coming
Devdutt Pattanaik 0 *Shikhandi and the Other Stories They Don't Tell you* (Extracts)

Unit II: Family & Relationships **6 hrs**

Nissim Ezekiel – Night of the Scorpion
Langston Hughes – Mother to Son
Kate Chopin – The Story of an Hour
Henrik Ibsen – A Doll's House (Extract)

Unit III: Horror & Suspense **7 hrs**

Edgar Allan Poe – The Raven
Bram Stoker – A Dream of Red Hands
Satyajit Ray – Adventures of Feluda (Extract)

Unit IV: Education **7 hrs**

The Dalai Lama – The Paradox of Our Times
Kamala Wijeratne – To a Student
Sudha Murthy – In Sahyadri Hills, a Lesson in Humility
Frigyes Karinthy – Refund

Reference Books:

- Finneran, Richard J. *The Collected Works of W.B. Yeats*(Volume I: The Poems: Revised Second Edition). Simon & Schuster, 1996.

- Pattanaik, Devdutt. *Shikhandi: Ánd Other 'Queer' Tales They Don't Tell You*. Penguin Books, 2014.
- Ezekiel, Nissim. *Collected Poems* (With A New Introduction By John Thieme). OUP, 2005.
- Hughes, Langston. *The Collected Poems of Langston Hughes*. Vintage, 1995.
- Chopin, Kate. *The Awakening and Selected Stories of Kate Chopin*. Simon & Schuster, 2004.
- Ibsen, Henrik. *A Doll's House*. Maple Press, 2011.
- Poe, Edgar Allan. *The Complete Poetry of Edgar Allan Poe*. Penguin USA, 2008.
- Stoker, Bram. *Dracula*. Fingerprint Publishing, 2013.
- Ray, Satyajit. *The Complete Adventures of Feluda* (Vol. 2). Penguin Books Ltd., 2015.
- Lama, Dalai. *Freedom In Exile: The Autobiography of the Dalai Lama of Tibet*. Little, Brown Book Group, 1998.
- Murthy, Sudha. *Wise and Otherwise: A Salute to Life*. Penguin India, 2006.

Course Code	Environmental Microbiology	Course Type	L	T	P	C	CH
B21MI0401		**HC**	**2**	**1**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

Students should have the knowledge of microbes in the environment.

Course Objectives:

1. Understand the microorganism and evolution in the nature.
2. Provide the fundamental microbial process in the environment
3. Understand the various types of interaction of microorganisms in the ecosystem.
4. Explore the beneficial microorganisms for ecosystem management.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0401	CO1	2	1	1	2			1	1		3	2	1	
	CO2	1	2	2	1			1			2	1	1	1
	CO3	1	2	2	1			1			2	1	1	2
	CO4	1	1	2	2	1	1	2	1		2	2	2	

Course Outcomes:

By the end of the course the student will be able to:

1. Strengthen the knowledge of microorganisms and their role in the environment.

2. Analyse the microbiological process associated in environment and ecosystem maintenance.
3. Explore the various interactions of the microorganisms in the ecosystem.
4. Exploit the various microorganisms and their products for environment management

Course Contents:

Unit-I Introduction to Environmental Microbiology 12hrs

Microbes in the environment. Water microbiology: Waste water treatment: methods: aerobic and anaerobic processes. Solid waste management; Landfills, containment types, Composting and applications. Bioremediation and phytoremediation: biofilters, Microbial polymers, microbial plastics. Bioaccumulation, Biomagnification, Marine pollution: concepts and remediation strategies.

Unit II Biogeochemical process in environment 12hrs

Biogeochemical cycles, Carbon cycle, organic matter decomposition, humus formation, Nitrogen cycle - nitrogen fixation, ammonification, nitrification, denitrification, reactions – organisms involved. Nitrogen fixation – symbiotic - root nodulation, non-symbiotic, associative organisms, nitrogenase, hydrogenase, nif gene, nod gene. Microbial transformation of phosphorus, solubilization by phosphobacteria and P- mobilization by mycorrhizal fungi, Microbial transformation of sulphur - sulphur toxicity and sulphur bacteria.

Unit-III Microbe interactions in ecosystem and diversity 12hrs

Interaction between soil microbes–Neutralism, Commensalism, Symbiosis, Synergism, Amensalism, Parasitism, Predation and Competition. Interrelationships between soil microbes and plants, Rhizosphere concept, R:S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae-types, Rumen flora, Insects microbial interactions.

Unit-IV Microorganisms for ecosystem maintenance 12hrs

Bioremediation: Concepts and principles, bioremediation using microbes, in situ and ex situ bioremediation, biosorption and bioaccumulation of heavy metals. Xenobiotics: Degradation by microorganisms with reference to pesticides, herbicides, polyaromatic hydrocarbons. Relevance of GMO to the environment. Current status of biotechnology in environment protection.

References

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott.
3. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Course Code	Chemistry –IV	Course Type	L	T	P	C	CH
B21CH0401		HC	3	0	0	3	4

Prerequisites:

Periodic table, Stereochemistry, Electrochemistry and Chemical kinetics.

Course Objectives:

1. The importance of acid-base concept, HSBA rule in compound formation, non-aqueous solvent and noble gas chemistry
2. The fundamental concepts of organic chemistry synthesis of various functional organic compounds
3. Illustrate the Vital concepts thermodynamics and its principles and its importance.
4. Correlate the reaction kinetics and foundation theory and relevant applications.

Course Outcomes:

On the successful completion of this course, the student shall be able to**:**

1. Apply the knowledge of noble gases, compounds of N, S and pseudo halogens in explaining, interpreting structures and their reactivities of noble gases and organometallic compounds.
2. Analyze the bonding stability organic compounds and their applications.
3. Recognize the typical named organic reactions and explain their mechanisms through various steps.
4. Correlate the importance of adsorption and catalysis reactions of chemical compounds in industries e.g. Hydrogenation, dehydrogenation.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ Cos	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0401	CO1	1	2	1	1	1	1	1			1	2	1	
	CO2	2	2	1	1	1	2	1			1	2	2	
	CO3	1	2	1	2	1	2	1			1	1	1	
	CO4	2	1	1	2	1	1	2			1	1	2	

Course Contents:

UNIT-I **12 Hrs**

Noble Gases: Preparation, separation of Noble gases-Dewar'smethod. Preparation, Structure and properties of compounds of Xenon and Krypton (XeF_2, XeO_3, KrF_2, KrO_3), Clathrates (explanation with suitable examples, essential conditions for the formation and uses).

Organometallic Compounds: Definition with example, Organo magnesium and organolithium compounds: preparation and synthetic applications. Metal carbonyls: Definition, classification with examples, nature of M-CO bonding in carbonyls. nitrosyls and metallocenes.

Bioinorganic Chemistry: Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially Fe^{2+}, Fe^{3+}, Cu^{2+} and Zn^{2+}; structure and function of hemoglobin and myoglobin and carbonic anhydrase.

Non-aqueous solvents: classification of solvents, Liquid ammonia-reasons for the solvent properties, typical reactions- solubility of alkali metals; acid-base, precipitation, Ionization of weak acids, advantages and disadvantages.

UNIT-II **12 Hrs**

Stereochemistry – Introduction, Stereo isomerism; Optical isomerism; Symmetry and chirality; Absolute and relative configuration. D and L. Enantiomers and diastereomers; Racemic mixture, racemisation and resolution. Threo and erythro; CIP Rules: R/S and E-Z system of nomenclature. Optical isomerism in compounds with stereocenters (lactic acid and tartaric acid) and without any stereocenters (allenes, biphenyls); atropisomerism. conformation of acyclic systems (substituted ethane/n-propane/n-butane) and cyclic systems (mono- and di-substituted cyclohexanes).

Pericyclic and photochemical reactions:

Pericyclic reactions: Introduction. Classification of pericyclic reactions, electro cyclic reactions-con rotation and dis rotation. Electro cyclic closure and opening in 4n and 4n+2 π systems.

Organic Photochemistry: Introduction, types of photochemical reactions-laws of photochemistry, photo dissociation - isomerization- cyclisation- dimerization and oxetane formation. Norrish-I and II reactions. Barton reaction- photo Fries rearrangement, Paterno Buchi reaction.

UNIT-III **12 Hrs**

Free Energy: Helmholtz and Gibb's free energy – their definitions and their relationship, Gibb's –Helmholtz equation at constant pressure and volume, thermodynamic criteria of equilibrium and spontaneity, Claussius – Clappeyron equation, integrated form of Claussius – Clappeyron equation (to be assumed) and its applications (enthalpy of vapourization, boiling point and freezing point at different temperatures), Van't Hoff's reaction isotherms and isochore equations.

Adsorption: Introduction, principle involved. Sorption, absorption and adsorption (statement, differences and examples) physical and chemical adsorption – definition and differences. Adsorption of gases on solids – factors which influence, **t**ypes of adsorption, factors affecting adsorption. Free energy change in adsorption, Adsorption isotherms –Freundlich's isotherm and Langmuir's adsorption. Equation of Langmuir's adsorption isotherm, BET equation (derivation not required) applications.

Catalysis-types, general characteristics, homogeneous and heterogeneous catalysis. Theories of catalysis, intermediate compound formation theory and adsorption theory. Enzyme catalysis –lock and key mechanism with example. Michaelis-Menton enzyme catalytic equation, Industrial applications of enzymes and catalysts.

UNIT-IV **12 Hrs**

Chemical Kinetics: Rate of reaction, rate equation, factors influencing the rate of a reaction. Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction. Half-life period of a reaction. Methods of determination of order of reaction, effect of temperature on the rate of reaction – Arrhenius equation. Theories of reaction rate – Simple

collision theory for unimolecular and bimolecular collision (hard sphere model). Transition state theory of bimolecular reactions.

Electrochemistry: Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration. Arrhenius theory of ionization, Ostwald's Dilution Law. Debye- Hückel – Onsager's equation for strong electrolytes (elementary treatment only) Transport number, definition and determination by Hittorfs methods, (numerical included), Kohlarausch's Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. Applications of Kohlarausch's Law: Calculation of conductance of weak electrolytes at infinite dilution, determination of degree of dissociation, determination of K_a of acids and determination of solubility product of sparingly soluble salts.

Reference Books:

1. D.W. Ball, Physical Chemistry, Thomson Press, India, 2007.
2. G.W. Castellan, Physical Chemistry, 4th Ed. Narosa, 2004.
3. B.S. Bahl, A. Bhal, G. D. Tuli, Essentials of Physical Chemsitry, S. Chand & Company Edition 2006.
4. Gurudeep Raj, Advanced Physical Chemistry, Goel Publication
5. M.K. Jain, A Text book of Organic Chemistry, S. Chand & Company.
6. A. Bhal and B.S. Bhal, A Text book of Organic Chemistry, Chand & Company.
7. P.L. Soni, A Text book of Organic Chemistry, S. Chand & Company.
8. Puri, Sharma and Kalia, Principles of Inorganic Chemistry, Shobhanlal Nagin Chand Co.
9. Gurudeep Raj, A Text book of Inorganic Chemistry.
10. J.D. Lee, Concise Inorganic Chemistry, B-Block Well Science Ltd.

Course Code	Developmental Genetics	Course Type	L	T	P	C	CH
B21GN0401		HC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of developmental process.
2. Students should be familiar with gene expression.

Course Objectives:

The objective of this Course is to

1. To learn the essentials of developmental biology.
2. To get familiarized with the embryonic development.
3. To distinguish the organogenesis and metamorphosis.
4. To study the developmental disorders.

Course Outcomes:

After the end of the Course students will be able to:

1. Differentiate the developmental stages.
2. Compare the developmental milestones of different organisms.
3. Illustrate the phenomenon of organogenesis and metamorphosis.
4. Outline the characteristics of developmental disorders.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0401	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3				2				3	3		
	CO3	3	3	3	3	3	2				3	3	2	
	CO4	3	3	3			3	3	2		3	3	2	

Course Contents:

UNIT-I **12 hrs**

Essential Concepts in Developmental Biology

Early embryonic development in Frog, Gametogenesis, fertilization, cleavage, blastula and gastrula. Nuclear transplantation experiments in Amphibians and *Acetabularia*. Epigenesis and preformation - Generating new cells and organs — Cell-cell communication in development – Fate Maps.

UNIT-II **12 hrs**

Embryonic Development and Germ Layer Specification

Genetics of development in plants – *Arabidopsis*: Flower development (Floral morphogenesis and Homeotic gene expression).

Genetics of development in Animals - *Drosophila*: Early development; Origin of anterior-posterior and dorso-ventral polarity: Role of Maternal genes, Zygotic genes- Segmentation genes (gap, pair rule and segment polarity genes) and Homeotic selector genes. d. Switching genes on and off during development- Ex. Differential expression of haemoglobin

C. elegans – Early development in Vertebrates – Early mammalian development – Origin and emergence of Ectodermal, Mesodermal and Endodermal cell layers

UNIT-III **12 hrs**

Organogenesis and Sex Determination

CNS and epidermis –Neural crest cells – The Somites and their derivatives – Development of tetrapod limb –Development of gonads-– Sex determination.

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UNIT-IV **12 hrs**

Metamorphosis, Regeneration and Ageing

Insect and amphibian metamorphosis – Stem Cell mediated regeneration –

Regeneration in planaria and zebrafish – Biology of senescence – Role ofmTOR pathway and telomeres in ageing (gerontology).

Developmental Disorders

Embryonic origins of adult disease - Genetic errors of human development – Teratogenesis – Transgenerational inheritance of developmental disorders – Cancer as a disease of development – Disease models and mechanisms.

Reference Books:

1. Balansky, Text book of embryology.
2. Principles of Development by Lewis Wolpert et al. 5th Edition. oxford University press 2015.
3. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (2002) Genetics, 4th edition, Viva Books
4. Lewin, Benjamin; Krebs, Jocelyn E.; Goldstein, Elliott S.; Kilpatrick, Stephen T. (2014),
5. Genes XI, Jones and Bartlett Learning.
6. Brown, T.A., Chapman and Hall (2011) Genetics a Molecular Approach, 2nd edition, Garland science.
7. Gilbert. (2013) Developmental biology. 10th edition.

Course Code	Aeromicrobiology & Aquatic Microbiology	Course Type	L	T	P	C	CH
B21MIS411		SC	2	1	0	3	4

Prerequisites/Pre reading for the course:

Students should have basics of microbes present in the air and water samples.

Course Objectives:

1. Understand the microbial dynamics in the atmospheric air.
2. Explore various sampling methods and enumerating the microbial load in air sample.
3. Learn various water sampling and processing for water quality.
4. Explore various marine microorganisms and their significance.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS411	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	1	1	1		2	2	1	1	1
	CO3	1	2	2	1	1	1	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	2

Course Outcomes:

By the end of the course the student will be able to:

1. Analyse the microbial dynamics and their significance in the air samples
2. Explore various methods to study the microbial dynamics in the atmosphere
3. Analyse the normal and polluted water microflora and their significance
4. Explore the various marine microflora and their commercial products.

Course Contents:

Unit-I Introduction to Aeromicrobiology **12 hrs**

Definition, history and development of air microflora, aim and scope of aerobiology, geomicrobiology and its importance. Atmospheric layers, sources of microorganisms, air flora of indoor and outdoor environment & its significance, factors affecting air spores and their significance

Unit-II Sampling and isolation techniques **12 hrs**

Techniques of trapping air-borne microorganisms-Gravity slide, Petri plate exposure, Vertical cylinder spore trap, Hirst spore trap, Rotorod sampler, Anderson sampler, impingers and filtration, principle and its advantages & disadvantages Air-borne microorganism examples with major disease and their health effects. Air borne disease-4 important diseases and its management**.**

Unit III Microbiology of Water **12 hrs**

Distribution of microorganisms in the aquatic environment, Determination of sanitary quality of water, Sources of water-borne diseases-viral (jaundice), bacterial (cholera) and protozoan, (amoebic dysentry) Biological indicators of water pollution. Sources, characteristics of waste water-domestic & industrial waste water, Waste water treatment-primary, secondary & tertiary treatment, Solid waste recycling: Anaerobic digestion process, Biogas and composting

Unit IV Marine microbiology **12 hrs**

Marine environment, marine microbial community–planktons, bacteria, fungi, protozoa, Methods of collection and estimation of marine microbes, influence of physical, chemical and biological factors on marine microbes. Marine microbial products-Biosurfactants, biopolymers and enzymes from marine microbes, microbial indicators of marine pollution and control, biofouling, biocorrosion, biofilms, biodegradation and bioremediation of marine pollutants

Reference

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
2. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2 nd edition, Academic Press
4. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
5. Karl,D & Buckley,M (2005) Marine Microbial Diversity
6. Mitchell,R(2008) Microbial Ecology of the Oceans Wiley

7. Colwell,R & Belkin,(2010) Ocean & health: Pathogens of the Marine Environment Springer
8. Miller, C.,Wheeler,P.A (2012) Biological Oceanography Wiley-Blackwell
9. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.

Course Code	Immunity and Medical Microbiology	Course Type	L	T	P	C	CH
B21MIS412		SC	2	1	0	3	4

Prerequisites/Pre reading for the course:

Students should have basics of Immunology and microbial diseases

Course Objectives:

1. Better understanding of the cells and organs of immune system involved in defence mechanisms.
2. Identification and characterisation of the medically important bacteria.
3. Study the characteristics and transmission of medically important protozoans
4. Understand the control of medical pathogens for the diseases.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MIS412	CO1	2	1	1	2	1	1	1	1	1	3	2	1	1
	CO2	1	2	2	1		2	1	2	2	2	1	1	1
	CO3	1	2	2	1	1	1	1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1

Course Outcomes:

By the end of the course the student will be able to:

1. Have deep knowledge of the cells and organs of immune systems of humans.
2. Understand the pathogenic nature of medicinal bacteria
3. Better understanding of the lifecycle and pathogenesis of the protozoan diseases.
4. Underline concepts and mechanisms for the control of the microbial diseases.

Course Contents:

UNIT-I Introduction to immune system **12 hrs**

Innate and Adaptive immunity, Antibody (humoral) mediated immunity, Complement-system and Cell mediated immunity, Cells and tissues of immune system- B&T lymphocytes,

phagocytes, killer cells, NK cells, Antigens – nature and types, Antibodies – Structure of lgG. Classes of antibodies and their functional diversity, Antigen-antibody reactions- Agglutination reaction – Widal test, Neutralisation test- Opsonisation, Precipitation reaction-VDRL Test.

UNIT II Bacterial and viral diseases of humans **12 hrs**

Pathogen- morphology, cultural and biochemical characteristics, classification, resistance pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of the following: Bacterial diseases – Tuberculosis, Cholera, Typhoid, Syphilis. Viral diseases – Hepatitis, Poliomyelitis, AIDS.

UNIT III Fungal and protozoan diseases of humans **12 hrs**

Pathogen-morphology, cultural and biochemical characteristics, classification, resistance pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of the following: Fungal diseases - Candidiasis, Dermatomycosis (Tinea - ringworm infection). Protozoan diseases – Malaria, Trichomoniasis.

UNIT IV Pathogens and their control mechanisms **12 hrs**

Normal flora of human body, Infection – types of infection, modes of transmission, Pathogenesis – Virulence – attenuation and exaltation with an example each. Control of pathogenesis and virulence: Antibacterial agents: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism. Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin. Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine.

Reference

1. Mark Peakman, Basic and Clinical Immunology; Churchill Livingstone. 2 nd Ed., 2009.
2. Collee JG & Mackie TJ (1996) Mackie and McCartney Practical Medical Microbiology.
3. Topley, W.W.C., Wilson, G.S., Parker, T., and Collier, L.H. (1990). Topley and Wilson's Principles of Bacteriology, Virology and Immunology (Edward Arnold)
4. Zinsser, H., and Joklik, W.K. (1992). Zinsser microbiology (Lange) 20th ed.
5. Ananthanarayan, R., and Paniker, C.K.J. (2006). Textbook of microbiology (Orient Blackswan) 7th ed
6. Mackie, T.J., McCartney, J.E., and Collee, J.G. (1989). Mackie & McCartney practical medical microbiology. Churchill Livingstone, 13th ed

Course Code	Environmental Microbiology Lab	Course Type	L	T	P	C	CH
B21MI0402		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Students should have the knowledge of culturing and identification of microbes from various environmental samples.

Course Objectives:

1. Practical handling and determination of dissolved nutrients in water samples.
2. Quantitative and quantitative microbiological analysis of water samples.
3. Explore the various beneficial microorganisms for commercial purpose.
4. Explore various biocontrol agents in control of phytopathogens.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0402	CO1	2	1	1	2			1	1		3	2	1	1
	CO2	1	2	2	1	2	1	1		2	2	1	1	1
	CO3	1	2	2	1	1	2	1		3	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	1

Course Outcomes:

1. nds on experience on the handling of environmental samples for chemical analysis.
2. Analyse the microbiological quality of various water sources.
3. Understand the various beneficial microorganisms for commercial uses.
4. Develop various microbial controls and technologies in the control of plant diseases.

Course Content:

1. Determination of BOD of water samples
2. Microbial qualitative analysis of water-MPN test
3. Isolation and characterisation of root nodulating *Rhizobium spp.*
4. Phosphate solubilising potential of microorganisms
5. Isolation and characterisation of cellulase degrading microorganisms
6. Isolation and characterisation of starch degrading microorganisms.
7. Root nodulation test and effect of fertilisers in nodulation
8. Biocontrol agents test-Trichoderma and Pseudomonas fluorescens

References

1. Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi.

2. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York.

3. R,M, Atlus and Richard Bartha (2000). Microbial Ecology, Fourth edition, An imprint of Addison Wesley Longman, Inc, New York.

Course Code	Chemistry Practical–V	Course Type	L	T	P	C	CH
B21CH0402		HC	0	0	1.5	1.5	3

Prerequisites:

Theory of conductometry, potentiometry and chemical kinetics.

Course Objectives:

1. Knowledge on different analytical instrumentation techniques for the estimation of analyte.
2. Apply the laboratory skills in quantitative techniques.
3. Understand the importance electrodes in physical related experiments.
4. Compare the involvement various physical properties in experiments.

Course Outcomes:

1. Analyse the importance of instruments while conducting lab experiments.
2. Demonstrate the experimental skills in labs.
3. Operate and interprete experimental data.
4. Identify the causes for unexpected results and to the reach better results.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0402	CO1	1	2	1	1	1	1	1			1	2	1	2
	CO2	2	2	1	1	1	2	1			1	2	2	
	CO3	1	2	1	2	1	2	1			1	1	1	1
	CO4	2	1	1	2	1	1	2			1	1	2	

Course Contents:

1. Hydrolysis of methyl Acetate or Ethyl Acetate at Constant temperature.
2. Potentiometric titration of FAS vs $K_2Cr_2O_7$.
3. Conductometric titration of strong acid v/s strong base and acid mixtures v/s strong base.
4. Colorimeteric estimation of Cu^{2+} ion using NH_4OH as complexing agent.
5. Determination of percentage composition of sodium chloride solution by determining the miscibility temperature of phenol - water system.
6. pH titration of strong acid against strong base (by observing change in pH).
7. Determination of molecular weight of a polymer material by viscosity measurements (celluloseacetate/methyl acrylate).
8. Colorimetric estimation of Fe^{3+} ion using ammonium thiocyanate as complexing agent.
9. Determination of partition coefficient of acetic acid between n-butanol and water.
10. Verification of freundlich adsorption isotherm of acetic acid on charcoal.
11. Determination of chloride content of water by argentometry.

Reference Books for Practicles

1. B.D. Khosla, V.C. Garg and A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.
2. S.W. Rajbhoj and T.K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication, Second Edition, 2000.
3. Sunita Rattan, Experiments in Applied Chemistry, S.K. Kataria & Sons, Second edition, 2008.
4. B.D. Khosla, V.C. Garg, and A. Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2011.

C.W. Garland, J.W. Nibler and D.P. Shoemaker, Experiments in Physical Chemistry.

Course Code	Developmental Genetics Lab	Course Type	L	T	P	C	CH
B21GN0402		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

1. Students should know the developmental process.
2. They should be capable of Logical thinking.

Course Objectives:

1. To study the developmental pattern of different stages.
2. To understand the involvement of genes in development.
3. To study the potentiality of organ formation.

Course Outcomes:

After the course, student will be able to

1. Outline the patterns of the development.
2. Co-relate the gene expression and development.
3. Analyse the development of organs from pre-determined mass of cells.
4. Involve in project-based learning.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0402	CO1	3	3			3	2				3	3	2	
	CO2	3	3			3					3	2	2	
	CO3	3	3			3					3	3		
	CO4	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents

1. Early embryonic development in Frog0 Egg, cleavage, blastula and gastrula.

2. Genetics of development in Arabidopsis – ABC model Homeotic gene expression (Slide/Chart)
3. Genetics of development in Drosophila 0 Anterior0posterior/dorso0ventral polarity (Slide/Chart)
4. Study of imaginal discs in Drosophila
5. Effect of toxins on development
6. Study of development in Drosophila.
7. Study of developmental disorders.
8. Study of development of chick embryo.

Reference Books:

1. Balansky, Text book of embryology.
2. Developmental biology by Scott.F. Gilbert. Sinauer Associates, Sunderland. 2000.
3. Principles of Development by Lewis Wolpert et al. 5th Edition. oxford University press 2015.
4. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (2002) Genetics, 4th edition, Viva Books
5. Lewin, Benjamin; Krebs, Jocelyn E.; Goldstein, Elliott S.; Kilpatrick, Stephen T. (2014),
6. Genes XI, Jones and Bartlett Learning.
7. Brown, T.A., Chapman and Hall (2011) Genetics a Molecular Approach, 2nd edition, Garland science.
8. Gilbert. (2013) Developmental biology. 10th edition.

FIFTH SEMESTER

Course Code	Microbial Physiology & Technology	Course Type	L	T	P	C	CH
B21MI0501		**HC**	**2**	**1**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

Students should have basics of microbial metabolism and their various adaptations.

Course Objectives

1. Understand the biochemical mechanism of the basic process in microorganisms.
2. Provide information on the microbial metabolic process.
3. Explore the various techniques for products development obtained from microbes.
4. Explore the various commercially important products from microbial fermentation.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0501	CO1	2	1	1	2		1	1	1	2	3	2	1	2

	CO2	1	2	2	1	1	1	1		2	2	1	1	1
	CO3	1	2	2	1	2	2	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	3	2	2	2	2

Course Outcomes:

By the end of the course the student will be able to:

1. Understand the microbial metabolic process that can be exploited for allied areas
2. Explore the possible benefits of the microbial anabolic process for environment
3. Understand the various fermentation and their process for commercially useful products
4. Analyse the manufacturing process of commercially important microbial products

Course Contents:

Unit –I Microbial metabolism **12 hrs**

Metabolism, anabolism & catabolism, Aerobic and anaerobic respiration-fermentation process, glycolysis, TCA cycle, Entner Duodruffs pathway, pentose phosphate pathway, electron transport chain and energetic at each steps; entry of other carbohydrates and its significance.

Unit- II Microbial photosynthesis **12 hrs**

Bacterial photosynthesis (green and purple bacteria)-oxygenic & anoxygenic photosynthesis, role of photosystem and accessory pigments in the photosynthesis, biochemical nitrogen fixation–non-symbiotic and symbiotic bacteria

Unit-III Fermentation technology **12 hrs**

Concept of fermentation & Fermentation processes-batch and continuous, plug flow method, Solid state fermentation and liquid fermentation, Fermenter-basic design and types of fermenter, Isolation of industrially important microbial strains, strain improvements & fermentation medium-natural and synthetic medium, different sources, antifoams, precursors and inducers. Various types of fermenters and their design.

Unit-IV Microbial products in industries and its processing **12 hrs**

Products of industrial fermentation and downstream processing, outline of the production for ethanol, vinegar, citric acid, amylase, vitamin B, antibiotics (penicillin and streptomycin), brewing and wine making.

References

1. Outlines of Biochemistry Cohn and Stumpf.
2. Microbiology by Dubey & Maheswari
3. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company.

Course Code	Chemistry –V	Course Type	L	T	P	C	CH
B21CH0501		HC	3	0	0	3	4

Prerequisites:

Knowledge of absorbate and adsorbent, polarity of solvents, basics of polymer.

Course Objectives:

1. To impart basic knowledge about different Chromatographic techniques.
2. To explore polymers and understand the process of synthsis and using for different purposes.
3. To understand the mechanism of rearrangement and named reaction and their importanw.
4. To introduce the basic aspects of spectroscopies such as Molecular spectroscopy (rotational spectroscopy, vibrational spectroscopy, and Raman spectroscopy) and photochemistry.

Course Outcomes:

1. Understand the basic principles and different types of chromatographic techniques and evaluate R_f value.
2. Enhance the understanding of polymerization and their applications.
3. To synthesis and different rearrangement and named reactions
4. Illustrate the basic principles involved in different molecular spectroscopic techniques and give selection rules and brief the laws of photochemistry.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0501	CO1	2	1	1	1			1			2	1	2	
	CO2	3	2	2	1			1			2	2	2	
	CO3	2	1	1	0								2	
	CO4	2	1	1	1			1			1	2	2	

Course Contents:

UNIT-I **12 Hrs**

Chromatography:

Introduction, classification of chromatographic techniques.

Paper Chromatography: introduction, Principles, R_f values, experimental procedures, choice of paper and solvent systems, developments of chromatogram - ascending, descending and radial., applications.

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting Rf values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots, two-dimensional chromatography, Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique.
Ion Exchange chromatography-separation of anions and cations,
HPLC: Basic principles, Instrumentation and applications.

UNIT-II **12 Hrs**

Polymerisation: Classification, types, addition and condensation polymerisation Molecular weight of Polymers: Expression for Weight average and Number average (experimental determination is not required), Polydispersity.

Organic and Inorganic Polymers: Inorganic Polymers: structure and applications of silicones, phosphazenes, S-N compounds, S-P compounds, Differences between inorganic and organic polymers.

Organic Polymers: Preparation and applications of the following types of polymers

1. Plastics:
   i)thermosetting plastics (Phenol-formaldehyde)
   ii) thermo softening plastics (PVC).
2. Fibers: Acrylic, polyamide, polyester types: one example for each.
3. Rubber: Neoprene,
4. Fluoro Carbons: Teflon,
5. Polyaniline, Polythiophene and Orlan.

UNIT-III **12 Hrs**

Organic Reaction Mechanism and Synthetic Applications:

Rearrangement reactions: Classification – inter molecular and intra molecular rearrangements-Mechanisms, evidences, migratory aptitude, inter or intra molecular of the following rearrangements: Hofmann, Curtius, Lossen, Beckmann rearrangements, Wolff rearrangement, Pinacol-pinacolone, Favorskii, Benzil-benzilic acid rearrangement, dienone-phenol rearrangement, Cope and Claisen (sigmatropic) rearrangement.

Named Reactions: Simmons-Smith reaction, Reimer-Tiemann reaction, Mannich reaction, Darzens reaction, Chichibabin reaction and McMurry reaction; Baeyer-Villeger reaction. Suzuki and Stille coupling reactions. Oxidation and reduction reactions in organic chemistry.

Reagents: $NaBH_4$, $LiAlH_4$, DDQ, DCC, SeO_2, MnO_2, Organocopper reagents in organic synthesis.

Functional group inter-conversions and structural problems using chemical reactions.

UNIT-IV **12 Hrs**

Molecular spectroscopy: The basis of absorption and emission of radiation by molecular species, the wave properties of the light, the quantum theory of light, quantum theory of matter, molecular energies and the types of molecular motion.

Rotational spectroscopy – Classical description of molecular rotation, quantum mechanics of molecular motion, rotational spectra, rotational energy levels (from Schrodinger equation), selection rules. determination of the bond length from rotational constants,

Vibrational spectroscopy – Quantum description of molecular vibrations, vibrational selection rules, harmonic and a harmonic vibration, vibration of polyatomic molecules.

Raman Spectroscopy – description of Raman scattering, Rayleigh scattering, Stokes and anti-Stokes's scattering, polarizability of the molecules, rotational Raman spectra, Comparision of Raman and IR.

Reference Books:

1. P. W. Atkins – Physical Chemistry, eighth Edition, New York, 2006,
2. P.W. Atkins, and J.D. Paula, Physical Chemistry for the Life Sciences, New York, 2011
3. P.J. Larkin, IR and Raman Spectroscopy, Principles and Spectral Interpretation, Elsevier, 2011.
4. S.M. Khopkar, Basic concepts of Analytical Chemistry. New Age International
5. Madan, Malik and Tuli, Selected Topics in Inorganic Chemistry, S. Chand & Company.
6. B.K. Sharma, Instrumental methods of Chemical analysis, Goel Publishing House.
7. Willard, Meritind and Dean, Analytical Chemistry, New Age Publications.
8. H.H. Willard, L.L. Merrite, K.A. Dean and F.A. Kettle, Instrumental methods of Chemical analysis CBS Publishers.
9. C.N. Banwell, Fundamentals of Molecular Spectroscopy.
10. W.A. Gullory, Introduction to Molecular Structure and Spectroscopy.
11. R Chang, Basic Principles of Spectroscopy.
12. M. Kundan and S.K. Jain, Physical Chemistry, S. Chand & Company.
13. K.K. Sharma and C.K. Sharma, Text book of Physical Chemistry, Vani Educational Books.

Course Code	Human Genetics	Course Type	L	T	P	C	CH
B21GN0501		HC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have basics of genetics knowledge.
2. They should have knowledge of morphology of chromosomes.

Course Objectives

The objective of this Course is:

1. To know the history of human genetics.
2. To employ the techniques such as karyotyping, FACS, genetic counselling.
3. To outline the inheritance pattern of genetic disorders.
4. To familiarize the diagnostic techniques used in medical and forensic fields.

Course Outcomes:

After completing the course, the student should be able to:

1. Outline the different patterns of inheritance of allosomes and autosomes.
2. Analyze the aberrations by karyotypes and Flow ctometry.
3. Interpret the inheritance by analysing pedigree tree.
4. Familiarize with the prenatal diagnosis, genetic counseling and dermatoglyphics.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0501	CO1	3	3	3			3	3	3		3	3	2	3
	CO2	3	3	3	3		3	3	3		3	3	2	3
	CO3	3	3	3			2	2	2		3	3	2	3
	CO4	3	3	3	3	3	3	3	2	2	3	3	2	3

Course Contents:

UNIT- I **12 Hrs**

History of Human Genetics.

Paris Nomenclature, Flow karyotyping (Quantification of DNA of individual chromosomes) FACS-Fluorescence Activated Cell Sorter.

Human chromosomes and karyotyping: G-banding, nomenclature of banding

Nomenclature of aberrant karyotypes

Common syndromes due to numerical chromosome changes

Common syndromes due to structural alterations (translocations, duplications, deletions, microdeletion, fragile sites)

UNIT- II **12 Hrs**

Genetic Diseases and Inheritance Pattern: Autosomal inheritance- Dominant (Ex. Adult polycystic kidney, Achondroplasia and Neurofibromatosis) Autosomal inheritance- Recessive (Ex. Albinism, Sickle cell anaemia, Phenylketonuria) X-linked – Recessive: (Ex. Duchenne muscular dystrophy-DMD) X-linked- Dominant: (Ex. Xg blood group) Y-linked inheritance: Holandric gene (Ex. Testes determining factor - TDF) Multifactorial inheritance: (Ex. Congenital malformations: Cleft lip and palate, Rheumatoid arthritis and Diabetes) Mitochondrial diseases: (Ex. Leber's hereditary optic neuropathy)

UNIT-III **12 Hrs**

Pedigree studies and Genetic Counselling: Symbols used in pedigree studies, Pedigree analysis and construction, Pedigree analysis for the inheritance pattern of genetic diseases,

Genetic Counselling.

Stage 1: History and pedigree construction

Stage 2: Examination

Stage 3: Diagnosis

Stage 4: Counselling

Stage 5: Follow up.

Problems and case studies.

UNIT-IV **12 Hrs**

a. Dermatoglyphics: Introduction and Patterns. Dermatoglyphics in clinical disorders- Down's syndrome, Turner's syndrome, Klinefelter's syndrome and Cri du chat syndrome. Clinical applications, Advantages and Limitations.

b. Prenatal Diagnosis: Introduction and types Invasive Prenatal diagnosis - Amniocentesis, Chorionic villus sampling. Non – Invasive Prenatal diagnosis – Ultrasonography.

c. Genetics and Society: Eugenics: Positive and negative, Euthenics, Euphenics Human genome project – introduction and significance Gene therapy with reference to SCID Stem cells- Properties, types and sources. A brief account on Cord blood banking and Stem cell therapy.

Reference Books:

1. Basic Human Genetics by EJ. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics- Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Sounders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R. Korf. 2000
8. Human Genetics: Concepts and Applications by Lewis R (2001) McGrawHi; Boston.
9. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
10. Medical Genetics. Lynn Jorde John CareyMichaelBamshad. 2015.
11. Mendelian inheritance in Man by-Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
12. Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (EdsOMcGrawHill, New York.

Course Code	Medical Genetics	Course Type	L	T	P	C	CH
B21GNS511		SC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have basics of genetics knowledge about pathology.
2. They should have knowledge of cancer biology.

Course Objectives:

The Objective of this Course is:

5. To teach the basics of medical genetics and learn the patterns of heredity
6. To categorize the genetic disorders.
7. To explore the molecular therapeutics for disease management
8. To understand the mechanism of carcinogenesis.

Course Outcomes:

After completing the course, the student should be able to:

1. Predict the patterns of heredity.
2. Analyze the molecular reason of genetic disorders and therapeutic methods.
3. Illustrate the process involved in recombinant protein production.
4. Understand the characteristics and categories of cancer

Mapping of Course Outcomes with programme Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PS01	PS0 2	PS0 3
B21GNS511	CO1	3	3	3			3		3		3	3	2	
	CO2	3	3	3			3		3		3	3	3	2
	CO3	3	3	3	3		2				3	3	3	3
	CO4	3	3	3	3		3		3		3	3	3	

Course Contents:

UNIT-I Genetics in medical Practice **12 Hrs**

Genetic Principles and their application in medical practice, Case studies (Interacting with patients, learning family history and drawing pedigree chart), Syndromes and disorders: Definition and their genetic basis. Genetics of diseases due to inborn errors of metabolism: Phenylketonuria, galactosemia.

UNIT-II Human Genetic Disorders of Nervous system and Eye **12 Hrs**

Neurogenetic disorders - Charcot-Marie tooth syndrome, Spino-muscular atrophy, Alzheimer's disease & Syndromes due to triplet repeat expansion, Parkinson's disease, Prion diseases, Colour Blindness, Retinitis pigmentosa, Glaucoma & Cataracts.

UNIT-III **12 Hrs**

Oncogenetics: A brief account of cancer-definition, types-Benign and Malignant; Sarcoma, Carcinoma, Lymphoma and Leukaemia Properties of malignant cells.

Types of genes - Proto oncogenes, Oncogenes, Difference between V- and C oncogenes, Tumor Suppressor genes-p53, pRb.

Chromosomal abnormalities associated with the specific malignancies- Acute Promyelocytic Leukaemia (APL), Chronic Myeloid Leukaemia (CML) and Acute lymphoblastic leukaemia (ALL)

UNIT-IV **12 Hrs**

Patterns of Single Gene Inheritance: Haematopoietic systems-Sickle cell Anemia, Thalassemias and Haemophilias, Muscle genetic Disorders-Duchenne Muscular Dystrophy, Becker Muscular Dystrophy, Cystic Fibrosis, Tay Sach's Syndrome & Marfan syndrome.

Gene therapy, molecular therapeutics, Production of recombinant insulin, interferon and human growth hormone (HGH) Vaccines: Hepatitis B vaccine Preparation of molecular probes, Monoclonal antibodies and diagnostic kits, Microarray

Reference Books:

1. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
2. Medical Genetics. Lynn Jorde John CareyMichaelBamshad. 2015.
3. Mendelian inheritance in Man by-Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
4. Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (EdsOMcGrawHill, New York.

Course Code	Applicative Genetics	Course Type	L	T	P	C	CH
B21GNS512		**SC**	**2**	**1**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

1. Students should have basics of Recombinat DNA technology.
2. They should have knowledge about sequencing.

Course Objectives:

The Objectives of this course is to:

1. To understand the process of recombinant DNA technology and its applications.
2. To learn the methodology of DNA fingerprinting and its applications.
3. To explore the world of genomics and proteomics.\
4. To study the basics of bioinformatics.

Course Outcomes:

After completing the course, the student should be able to:

1. Outline the process involved in the production of molecular therapeutics.
2. Design the sequencing process and analyse the data.
3. Align the sequences and interpret them in constructing phylogeny.
4. Apply the knowledge of genetics in pharmacogenomics and transgenic technology.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PSO 3

B21GNS12	CO1	3	0	3					3		3	3	3	
	CO2	3	3	3	3	2	2				3	3	3	
	CO3	3	3	3	3	3	3		3		3	3	3	
	CO4	3	3	3	3	3	3				3	3	3	

Course Contents:

UNIT-I CRYOBIOLOGY: CRYOGENETICS **12 Hrs**

Cryogenetics: Stem cell bank, cell bank, gene bank, cDNA library, embryo bank, sperm bank, pollen bank,

DNA fingerprinting and Methodology

Molecular markers –RAPD, RFLP, Microsatellite, SNPs, STR

UNIT-II Genomics and Proteomics **12 Hrs**

Genomics:

Structural and functional genomics. Whole genome sequencing – Maxam-Gilbert sequencing, Sanger sequencing, Pyrosequencing, Next generation sequencing.

Protein engineering and proteome analysis:

Insertional and deletion mutagenesis, Site directed mutagenesis, Proteome analysis, Protein arrays and their applications.

UNIT-III Bioinformatics **12 Hrs**

Biological databases: Overview, modes of database search, mode of data storage (Flat file format, db0tables), flat0file formats of GenBank, EMBL, DDBJ, PDB.

Sequence alignment:

Concept of local and global sequence alignment, pairwise sequence alignment, scoring an alignment, substitutional matrices, multiple sequence alignment.

Phylogenetic analysis:

Basic concept of phylogenetic analysis, rooted/unrooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbor joining, Maximum parsimony, Maximum likelihood).

UNIT-IV Applicative Genetics **12 Hrs**

Transgenic plants and animal: Creating transgenic animals and plants. Plant tissue culture. Animal cloning. Restriction and regulation for the release of GMOs into environment. Ethical, legal, social and environmental Issues related to rDNA Technology. Biosafety and Bioethics.

Pharmacogenetics: History, Early evidence; Clinical determinants; Molecular insights (genes involved in pharmacokinetics and pharmacodynamics of drugs); Applications in pre-prescription testing. Pharmacogenomics, Clinical trials.

Reference Books:

1. Gene cloning and DNA analysis, T.A. Brown (2010) 6th edition, Wiley-Blackwell publication

2. Human Molecular Genetics, Peter Sudbery (2002) 2nd Edition, Prentice Hall
3. Human Molecular Genetics, Tom Strachen and Andrew P. Read (1999) 2nd edition, John Wile and sons.
4. Molecular Biotechnology, Principles and application of recombinant DNA Glick and Pasternak. 2010.
5. Introduction to bioinformatics Arthur M Lesk

Course Code	Microbial Physiology and Technology Lab	Course Type	L	T	P	C	CH
B21MI0502		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

Students should have basics of microbial metabolic activities and their biochemical tests

Course Objectives:

1. Practical handling to isolate the microorganisms for industrial importance's.
2. Analyse the microbial metabolic processes involved commercially important products.
3. Perform the individual experiments related to microbial process.
4. Explore the microorganisms for the sustainable environmental conditions.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0502	CO1	2	1	1	2	1		1	1	1	3	2	1	1
	CO2	1	2	2	1	1	1	1		2	2	1	1	1
	CO3	1	2	2	1		2	1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	2	2	2	2	2

Course Outcomes:

By the end of the course the student will be able to:

1. Perform the enumeration and isolation of commercially important microorganisms
2. Produce the microbial enzymes and estimate its activity
3. Analyse microbial metabolites and their significance
4. Test and estimate the commercially important microbial products

Course Contents:

1. Isolation and enumeration of Microbes from starch degraders
2. Production of amylase and cellulases from microbes
3. Staining of root nodules from legumes
4. Methylene blue reduction tests of milk Samples

5. Production of wine
6. Estimation of Lactic acid in microbial products
7. Microbial production of Citric acid & its estimation
8. Antibiotics production & AST

References

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company.

Course Code	Chemistry Practical–V	Course Type	L	T	P	C	CH
B21CH0502		HC	0	0	1.5	1.5	3

Prerequisites:

Knowledge of principles of gravimetry and paper chromatography.

Course Objectives:

1. Intended to impart analytical skills with an emphasis on application oriented quantitative analysis such as gravimetric and chromatographic separation.
2. Define and understand the concept of gravimetric analysis.
3. Able to use different instrument to validate the theoretical concepts with experimental results.
4. Expertise in using the conductometry, colorometry, Abbe's reflectometry and perform the experiments to measure the physical and chemical properties.

Course Outcomes:

1. Interpret different gravimetric analysis methods.
2. Acquire training in the quantitative analysis of metal ions and anions using gravimetric method.
3. Develop skills in handling the conductometry, colorometry, Abbe's reflectometry instruments.
4. Compute the result of analysis and to document its reliability.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0502	CO1	1	2	2	1			2				3	1	2
	CO2	1	2	1	3			3				3	1	1
	CO3	1	2	2	2			2				3	1	1
	CO4	1	1	2	1			2			2	3	1	2

Course Contents:

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of copper as copper (I) thiocyanate.
3. Gravimetric estimation of nickel as nickel dimethylglyoximate.
4. Gravimetric estimation of zinc as zinc oxide.
5. Paper chromatographic separation of Fe^{3+} and Ni^{2+} ions.
6. Determination of solubility of sparingly soluble salt (like $BaSO_4$) by conductometric method.
7. Determination of Ka (dissociation constant of a weak acid) by conductometric method.
8. Determination of rate constant of saponification of ethyl acetate by conductivity measurements.
9. Determination of percentage composition of a given mixture containing two miscible liquids by Abbe's refractometer (Demo).
10. Colorimetric study of kinetics of oxidation of indigocarmine by chloramine-T.
11. Preparation of standard potassium dichromate solution and estimation of iron in the given sample of hematite by dichromate method.
12. Estimation of copper in bronze by iodometric method.

Reference Books

1. A.I. Vogel, A Textbook Quantitative analysis, ELBS.
2. B.K. Sharma, Instrumental methods of Chemical analysis, Goel Publishing House.
3. Gurudeep Raj, Advanced Practical Inorganic Chemistry, Goel Publishing House.
4. M.A. Malati, Experimental Inorganic/Physical Chemistry, Horward Series in Chemical science.

Course Code	Human Genetics Lab	Course Type	L	T	P	C	CH
B21GN0502		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

1. Students should have basics of genetics knowledge.
2. They should have knowledge of morphology of chromosomes.

Course Objectives:

The Objectives of this course is to:

1. To study different banding techniques and karyotypes
2. To understand the concept of dosage compensation in different cells.
3. To analyse the count of blood cells
4. To construct the pedigree and record the fingerprints.

Course Outcomes:

After completing the course, the student should be able to:

1. Analyse the karyotypes and interpret the disorder.
2. Visualize Barr body in epithelial cells and drumsticks in neutrophils.
3. Diagnose genetic diseases.
4. Compare the fingerprints in forensic investigation.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0502	CO1	3	3	3			3	0			3	3	3	3
	CO2	3	3	3	3		3	3			3	3	3	
	CO3	3	3	3	3		3				3	3	2	3
	CO4	3	3	3	3		3	3	3		3	3	3	3

Course Contents:

1. Study of Karyotypes I: Normal Karyotyping in Human 1Prc. Male (46, XY) Female (46, XX).
2. Study of Karyotypes II: Abnormal Karyotypes 1 Prc. Down's syndrome (autosomal). Turner's syndrome (sex chromosomal), Klinefelter's syndrome (sex chromosomal)
3. Study of banding techniques (G-banding technique).
4. Study of drum sticks in Neutrophils of Blood smear.
5. Blood Cell counting using Haemocytometer (RBC and WBC).
6. Pedigree analysis and construction: Symbols used and problems associated with autosomal recessive disorder, autosomal dominant disorder, Sex linked inheritance (X and Y)
7. Dermatoglyphics: Recording of print of fingertips and palm. Classifying ridges on the Finger tips: arch, loop, and whorl. Palm print - area demark as hypothenar, thenar and inter - digital areas, Recording presence or absence of Simian crease. Ridge Counting and angle calculation.

Reference Books:

1. Basic Human Genetics by EJ. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics- Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Sounders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R. Korf. 2000
8. Human Genetics: Concepts and Applications by Lewis R (2001) McGrawHi; Boston.
9. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
10. Medical Genetics. Lynn Jorde John CareyMichaelBamshad. 2015.

11. Mendelian inheritance in Man by-Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
12. Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (EdsOMcGrawHill, New York.

SIXTH SEMESTER

Course Code	Agriculture Microbiology	Course Type	L	T	P	C	CH
B21MI0601		**HC**	**2**	**1**	**0**	**3**	**4**

Prerequisites/Pre reading for the course:

Students should have the knowledge of use of microbes in the agriculture

Course Objectives:

1. Explore the role of microorganisms and their application in agriculture.
2. Inculcate the beneficial aspects of microorganisms for sustainable agriculture.
3. Utilisation of microorganisms and its important role in sustainable environment.
4. To acquire the knowledge of environmental pollution sources, effect and control measure using microorganisms.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0601	CO1	2	1	1	2	3	1	1	1		3	2	1	1
	CO2	1	2	2	1	2	2	1		1	2	1	1	1
	CO3	1	2	2	1	1	1	1		2	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	3

Course Outcomes:

By the end of the course the student will be able to:

1. Analyse agricultural microorganisms and their beneficial and deleterious aspects
2. Utilisation of various microbes for sustainable soil fertility and crop development
3. Analyse the environmental issues, conditions and their deleterious effects
4. Designing for better bioremediation and waste management strategies.

Course Contents:

Unit-I Soil Microbiology **12 hrs**

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and a symbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllo sphere. Plant diseases causing Microbes, Bacterial Blight, Powdery mildew. Mosaic Virus.

Unit -II Microbes for Sustainable Agriculture 12 hrs

Silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste. Definition of biotransformation, Biotransformation process, Biotransformation in plant cells via Agrobacterium mediated gene transfer. Applications of Biotransformation.

Unit-III Phytopathogens and its control 12 hrs

Importance and history, definitions and concepts of plant diseases, Classification of Plant Diseases. Phytopathology – Classification of plant diseases, signs, and related terminology. Bacterial disease – Citrus canker, Blight of paddy, Fungal Disease- Red rot of sugarcane, Black stem rust of wheat, Tikka leaf spot, Wilt of cotton, Viral Disease – TMV, Vein clearing disease. Principles and methods of plant disease management, integrated plant disease management

Unit-4 Microbial Interaction in the environment 12 hrs

Interaction between soil microbes–Neutralism, Commensalism, Symbiosis, Synergism, Amensalism, Parasitism, Predation and Competition. Interrelationships between soil microbes and plants, Rhizosphere concept, R:S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae-types, Rumen flora, Insects microbial interactions.

References

1. Subba Rao NS (2004). Soil Microbiology.Fourth edition, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.

2. Mishra RR (2004). Soil Microbiology. First edition, CBS Publishers and distributors, New Delhi.

3. Rangaswami G and Mahadevan A (2002). Disease of Crop Plants in India.Fourth edition, PHI Learning (P) Ltd., New Delhi.

4. Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi.

5. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York.

6. R,M, Atlus and Richard Bartha (2000). Microbial Ecology, Fourth edition, An imprint of Addison Wesley Longman, Inc, New York.

Course Code	Chemistry-VI	Course Type	L	T	P	C	CH
B21CH0601		HC	3	0	0	3	4

Prerequisites:

Basic Knowledge of ligand, types of chemical bonding, periodic table, pi bond and sigma bond,

laws of photochemistry.

Course Objectives:

1. To give students a firm grounding in Co-ordination chemistry.
2. To impart knowledge about radioactivity and nuclear chemistry.
3. To introduce the photochemistry, important photochemical process in our lives and understand the different photochemical reactions. Also introduce the solidstate chemistry and importance X-ray diffraction to understand the crystalline materials structure.
4. To impart knowledge about different spectroscopic techniques.

Course Outcomes:

1. Understand the fundamentals of coordination chemistry, Isomerism and M-L bonding in transition metal complexes.
2. Acquire the knowledge about different nuclear energy resources, radioactivity and nuclear chemistry.
3. Appreciate the natural photochemical reactions, drive towars the usage of natural energy resource and to be analyse structure of crystalline solids with the help of XRD.
4. Analyse the different organic compounds using the UV-vis, IR aand NMR spectroscopy and to elucidate their structures.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0601	CO1	2	2	2	1		1				1		1	
	CO2	3	2	1	1						2	1	1	
	CO3	2	1	2	2		1				2	2	1	
	CO4	2	3	1	2		1	1			2	1	1	

Course Contents:

UNIT-I **12hrs**

Coordination and Organometallic compounds:

Coordination compounds, ligands and their classification (mono, bi, tri, tetra, penta and hexa dentate ligands) and ambidentate ligands, coordination number, nomenclature of coordination compounds in detail. Theories of structure and bonding (Explanation for the formation of complexes by Werner's Theory in detail and its limitations). EAN rule, Valence bond theory postulates, low spin and high spin complexes with examples, limitations of VBT. Crystal field theory (octahedral, tetrahedral and square planar complexes). Crystal field splitting and crystal field stabilization energies, limitations of CFT. Magnetic properties of $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$. Spectral properties of $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$.

Isomerism-Structural: ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism-geometrical and optical isomerism (CN: 4 & 6) with examples.

Organometallic compounds– ligands, classification (hapticity). Synthesis and structure of $K[PtCl_3(\eta^2\text{-}C_2H_4)]$ and $[Fe(\eta^5\text{-}\ C_5H_5)_2]$.

UNIT-II **12Hrs**

Nuclear Chemistry: Introduction to Nuclear forces (brief explanation), nuclear stability-n/p ratio, Mass defect, Binding energy, Inner structure of nucleus- Liquid drop model, Nuclear fission-(definition with suitable examples), Calculation of energy release in nuclear fission, modes of release of fission energy (uncontrolled and controlled).

Plutonium as a fissionable material (Plutonium bomb), nuclear fusion and its advantages over nuclear fission reactions, hydrogen bomb, nuclear transmutation-artificial radioactivity. Detection and measurement of radioactivity – G. M. counter. Cyclotron, Nuclear reactor, Breeder reactor, Q values of nuclear reactions.

Uses of radio isotopes – tracer technique, agriculture, medicine, food preservation and carbon-14-dating (explanation). Separation of uranium isotopes – Laser irradiation method (atomic and molecular routes). Nuclear programme in India.

UNIT-III **12Hrs**

Laws of Photochemistry: Grotthus-Draper law, Stark-Einstein law, Differences between photophysical and photochemical processes with examples. Comparison of photochemical and thermal reactions. Quantum yield of photochemical combination of (1) H_2 - Cl_2 (2) H_2 - Br_2, (3) dissociation of HI (4) dimerisation of anthracene. Photochemistry: Primary and secondary processes in photochemical reactions. Photoelectric cells.

Basics of Crystallography: Classification of solids, CCP, HCP, Packing fraction, voids etc, Laws of crystallography – (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements of crystals. Definition of unit cell & space lattice. Bravais lattices, crystal system. X-ray diffraction by crystals. Derivation of Bragg equation and its application in the determination of crystal structure of NaCl by rotating crystal method (Numericals).

UNIT-IV **12Hrs**

Spectroscopy of Organic compounds

UV-Visible spectroscopy: Introduction to spectroscopy, Absorptions laws, types of electronic transitions. Chromophores and auxochromes, blue shift and red shift. Conjugation and solvent effects. UV-visible spectra of some organic compounds (naphthalene, anthracene and beta-carotene).

IR spectroscopy: Introduction, principle, theory of molecular vibrations, number of fundamental vibrations, factors influencing vibrational frequencies. Stretching frequency of –OH (free and H-bonded), alkyl –C-H, -C=C-H, C=C, C-C, C=O and C-O groups (by taking suitable examples). IR spectra of some organic compounds.

NMR Spectroscopy: Basic principles, quantum approach- Magnetic nature of electron and nucleons, basic NMR equation. Equivalent and non-equivalent protons. Chemical shift. TMS as reference, Spectra of simple organic molecules ethanol, ethyl bromide, acetaldehyde, and toluene.

Qualitative Organic Analysis: Identification of functional groups by chemical tests; elementary UV, IR and ^1H NMR spectroscopic techniques as tools for structural elucidation.

Reference Books:

1. Puri, Sharma & Kalia Shobhanlal Nagin, Principles of Inorganic Chemistry, Chand Co.

2. Gurudeep Raj, A Textbook of Inorganic Chemistry.
3. J.D. Lee, Concise Inorganic Chemistry B-Block Well Science Ltd.
4. Sathya Prakash, A Textbook of Inorganic Chemistry
5. D.L. Pavia, G.M. Lampman, G.A. Kriz and J.R. Vyvyan, Introduction to Spectroscopy, Cingage Learning, 5th edition, 2015.
6. M.K. Jain, A Textbook of Organic Chemistry, S. Chand & Company.
7. Bhal & Bhal, A Textbook of Organic Chemistry, S. Chand & Company.
8. V.K. Ahluwalia & Renu Aggarwal, Organic Synthesis special techniques, Narosa publishing.

Course Code	Evolutionary & Biometrical Genetics	Course Type	L	T	P	C	CH
B21GN0601		HC	2	1	0	3	4

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of theories of evolution.
2. Students should be aware Basic mathematical concepts.

Course Objectives:

The Objectives of this course is to:

5. To explain the concept of population genetics and its application in studying the evolution of the species.
6. To discuss the inheritance involving quantitative characters.
7. To study the basics of statistics and its applications.
8. To apply the knowledge of biometry in genetic variation.
9.

Course Outcomes:

After completing the course, the student should be able to:

1. Characterize the genetic variations observed in population.
2. Explore the mechanism of transposition.
3. Discuss the inheritance of quantitative characters.
4. Apply the knowledge of biometry in the phenotypic variation of traits.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0601	CO1	3	3	3		3	2	2			3	3	2	
	CO2	3	3	2							3	3	2	
	CO3	3	3	3		3	2				3	3	2	
	CO4	3	3	3	3	3	2					3	2	

Course Contents:

UNIT-I **12 hrs**

Darwinism, Neo Darwinism and Synthetic Theory.
Population genetics: Gene pool, Gene and genotype frequencies: Hardy-Weinberg principle,
Evolutionary agents: Selection – differential selection, gametic selection, zygotic selection, fitness; Migration; Mutation and Random drift.
Speciation: Methods of speciation, - Isolating Mechanisms-Pre-mating and Post mating. Evolution at molecular level: - Nucleotide sequence.
Transposable elements: Bacteria, Yeast, Maize and *Drosophila*, humans.

UNIT-II **12 hrs**

Quantitative Characters and Inheritance:
Quantitative Characters: -Types- Continuous, meristic and threshold characters with examples.
Quantitative inheritance: -Features of polygenic traits in relation to oligogenic traits. Inheritance of Kernel color in wheat and Skin colour in human.
Transgressive inheritance in Poultry.
Environmental effects–IQ in Humans
Significance of polygenic inheritance-Twin study

UNIT-III **12 hrs**

Elements of Biometry
Measures of Central Tendency – Mean, Median and Mode
Measures of Dispersion – Variance and Standard deviation
Test of Hypothesis – Student's 't' Test, Chi square Test.
Probability – Definition and rules.
Distribution – Normal, Binomial and Poisson.

UNIT-IV **12 hrs**

Biometrical Genetics:
An introduction to Correlation, Regression and ANOVA (Analysis of Variance)
Genetic analysis of quantitative trait: - Ear length in Corn
Variances in polygenic traits: - Phenotypic, genotypic, environmental, additive, dominance and Epistatic variance; Genotype and environmental interaction.
Heritability: - Broad sense and Narrow sense heritability, Quantitative trait loci (QTL). Problems related to Variance and Heritability.

Reference Books:

1. Evolution –Stickberger, M. W (1990) Jones and Bartlett, Boston.
2. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
3. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
4. Introduction to Quantitative Genetics by Falconer, D (1995) 4th edition Longman, London.

5. Population Genetics and Quantitative Genetics by Mari selvi K. Kalyani Publications. 2008.

Course Code	Chemistry of Bio Molecules	Course Type	L	T	P	C	CH
B21CHS611		SC	3	0	0	3	4

Prerequisites:

Amino acids, proties, peptides, carbohydrates, lipids etc.,

Course Objectives:

1. Understand the significance of biomolecules in various biological functions.
2. Develop the knowledge on various methods to synthesis amino acids form available starting materials.
3. Explain the stuctue and functions of various biomoleucles such as nucleic acids, enzymes and vitamins.
4. Discuss the role of aminoacids, proteins and peptides in living system.

Course Outcomes:

1. Classify the different type of biomolecules, explain their structure and functions.
2. Predict the role of biomolecules in various biochemical mechanisms.
3. Outline the significance of amino acids, enzymes, lipids, nucleic acids and carbohydrates.
4. Build the importance of essential and trace elements in the biological processes.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS611	CO1	3	2	2	1		2				1	2	3	2
	CO2	3	2	2	2		1	1				2	3	3
	CO3	2	3	2	1						2	2	3	2
	CO4	2	3	2	2			1			1	3	3	2

Course Contents:

UNIT-I **12 hrs**

Introduction to Biomolecule.

Carbohydrates:

Introduction and definition, Types of naturally occurring sugars. Deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars. Structure, degradation and biological functions of starch, cellulose and chitin.

Lipids:

Introduction, isolation and properties of lipids. Oils and fats: definitions and significances of hydrogenation, iodine value, saponification value and auto-oxidation of oils and fats. Phospholipids: lecithins, cephalins and phosphatidyl serine. Sphingolipids: sphingosine, sphingomyelin and cerebrocides.

UNIT-II **12 Hrs**

Drugs: Chemotherapy and chemotherapeutic agents, definition of drugs, types of drugs, antipyretics, analgesics, anesthetics, sedatives, narcotics, antiseptics, antibacterials, antibiotics, antimalarials and sulpha drugs with examples. Synthesis of paracetamol, sulphanilamide, sulphaguanidine, Insectisides, Pesticides.

UNIT-III **12 hrs**

Enzymes and Vitamins

Enzymes

Characteristic features, classification (EC code number not required) active site, specificity, Fisher and Koshland models. Enzyme kinetics-factors affecting rate of enzymatic reactions, Michaels Menten equation (derivation not required). Competitive and non-competitive inhibition. Cofactors.

Vitamins

Definition, classification and deficiency manifestation of water soluble and fatsoluble vitamins. Coenzyme functions of B complex vitamins.

UNIT-IV

Amino acid, peptide and proteins **12 hrs**

Essential and non-essentialamino acids, amino acids buildingblocks of proteins, classification, structure and properties of amino acids, peptide bonds. Biologically important peptides, Protein-primary, secondary, tertiary andquaternary structures. Outline of variousbiological functions of proteins, Basictechniques in protein chemistry.

Reference Books:

1. J.D. Rawn, Biochemistry, Neil Pattuson publishers, North Carolina, USA, 1989.
2. I.L. Finar, Organic Chemistry, Vol I and Vol II, 6th edn. ELBS & Longman, London, 1975.
3. D. Chapman, Inroduction to Lipids, McGraw-Hill, 1969.
4. S.K. Ghosh, Advanced general Organic Chemistry, DK and Allied publishers (UBS), Calcutta, 1998.
5. E.S. West, W.R. Todd, H.S. Mason & J.T. Van Bugen, Text book o Biochemistry, 4th Edn. Amerind publishing co., New Delhi, 1974.
6. Ashuthosh Kar, Medicinal Chemistry, Tata Mcgraw Hill Publications.

Course Code	Electro-Analytical Chemistry	Course Type	L	T	P	C	CH
B21CHS612		SC	3	0	0	3	4

Prerequisites:

Basic knowledge of electorchemistry, cells, batteries, corrosion, electodes, anode, cathode, electrochemical series, standard hydrogen electrode potential, EMF.

Course Objectives:

1. Explain the fundamental concept, principles and laws of electrochemistry,
2. Discuss related to the types of electrodes and study of electrode reactions pathway.
3. Classify the types of corrosion and its controls.
4. Describe the concept of electrochemical sensor, electrochemical energy storage and conversion devices.

Course Outcomes:

1. Analyze the basic concepts of electroanalytical techniques.
2. Classify the types of electrochemical reaction and its mechanism.
3. Apply the knowledge of corrosion science and its control essential for the commercially available materials.
4. Design the electrode with suitable materials for various application in the field of electrochemical sensors, electrochemical energy storage and conversion devices.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CHS612	CO1	1		1	1						1	3	1	3
	CO2	1	2	2	1							1	1	2
	CO3	1		2	1						3	2	1	2
	CO4	1		1	2						2	3	3	1

Course Contents:

UNIT-I **12 Hrs**

Basic electro chemistry: Electrochemistry Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series.

Polarography: Definition, advantage of dropping mercury electrode, factors affecting on limiting current, Half wave potentials and significance, Ilkovic equations, Applications of Polarography

Amperometric Titrations: Basic principle involved in the Amperometry, Amperometric Titrations and applications, Advantages and disadvantages of Amperometric Titrations.

UNIT-II **12 Hrs**

Electro analytical methods: Potentiometry, Conductometry, Colorimetry, cyclic voltammetry and pulse voltammetry.

Electrochemical sensors: Potentiometric Sensors and voltammetric sensors, Non-enzymatic Sensors for determination of-Amino Acids, Glucose, hydrogen peroxide and urea.

UNIT-III **12 Hrs**

Electro Chemical Energy Storage and Conversion Devices:

Batteries: Definition, Types, primary batteries- dry cell, Secondary batteries- Lead acid, Ni-Cd, Lithium-Ion Batteries.

Super capacitors- Electrical double layer capacitor, pseudo capacitors and hybrid capacitors.

Fuels cells: Fuel cell working principle, classification of fuel cells-Hydrogen-Oxygen and Methanol-Oxygen, solid oxide fuel cell.

Photovoltaic Cells: Definition, synthesis of semiconductor grade silicon, doping of silicon, construction and working of PV cell.

UNIT-IV **12 Hrs**

Corrosion: definition, Types of Corrosion: Dry Corrosion (Direct Chemical attack), Wet Corrosion. Electrochemical analysis- Equilibrium potential methods, Anodization potential methods. Tafel plots and Impedence –Charge transfer resistance. Corrosion Control.Pourbias diagram: Water-iron system, water-Aluminium

Electrplating: Theory of electroplating, factor affecting nature of eleectrodeposits. Electroplating of gold using acid, basic and netral cyanide baths. Electroless plating of copper

Reference Books:

1. Monk, Fundamentals of Electroanalytical Chemistry.
2. B.K. Sharma, Engineering Chemistry
3. Jayaprakash and Venugopal, Engineering Chemistry.

Course Code	Agricultural Microbiology Lab	Course Type	L	T	P	C	CH
B21MI0602		HC	0	0	1.	1.	3

Prerequisites/Pre reading for the course:

Students should know importance of the microbiology in agriculture and their handling.

Course Objectives:

1. To acquire the knowledge of eco-friendly microorganisms.
2. To understand plant disease causing pathogens and their effect on crop production.
3. Explore various parameters to assess for environmental pollution level.
4. To facilitate the understand of impact of industrial effluent on environment.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21MI0602	CO1	2	1	1	2	1	2	1	1	2	3	2	1	2
	CO2	1	2	2	1	2	1	1		2	2	1	1	1
	CO3	1	2	2	1	1	1	1		3	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	1

Course Outcomes:

By the end of the course the student will be able to:

1. Hands-on experience in isolation and culturing of beneficial microorganisms
2. Analyse various techniques involved in testing soil microorganisms for crop productivity.
3. Determine the pollution level and their significance n environment.
4. Categorise the pollutants based on their hazardous effects.

Course Contents

1. Isolation and identification of *Rhizobium* root nodules
2. Isolation and identification *Azospirillum* from roots.
3. Isolation and identification of *Azotobacter* from soil and BGA
4. Isolation and identification of plant pathogens - Fungus and
5. Isolation and identification of plant pathogens - Bacteria.
6. Staining and microscopic examination of VAM.
7. Determination of Biofertilzer capacity in plant growth.
8. Determination of Biocontrols capacity and their interactions

References

1. Mishra RR (2004). Soil Microbiology. First edition, CBS Publishers and distributors, New Delhi.

2. Rangaswami G and Mahadevan A (2002). Disease of Crop Plants in India.Fourth edition, PHI Learning (P) Ltd., New Delhi.

3. Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi.

4. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York.

Course Code	Chemistry Practical–VI	Course Type	L	T	P	C	CH
B21CH0602		**HC**	**0**	**0**	**1.**	**1.**	**3**

Prerequisites:

Basic knowledge of ore, alloys and their compositions. Analytical techniques such as TLC and Column chromatography.

Course Objectives:

1. To demonstrate the analysis of given ore, alloy, phenol and biomolecules by titrimetric methods.
2. Exposure to prepare various standard soltutions using molarity and normality calculations.
3. Allow independently for the separation of organic compounds with the knowledge of TLC using colum chromatographic technique.
4. Analyze the spectral data to obtain the structure of the organic compound.

Course Outcomes:

1. Apply the knowledge on preparation of standard solution, estimation and separation of organic comounds using column chromatographic technique.
2. Estimate the quantitative analysis of organic and in organic compounds by titrimetric method.
3. Acquire knowledge on various titrimetric and complexometric methods in estimation of ore and organic molecules.
4. Design basic research problems in the analysis of ore, alloy and organic molecules.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21CH0602	**CO1**	3	3	3	3			2			2	3	2	3
	CO2	3	3	2	3			2			2	3	1	2
	CO3	3	3	2	3			2			2	3	2	2
	CO4	2	2	3	3			2			2	3	3	3

Course Contents:

1. Separation of p- and o- nitroaniline by TLC method and column chromatography. (Solvent extraction).
2. Estimation of glucose by Fehling solution method.
3. Estimation of ascorbic acid by iodometric method.

4. Determination of Iodine value of oils by chloromine-T.
5. Study of enzyme kinetics (by taking any one example)
6. Estimation of alpha amino acids by using Ninhydrin by colorimetric method.
7. Estimation of creatinine by Jaffe's method.
8. Separation of a-amino acids by paper chromatography.
9. Estimation of total reducing sugars by DNS (dinitrosalicylic acid) method.
10. Isolation of lactose and casein from milk and estimation of lactose by colorimetric method.
11. Estimation of inorganic phosphate by Fiske- Subbarow Method
12. Isolation of Castor oil from Castor seeds.
13. Preparation nanocellulose from sugar cane bagasse.

References for Practicals:

1. A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford and P.W.G. Smith, Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. F.G. Mann, and B.C. Saunders, Practical Organic Chemistry, Orient-Longman, 1960.
3. O.P. Pandey, D.N. Bajpai and S. Giri, Practical Chemistry, Revised Edition, S. Chand Company Pvt Limited, 2014.
4. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., Pearson, 2009.
5. G. Svehla, Vogel's Qualitative Inorganic Analysis, Pearson Education, 2002.

Course Code	Evolutionary & Biometrical Genetics Lab	Course Type	L	T	P	C	CH
B21GN0602		HC	0	0	1.5	1.5	3

Prerequisites/Pre reading for the course:

1. Students should have the knowledge of evolution.
2. Students should be aware of the asic mathematical concepts.

Course Objectives:

The Objectives of this course is to:

1. To study various inheritance involving quantitative traits.
2. To compute the statistical analysis for biological data.
3. To calculate the allelic and genotype frequencies with different inheritance data.

Course Outcomes:

After completing the course, the student should be able to:

1. Understand the pattern of quantitative inheritance.
2. Learn the statistical concepts used for data collection.
3. Analyze the data statistically.
4. To predict the allelic variations in the population.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
B21GN0602	CO1	3	3		3	3	2	3		3	3	3	2	
	CO2	3	3	3	3		3	3	2	3	3	3	2	
	CO3	3	3	3	3		3	3		3	3	2		
	CO4	3	3	3		3	3	3		2	3	3	2	

Course Content:

1. Study of Quantitative inheritance in Kernel colour in Wheat/Skin colour in man .
2. Genetic problems on polygenic variance, Heritability and ANOVA
3. Biometrical Computation of:
   a. Mean, Median and Mode
   b. Variance, Standard Deviation

c. Problems on: Student's 't' test and Chi square test

4. Biometrical problems (Minimum 3 problems in each topic)
5. Hardy Weinberg Genetic equilibrium: Study of gene & genotype frequencies. (PTC Tasters &nontasters)
6. Blood group typing using haemagglutination tests and calculation of allele frequencies.
7. To test for colour blindness using Ishihara charts and calculation of allele frequencies
8. Study of frequency of twins in the local population.

Reference Books:

1. Evolution –Stickberger, M. W (1990) Jones and Bartlett, Boston.
2. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
3. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
4. Introduction to Quantitative Genetics by Falconer, D (1995) 4th edition Longman, London
5. Introduction to Quantitative Genetics by Falconer, D (1995) 4th edition Longman, London.
6. Population Genetics and Quantitative Genetics by Mari selvi K. Kalyani Publications. 2008.

Course Code	Project	Course Type	L	T	P	C	CH
B21SE0601		**HC**	**0**	**0**	**4**	**4**	**8**

CAREER OPPORTUNITIES

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look forinclude:

1.Willingness to learn

2.Self motivation

3.Team work

4.Communication skills and application of these skills to real scenarios

5.Requirement of gathering, design and analysis, development and testing skills

6.Analytical and Technical skills

7.Computer skills

8.Internet searching skills

9. Information consolidation and presentationskills

10. Roleplay

11. Group discussion, and soon

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full0fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre0placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overallpersonality.

The need of the hour in the field of Microbiology, Chemistry, Genetics isnot only the knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along

with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Applied sciences also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day-to-day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University0Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre, the students shall compulsorily complete at least two skills / certification-based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOUs with Multi0National Companies, researchinstitutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certificationprograms.

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REVA UNIVERSITY
Bengaluru, India

(School of Arts, Humanities and Social Sciences)

BA PEJ

HANDBOOK

2021-24

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Content

Chancellor‟s Message

“Education is the most powerful weapon which you can use to change the world.”

- Nelson Mandela

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when „intellectual gratification‟ has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of „Knowledge is Power‟, we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I am always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practise the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author of the 19th century - Benjamin Disraeli, once said „A University should be a place of light, of liberty and of learning‟. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

The Founder and Honorable Chancellor, REVA University

Vice-Chancellor‟s Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum “Knowledge is Power”, REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this „temple of learning‟ has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Benchmarked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevance to industry requirements. Structured training programs on soft skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character – that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of overall personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Vice-Chancellor, REVA University

Message from the Director of the School

“For last year‟s words belong to last year‟s language/ And next year‟s words await another voice/and to make an end is to make a beginning.” (T.S. Eliot) A hearty welcome to this „new beginning‟! The School of Arts, Humanities and Social Sciences at REVA University, one of the most sought-after schools, has cut a niche for itself by building a prominent academic record. The School offersUndergraduate, Postgraduate, and Ph.D. programs to scholars from all over the world, initiating inthem the continuous urge to delve into the vast arena of creative and critical thinking.

The programs of study offered in the school foster cultural, social and political understanding and enhance the creative abilities of the scholars. Here, students not only develop knowledge in their areaof specialization but also acquire practical skills useful for their future careers. We are at a wonderfulphase when the domain of Arts, Humanities and Social Sciences all over the world is taking very meaningful and innovative turns. With various new career opportunities and specializations coming to the forefront, young enthusiasts have the boon of limitless career choices. We, at REVA University, deem it fit to channelize the potential of the young minds towards newer horizons. With the expertise of the highly qualified and committed teaching faculty members of the School, we continuously strive to provide the best practical knowledge to our students.

This academic year, keeping in mind our trend, our goals are set very high. Focusing primarily on Research and Development, the School will initiate every scholar under our wings to take a step forward in their specialized areas by engaging in collaborative and individual research projects. Research collaboration with other prestigious organizations is also in the pipeline. Many external subject specialists from the teaching fraternity as well as industry will bring in their expertise to our scholars, providing them with current scenarios of the entire world.

I invite you to participate in the many opportunities offered by the School of Arts, Humanities and Social Sciences join our hands to strengthen our participation in the international global Humanities forum.

The curriculum caters to and has relevance to Local, Regional, National, and Global developmental needs.

Maximum number of courses are integrated with cross-cutting issues with relevant to professional ethics, gender, human values Environment & Sustainability.

With Best Wishes,

Dr. Payel Dutta Chowdhury
Director
School of Arts, Humanities and Social Sciences

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born out of the philanthropic instincts of Dr. P. Shyama Raju to engage in public welfare, quite in keeping with his support to other socially relevant charitable works, such as, maintaining the Richmond Road Park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to Ph.D. degrees. REVA has well qualified experienced teaching faculty members of whom majority are doctorates. The faculty members are supported by committed administrative and technical staff. Over 15,000+ students study various courses across REVA‟s three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette dated 27th February, 2013. The University is empowered by UGC to award degrees in any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University, located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library, central computer center, a well-planned sports facility with cricket ground, running track and variety of indoor and outdoor sports activities, and facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and support staff.

The University is presently offering 26 Post Graduate Degree programs, 34 Undergraduate Degree programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 410 scholars pursuing research leading to Ph.D. in 19 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to Ph.D.

The programs offered by the REVA University are well planned and designed after detailed study with emphasis on knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty members and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for various programs. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty members supported by the experts from industries, business sectors and such other organizations.

REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in the confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students" placements.

REVA University recognizes the fact that research, development and innovation are the important functions of any university and has therefore, established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. Interdisciplinary and multidisciplinary research is given the topmost priority. The division continuously liaisons between various funding agencies, R&D Institutions, industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

REVA University has also given utmost importance to develop the much-required skills through variety of training programs, industrial practice, case studies and such other activities that induce various skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor and Dean, and supported by well experienced Trainers, Counselors and Placement Officers is one of the highlights of the university.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on

courses in challenging areas of development. It is always active in facilitating students a variety of Skill Development Training programs.

The University has collaborations with industries, universities abroad, research institutions, corporate training organizations, and Government agencies, such as, Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitate students to study some of the programs partly in REVA University and partly in foreign university, viz, MS in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training the faculty members to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA University organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities, such as, Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc, and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defense Dr. Sathish Reddy, Scientific Advisor, Ministry of Defense, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring the youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such awards instituted by REVA University is **„Life Time Achievement Award‟** to be awarded to successful personalities who have made a mark in their field of work. This award is presented on the occasion of the **“Founders‟ Day Celebration”** at REVA University on 6th January every year in the presence of dignitaries, faculty members and students. The first “REVA Lifetime Achievement Award” for the year 2015

has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr. K J Yesudas, renowned playback singer for the year 2017. REVA has also introduced the "**REVA Award of Excellence"** in the year 2017 and the first awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA University organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVOTHSAVA conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, quizzes, group discussions, seminars, exhibitions and a variety of cultural events. Another important event is the Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective sphere of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised with awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday for students, faculty members, administrative staff and their family members and organises yoga camps for villagers in the vicinity.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honoured with many more such honours and recognitions.

SCHOOL OF ARTS, HUMANITIES AND SOCIAL SCIENCES

The School of Arts, Humanities and Social Sciences, established in the year 2014, is one of the most sought-after Schools for Humanities programmes. At present the School offers three under-graduate programmes - B.A. in Journalism, English and Psychology; B.A. in Political Science, Economics and Journalism and B.A. in Tourism, History and Journalism and three post-graduate programmes – M.A. in English, M.A. in Journalism and Communication and M.Sc. in Psychology. The School offers programs that prepare graduates who are aware of and can interact with contemporary thought and research in their respective specializations and utilize the same in their professional lives. The graduates will also be equipped with foundation of subjects and variety of skills required to compete in the global job market. The School also facilitates research leading to Ph.D. in humanities disciplines in English, Psychology, Hindi and Kannada.

Why Arts, Humanities and Social Sciences @ REVA University?

The UG and PG programs offered by the school are designed with an extremely contemporary curriculum, where learners get a variety of choices to select electives and specializations that they desire.

In **B.A. (JEP), B.A. (PEJ) and B.A. (THJ), B.A (JMC)** programs, students can experience a contemporary curriculum in a triple major scheme. In B.A. JEP, the focus is on equipping learners with various journalistic skills as well as creating a strong foundation of Psychology. The courses in English enable them to hone their communication which is the very basis of any career that they may choose in future. The triple combination opens wider avenues of career choices and ensures that students can decipher their own specialties in each stream. The needs of employers today are very global and intersperse different areas. Journalism provides opportunities in content writing, editing, filmmaking, photography, animation, print media, advertising, public relations etc. Psychology opens new areas in mental health such as counseling, clinical psychology, criminal psychology, human resources, personnel training etc. English is rudimentary to every aspect of the media field, particularly to writing, editing, publishing, content development, communication and teaching. The opportunities provided are limitless and with the emergence of New Media various individuals and associations are making their foray into blogging, vlogging, webcasting, podcasting and digital media marketing. Internships, research projects and placement trainings are integrated with the program to make it a full-fledged one. In B.A. PEJ, the students will gain an understanding of three

major core disciplines associated with humanities and social sciences - Political Science, Economics and Journalism and gather proficiency and eligibility to pursue higher studies in any of the branch of studies and also allied branches. They will also be equipped to prepare for various competitive exams for banking sector, central and state administrative government jobs. A Bachelor‟s Degree in Political Science, Economics and Journalism can help students to gain insights in various fields like media, management and administration in the public and private sectors. Career opportunities are available in academia, banking, economic consultancy, political campaign manager, politician, political consultant, international business specialist, PR specialist, and market researcher. The programme takes amulti-disciplinary approach to enlighten the students on the integral working of the significant three core subjects of the programme. In B.A. THJ program, the students will gain an understanding of three major core disciplines associated with humanities and social sciences - Tourism, History and Journalism and gather proficiency and eligibility to pursue higher studies in any of the branch of studies and also allied branches. A Bachelor‟s Degree in Tourism, Journalism & History addresses the requirements in the key sectors like hotels, restaurants, retailing, transportation, travel agencies, tour companies, tourist attractions, leisure, recreation and sport, and cultural industries. Besides these, students can also find scope in the industry as Travel Journalist, Travel Photographer, Blogger & Vlogger Archivist, Heritage manager, Historic buildings conservation officer, Museum or gallery curator, academia and research. The forte of this program is its multi-faceted approach to prepare skilled, confident, well-groomed and diligent aspirants who are well versed in the integral workings of the Tourism & Hospitality industry. In BA Journalism and Mass Communication programme, students are exposed to holistic learning that broadens their world-view and equips them to become effective communicators in all walks of life. This intricacy of maneuvering as a skilled communicator in both professional and personal spaces is what sets the programme apart and highlights its multi-dimensional nature.

The PG programs in English; Journalism and Communication, and M.Sc. Psychology are designed to make students ready for their future career. The focus in **M.A. English** program is to equip students with a complete knowledge of recent trends and concerns in literature and language in a global context. Emphasis is on building research skills in the learners and the courses are also exposed from that perspective. Learners are mentored and guided to take up various MOOC and other certification programs in their areas of interest. A compulsory research project is carried out by all students which is a preparation for serious research in the future. Various placement trainings in content writing, teaching pedagogy, etc. are designed within the curriculum. The **M.A. in Journalism &**

Communication at REVA University is outlined with subtle observation on the contemporary advancements in the field of journalism and mass communication. The curriculum is precisely refined to promote an innovative learning platform to assimilate the fundamentals of journalism & communication aspects. Students studying this influential discipline learn the usage of the various media i.e. print, radio, television, internet, photography, visual communication, graphics and animation, content writing, technical writing, media research and so on. They gain an insight into the history and organizational structure of these media which in turn aids them in evaluating the policies of media and how they are affecting and influencing the masses. The students of this program gain a firsthand knowledge of all such skills through real-life experiences, internships, projects, and so on.

M.Sc. Psychology (Dual Specialization in Clinical Psychology and Organizational Psychology) program at REVA University is an extensive program which provides students an in-depth knowledge and training in the application of psychological theories and principles to the areas of Clinical and Organizational Psychology. The course for M.Sc. Psychology is well-structured in terms of academics and also combine the training and practical skills to equip for the present job market.

M.Sc. Psychology program is designed for students in such a way that it enhances their skills and competencies of an individual which is required for professional psychologists in the areas of Research, Assessment, Mental Health, Counselling, and Organizational Behavior.

USP of the Programmes Run by the School of Arts, Humanities and Social Sciences:

- Hi-tech State of the Art Media Lab and Studio with recording facility, radio room and editing room
- Well-equipped Psychology Labs
- Language Labs
- Contemporary curriculum
- Ample scope to gain practical exposure through internships. Present batch students are undergoing internships at Star Sports, Adzu Advertising, Red Advertisement, and so on.
- Academia-industry interface – expert lectures and workshops by resource persons from various industries, media houses, authors and academicians.
- Chance to participate in Vox Pops conducted by various TV Channels
- Chance to participate in various extension activities, such as, road shows, street theatre, educative programs, etc. in association with newspapers like *The Hindu* and other media houses.
- Training in event management – both in-house events and outside events, such as, International Film Festival conducted by Innovative Film City
- Training in anchoring for in-house events and outside events, such as, the Edu Expo by *The Hindu*

- Practical exposure through visits to various news channels, High Court, Press Clubs, etc.
- Certification programs, such as, Pearson Global English, Certification in Animation, Certification in Photography, etc.
- Certificate programs in foreign languages – French, German, Mandarin and Japanese
- Certification and training program for CBSE UGC NET exam
- Demo classes in teaching
- Training in placement/ employability skills integrated within the curriculum
- Complete guidance in research activities – students are trained by their mentors on presenting their research papers in conferences and seminars. They are also trained to publish their research papers in reputed journals. Many students have received "Best Paper" awards during conferences.
- Compulsory research project with complete guidance by teachers; deserving projects are published in the form of book or papers in journals.

VISION

To promote excellence in advancement of Arts, Humanities and Social Sciences disciplines, professions, and services through education, research, innovation, extension and collaboration.

MISSION

- Impart quality education to meet the needs of profession and society, and achieve excellence in teaching-learning and research in the area of communication, Journalism and Psychology through student-centric learning, interdisciplinary approach and innovative pedagogies;

- Attract and develop talented and committed human resource, and provide an environment conducive to research, innovation, creativity, and team-spirit;

- To establish collaborations, promote industry-university partnership, encourage entrepreneurship, and involve in community development services;

- Develop excellent infrastructural facilities, facilitate effective interaction among faculty and students with other schools, and foster networking with alumni, industries, institutions and other stake-holders; and

- To practice and promote high standards of professional ethics, enrich personality traits, promote patriotism and moral values.

ADVISORY BOARD

11. Mr. T.R GopalaKrishnan
Former Editor, The Week Magazine

Board of Studies Members

Sl. No.	Name	Designation	Institutional Affiliation
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4.	**Prof. Xavier V.K.**	Member (External Expert)	HOD, Dept. of Economics, Jain (Deemed-to-be) University, Bengaluru
5.	**Ms. Sharon Sebastian**	Member (External Expert)	Producer & Anchor, Flowers TV, Des Plaines, USA
6.	**Dr. Nandini Lakshmikantha**	Member (External Expert)	Professor, School of Media Studies, Manipal University, Manipal
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13.	**Prof. Pilla Venkataswamy**	Invitee (Assistant Professor, Economics, School of Commerce)	REVA University
14.	**Mr. Wahidullah Taniwal**	Student Member (B.A. PEJ) & Campus Ambassador at Peace Campaign Nepal American University of Afghanistan (AUAF)	REVA University

REVA University Academic Regulations

Bachelor Degree (3 years) Programs

(Applicable for the programs offered from 2021-24 Batch)

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – Bachelor Degree Programs 2021-24 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following Bachelor Degree Programs of REVA University offered during 2021-24:

BBA Honours in Hospital and Health Care Management
BBA Honours in Strategy and Leadership
BBA Honours in Business Analytics and Design Thinking
BBA Honours in Banking and Finance
BBA Honours in Talent Management and Marketing
B. Com Honours (Accounting and Taxation)
B. Com Honours (Banking and Finance)
B. Com Honours (Statistics and Accounting)
B. Com Honours (Economics and Finance)
Bachelor of Business Administration
Bachelor of Business Administration (Honours)
Bachelor of Business Administration (Entrepreneurship)
B. Com (Industry Integrated)
BA in Journalism and Mass Communication
BA in Tourism, History and Journalism
BA in Political Science, Economics and Journalism
BA in Journalism, English and Psychology
BA in Performing Arts, English and Psychology
BCA
BSc Microbiology Chemistry, Genetics
BSc in Nutrition and Dietetics
BSc in Medical Radiology and Diagnostic imaging
Bachelor of Science Honours in Computer Science with specialization in Multimedia and Animation
Bachelor of Science in Computer Science with specialization in Cyber Security
B.Sc. (Honours) in Computer Science (specialisation in Cloud Computing and Big Data)
B.Sc. Physics, Mathematics and Chemistry PCM
B.Sc Physics, Mathematics and Computer science (PMCs)
B.Sc. – Bioinformatics (Biology, Computer Science and Mathematics –BCsM)
B.Sc. (Biochemistry, Microbiology, Medical Laboratory Technology)
B.Sc. Mathematics, Statistics and Computer Science MStCs
B.Sc. (Biotechnology, Biochemistry and Genetics BBG)

3. Duration and Medium of Instructions:

3.1 **Duration:** The Bachelor Degree program is of 6 Semesters duration. A candidate can avail a maximum of 12 semesters - 6 years as per double duration norm, in one stretch to complete the Bachelor Degree, including blank semesters, if any. Whenever a candidate opts for blank semester, s/he has to study the prevailing courses offered by the School when s/he resumes his/her studies.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 **Course: "Course" means a subject, either theory or practical or both, listed under a program;** Example: "Business Research Methodology" in BBA (Honors) program, "Auditing and Corporate Governance" in B Com (Industry Integrated) program are examples of courses to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely:

L	**Lecture**
T	**Tutorial**
P	**Practice**

Where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

4.2 Classification of Courses

Courses offered are classified as: Foundation Courses, Core Courses, Hard Core Courses, Soft Core Courses, Open Elective Courses, Project work/Dissertation

4.2.1 **Foundation Course:** The foundation Course is a compulsory course which should be completed successfully as a part of graduate degree program irrespective of the program of study

4.2.2 **Core Course:** A course which should compulsorily be studied by a candidate choosing a particular program of study

4.2.3 **Hard Core Course (HC) simply core course:** The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily

4.2.4 Soft Core Course (SC) (also known as Professional Elective Course)

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study

4.2.5 **Mandatory Course (MC):** The mandatory course is non credited but must be passed in order to complete the Graduate Degree Program.

4.2.6 Open Elective Course (OE):

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course**

4.2.7 Project Work / Dissertation:

School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is considered to be equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project.

"Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to **Three Years Bachelor Degree** Programs (6 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Commerce (Industry Integrated)	6 Semesters	Pass in PUC/10+2 with minimum 50% marks of any recognized Board / Council or any

		(3 years)	other qualification recognized as equivalent there to.
2	Bachelor of Commerce (Honours)		Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
3	Bachelor of Business Administration (Industry Integrated)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 50% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
4	Bachelor of Business Administration (Honours)	6 Semesters (3 years)	Pass in PUC/10+2 with minimum 75% marks of any recognized Board / Council or any other qualification recognized as equivalent there to.
5	Bachelor of Business Administration (Entrepreneurship)	6 Semesters (3 years)	
6	**Bachelor of Arts in** a) Journalism, English & Psychology (JEP) b) Political Science, Economics, Journalism (PEJ) c) Tourism, History & Journalism (THJ) d) Journalism and Mass Communication (JMC)	6 Semesters (3 years)	Pass in PUC /10+2 of any recognized Board / Council or any other qualification recognized as equivalent there to.
7	Bachelor of Arts in Performing Arts, English & Psychology	6 Semesters (3 years)	
8	Bachelor of Computer Applications	6 Semesters (3 years)	Pass in PUC/10+2 with at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council of any other qualification recognized as equivalent there to.
9	Bachelor of Science (Hons.) in Computer Science (with specialization in Cloud Computing & Big Data)	6 Semesters (3 years)	Pass in PUC/10+2 examination with Mathematics / Computer Science / Statistics as compulsory subject along with other subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC/ST category) in the above subjects taken together from any Board recognized by the respective State Government /Central Government/Union Territories or any other qualification recognized as equivalent thereto.
10	**B Sc in** a) Physics, Chemistry and Mathematics (PCM) b) Mathematics, Statistics and Computer Science	6 Semesters (3 years)	Pass in PUC/10+2 with Mathematics as compulsory subjects and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as

	(MStCs) c) Physics, Mathematics and Computer Science (PMCs)		equivalent there to.
11	**B Sc in** a) Bioinformatics – Biology, Computer Science & Mathematics (BCsM) b) Biotechnology, Biochemistry, Genetics c) Medical Laboratory Technology (BMLT)	6 Semesters (3 years)	Pass in PUC/10+2 with Biology as compulsory subject and at least 45% marks (40% in case of candidate belonging to SC/ST category) of any recognized Board/Council or any other qualification recognized as equivalent there to.

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, University from time to time.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks, out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for IAs and final examination, evaluation and announcement of results.

6.3 The credit hours defined as below

In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching-learning process.

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

For Example: The following table describes credit pattern

Table -2: Credit Pattern

Lectures (L)	Tutorials (T)	Practice (P)	Credits (L:T:P)	Total Credits	Total Contact Hours
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4
2	0	0	2:0:0	2	2

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course

7. Different C**ourses of Study**:

Different C**ourses of Study** are labeled as follows:

a. Foundation Course (FC)
b. Core Course (CC)
c. Hard Core Course (HC)
d. Soft Core Course (SC)
e. Mandatory Course (MC)
f. Open Elective Course (OE)
g. Project Work / Dissertation: School can offer project work/dissertation as a course. Depending on the duration required for completing the project/dissertation work, credits can be assigned. Normally 26 hours of practical work/project work/dissertation work is considered to be equivalent to a credit. School can classify project as a minor or a major project depending on the credits allotted. Normally, a minor project carries 4-6 credits and a major project carries double the number of credits of a minor project.

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

Registered candidates are required to earn the credits stated in the scheme

The following courses are Foundation Courses. Students registering for any of the programs mentioned in the table above are required to successfully complete the courses for the award of the degree.

1. Communicative English
2. Languages K / H / Additional English

The following courses are Mandatory Courses. Students registering for any of the programs mentioned in the table above are required to successfully complete the courses for the award of the degree.

1. Indian Constitution
2. Environmental Science

8.2. The concerned BoS shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective and classify the courses as **Foundation Course (FC), Hard Core (HC), Soft Core (SC), Mandatory Course (MC) and Open Elective (OE).**

8.3. The concerned BoS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular

program.

8.4. A candidate can enrol during each semester for credits as prescribed in the scheme of the program.

8.5 Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VI semester and complete successfully prescribed number of credits for the award of the degree for three year program in 6 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

8.6 Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:, a candidate can opt to complete a minimum of 18-20 extra credits either in the same discipline /subject or in different discipline / subject in excess to prescribed number of credits for the award of 3 year degree in the registered program.

The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the candidate contains the courses studied and grades earned.

9 Assessment and Evaluation

9.1 The Scheme of Assessment will have two parts, namely;

1. Internal Assessment (IA); and
2. Semester End Examination (SEE)

9.2 Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of for 3 year programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

9.3 The 50 marks of internal assessment for 3 and 4 credit courses shall comprise:

Internal Test	30 marks
Assignments / Seminars / Quizzes / Presentations / Case Studies etc.	20 marks

9.3.1 The assessment and evaluation procedure for integrated course with theory 2 credits and practical 2 credits that has been designed.
L: T: P: C - 2-0-2-4 (Total Contact Hours: 6 hrs)

Total semester end theory examination and practical examination marks will be scaled down to 50

The marks distribution is - IA1 +IA2 + SEE (Theory and practical) = 25+25+50=100

9.3.2 The assessment and evaluation procedure for 1 and 2 credit courses is as follows

IA1 – 25 marks

IA2 – 25 marks

Both IA1 and IA2 will be added and 50% of the internal assessment is considered

SEE – 50 marks

The SEE marks will be reduced to 50%

The total marks for overall assessment will be (IA1+IA2 + SEE) = 50 marks

The SEE will be conducted for 2 hours.

9.4 There shall be **two Internal Tests** conducted as per the schedule announced below. **The students shall attend both the Tests compulsorily.**

- 1st test is conducted for 15 marks during **8th week** of the Semester;
- 2nd test is conducted for 15 marks during **16th week** of the of the Semester;
- Suitable number of Assignments/quizzes/presentations are set to assess the remaining 20 marks of IA at appropriate times during the semester

9.5 The coverage of syllabus for the said tests shall be as under:

- Question paper of the **1st test should be based on first 50% of the total syllabus**;
- Question paper of the **2nd test should be based on second 50% of the total syllabus**;

9.6 The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

9.7 A test paper is set for a maximum of 30 marks to be answered as per the pre-set time duration (1 hr / 1 hr 15 minutes / 1 hr 30 minutes). Test paper must be designed with School faculty members‟ agreed pattern and students are assessed as per the instructions provided in the

question paper. Questions must be set using Bloom‟s verbs. The questions must be set to assess the students outcomes described in the course document.

9.8 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by School specific Question Paper Scrutiny Committee formed by the respective School Head /Director to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

9.9 The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.10 Assignment/seminar/Project based learning/simulation based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarise the answer from web or any other resources. An assignment / Quiz or combination thereof can be set for a maximum of 20 marks. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self-study.

9.11 Internal assessment marks must be decided well before the commencement of Semester End examinations

9.12 Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18^{th} and 19^{th} week of the semester and the entire course syllabus must be covered while setting the question paper.

9.13 Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have 3-4 sub questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom‟s verbs. The questions must be set to assess the students outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

9.14 There shall be three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of

Examiners particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

9.15 There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

9.16 Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

9.17 There shall also be an **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. **Program Assessment Committee (PAC)** shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

9.18 The report provided by the **Program Assessment Committee (PAC)** shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

9.19 During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

9.20 University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper

9.21 Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor

9.22 Online courses may be offered as per BACHELOR norms.
For online course assessment guidelines would be as follows:

1. If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA University norms.

2. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain at the discretion of the School.

9.23 The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

9.24 Utilization of one or two credit online courses would be:

4 week online course – 1 credit – 15 hours
8 week online course / MOOC – 2 credits – 30 hours
12 week online course / MOOC – 3 credits – 45 hours

9.25 **Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

S. No	Type of Assessment	when	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	30	15	8th week
2	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 8th week (10 marks)				
3	Test -2	During 16th Week	Second 50%	30	15	16th Week
4	Assignment / quiz / presentation / any other assessment method as decided by the School	On or before 16th Week (10 marks)				
5	SEE	19/20th Week	100%	100	50	20th Week

Note: 1. Examination and Evaluation shall take place concurrently and Final Grades shall be announced as per the notification from COE.

2. Practical examination wherever applicable shall be conducted after 2nd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Controller of

Examination who will notify the same immediately

10 Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:
a) Knowledge of relevant processes;
b) Skills and operations involved;
c) Results / products including calculation and reporting.

10.1 The 50 marks meant for Internal Assessment (IA) of the performance in carrying out Practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	**50 marks**

10.2 The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

i	Conducting of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

The duration for semester-end practical examination shall be decided by the concerned School Board.

10.3 For MOOC and Online Courses assessment shall be decided by the BOS of the School.

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

All assessments must be done by the respective Schools as per the guidelines issued by the Controller

of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

12. Requirements to Pass a Course:

A candidate‟s performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 , SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) which is compulsory.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below:

Marks, P	**Grade, G**	**Grade Point (GP=V x G)**	**Letter Grade**
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

a. Computation of SGPA and CGPA

The Following examples describe computation of Semester Grade Point Average (SGPA).

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : **SGPA (Si) = ∑(Ci x Gi) / ∑Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Examples on how SGPA and CGPA are computed

Example No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
	16			129

Thus, **SGPA = 129 ÷ 16 = 8.06**

Example No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
	20			141

Thus, **SGPA = 141 ÷ 20 = 7.05**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits for the respective programs are calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **$CGPA = \sum(Ci \times Si) / \sum Ci$**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example:
CGPA after Final Semester

Semester (ith)	**No. of Credits (Ci)**	**SGPA (Si)**	**Credits x SGPA (Ci X Si)**
1	20	6.83	20 x 6.83 = 136.6
2	19	7.29	19 x 7.29 = 138.51
3	21	8.11	21 x 8.11 = 170.31
4	20	7.40	20 x 7.40 = 148.00
5	22	8.29	22 x 8.29 = 182.38
6	18	8.58	18 x 8.58 = 154.44
Cumulative	**120**		**930.24**

Thus, **CGPA** = 930.24/120 = 7.75

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Example: CGPA Earned 7.75 x 10=77.5

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index)	Letter Grade	Performance	FGP
	G			Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. Provisional Grade Card: The grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The grade card provides **Semester Grade Point Average (SGPA).**

b. **Final Grade Card:** Upon successful completion of three year Degree, a grade card with **Cumulative Grade Point Average** (**CGPA)** will be issued by the Controller of Examinations.

14. Attendance Requirement:

14.1 All students must attend every lecture, tutorial and practical classes.

14.2 In case a student is on approved leave of absence (e g:- representing the University in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

14.3 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc., during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

15.1 In case a candidate‟s class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and S/he shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

15.2 In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and s/he shall seek re-admission to such dropped semester.

16. Absence during Internal Test:

In case a student has been absent from an internal tests due to the illness or other contingencies s/he may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), s/he can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. S/he can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if s/he is found guilty. The decision taken by the Grievance committee is final.

18. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation

and announcement of results, such students can approach Grievance Committee for redressal of grievances. Grievance committees will be formed by CoE in consultation with VC.

For every program there will be one grievance committee. The composition of the grievance committee is as follows:-

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

19. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

20. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

21. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters shall move to next semester of immediate succeeding year and final year of the study. However, s/he shall have to clear all courses of all semesters within the double duration, i.e., with six years of admission of the first semester failing which the student has to re-register to the entire program.

22. Revaluation:

a. A student who desires to apply for revaluation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. This revaluation is applicable only for semester end examination.

23. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

BA (Political Science, Economics, Journalism –PEJ) Program

Program Overview

Humanities deals with human life and human experience qualitatively. Humanities investigates how do human beings behave? Why do they behave this way? How do human beings interact with each other? How do human beings interpret the world around them? And What kind of political, social and cultural institutions do they form?

The field of humanities include Modern languages, Classical languages, Linguistics, Literature, History, Jurisprudence, Philosophy, Archaeology, Comparative religion, Ethics, History, criticism and theory of the arts, Journalism, Psychology, Political science and such subject areas.

Bachelor of Arts programme in Political Science, Economics, Journalism offered by School of Arts, Humanities and Social Sciences at REVA UNIVERSITY intends to develop critical thinking on Political science, Economics and Journalism. Also, it aims to develop skills like English language speaking and writing, news writing skills, technical skills required for electronic media pogramme production, analytical skills in terms of politics and economy and help in nurturing them as professionals.

Journalism is all about collecting information and disseminating the facts and figures to the public via print, television and Internet. Journalists present the news in a manner that is useful, informative and thought-provoking. Journalism careers include reporter, feature writer, intern, sub editor, designer, proof reader, news reader, news presenter, news analyst, news editor, editor and many such. The language skills and understanding the political science and economics of the country/ society helps a Journalist to gain expertise in his/her profession.

Political Science enhances the knowledge of the students and helps them in comparing and contrasting the Constitutions, types of governments, Administration, bureaucracy, political thoughts etc. The subject specific skills helps the students to find a career in NGOs, Consultancies, Media and so on.

Economics helps the students to understand the various economic concepts, methodologies and subjects. The students will be able to prepare and analyse the budgets of different types of companies, corporates and annual government budgets. They can find a career in NGOs, Corporates and get into Government jobs through competitive exams.

In this context, an undergraduate University Programme offered by **REVA UNIVERSITY** in Journalism, Political Science and Economics is relevant to meet the future human resources requirement of various media, NGO and government enterprises.

The programme focusses on Journalism, media studies, Political Science, Economics, English language and , in addition to various transferable skills particularly writing skills that are required for successful career development in Journalism.

Programme Educational Objectives

After few years of graduation, the graduates of B.A. (Political Science, Economics, Journalism) will be able to:

PEO-1: Pursue Higher Education and carry out research in Universities at national and international level.

PEO-2: Occupy a position and work as a team member in Public, Private, Corporate and Government Sector as techno managers, academicians, administrators or entrepreneurs, investigative agencies with effective Communication and moral principles.

PEO-3: Start own enterprise and communicate with customers effectively and adopt lifelong learning Skills for magnifying Business.

Program Specific Outcomes

On successful completion of the program, the graduates of B.A. (Political Science, Economics, Journalism) will be able to:

PSO 1: Demonstrate the Knowledge in Political Science, Economics and Journalism.

PSO 2: Analyze and report the problems in political science by understanding the economical situation of the country.

PSO 3: Use different techniques to gather information in Journalism and report effectively.

Program Outcomes

On successful completion of the program, the graduates of B.A. (Political Science, Economics, Journalism) will be able to:

- **PO 1: Disciplinary knowledge:** Demonstrating comprehensive knowledge and in understanding Political, Journalism and Economics study.
- **PO 2: Reasoning:** Analyze, interpret and draw conclusions from evidence and experiences from an open-minded and reasoned perspective.
- **PO 3: Problem solving:** Extrapolate and apply their competencies to solve different kinds of non-familiar problems and apply one‟s learning to real life situations using curriculum content knowledge.

- **PO 4: Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
- **PO 5: Research-related skills:** Recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.
- **PO 6: Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **PO 7: Cooperation/Team work:** Work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
- **PO 8: Communication Skills:** Express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one‟s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
- **PO 9: Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

BA (Political Science, Economics and Journalism – PEJ)

Scheme of Instructions

(Effective from 2021-2024)

Sl. No	Course Code	Title of the Course	Course Type	Credit Pattern and Value				Weekly Contact Hours
				L	T	P	Total	
FIRST SEMESTER								
1	B21ASM101	Environmental Science	MC	Non-credit Mandatory Course				2
2	B21AHE101	Communicative English – I	FC	1	1	0	2	3
3	B21AHK101	Language – II: Kannada-I	FC	1	1	0	2	3
	B21AHH101	Language – II: Hindi-I						
	B21AHA101	Language – II: Additional English-I						
4	B21AB0101	Political Science – I (Core Concepts of Political Science)	HC	2	1	0	3	4
5	B21AB0102	Political Science Practical – I	HC	0	0	2	2	4
6	B21AB0103	Economics – I (Principles of Micro Economics)	HC	2	1	0	3	4
7	B21JN0101	Journalism - I (Introduction to Media & Communication)	HC	2	1	0	3	4
8	B21JN0102	Journalism Practical – I	HC	0	0	2	2	4
9	B21ENS111	Interdisciplinary Elective 1 - Comic and Graphic Narratives	SC	1	1	0	2	3
	B21JNS112	Interdisciplinary Elective 2 – Event Management						
	B21TMS113	Interdisciplinary Elective 3 - Tourism Entrepreneurship						
		Total Credits		**9**	**6**	**4**	**19**	**31**
SECOND SEMESTER								
1	B21LSM201	Indian Constitution and Human Rights	MC	Non-credit Mandatory Course				2
2	B21AHE201	Communicative English – II	FC	1	1	0	2	3
3	B21AHK201	Language – II: Kannada-II	FC	1	1	0	2	3
	B21AHH201	Language – II: Hindi-II						

	B21AHA201	Language – II: Additional English-II						
4	B21AB0201	Political Science – II (Understanding Political Theory)	HC	2	1	0	3	4
5	B21AB0202	Political Science Practical - II	HC	0	0	2	2	4
6	B21AB0203	Economics – II (Principles of Macro Economics)	HC	2	1	0	3	4
7	B21JN0201	Journalism - II (Reporting & Editing)	HC	2	1	0	3	4
8	B21JN0202	Journalism Practical - II	HC	0	0	2	2	4
9	B21PYS211	Interdisciplinary Elective 4- Skill Acquisition and Training						
	B21PSS212	Interdisciplinary Elective 5 – Global Perspectives of Human Rights	SC	1	1	0	2	3
	B21ENS213	Interdisciplinary Elective 6 – Popular Culture						
		Total Credits		**9**	**6**	**4**	**19**	**31**
	THIRD SEMESTER							
1	B21AHK301	Language – II: Kannada-III	FC	1	1	0	2	3
	B21AHH301	Language – II: Hindi-III						
	B21AHA301	Language – II: Additional English-III						
2	B21AB0301	Political Science – III (Indian Constitution and Institutional Framework)	HC	2	1	0	3	4
3	B21AB0302	Political Science Practical - III	HC	0	0	2	2	4
4	B21AB0303	Economics – III (Economic Growth and Development)	HC	2	1	0	3	4
5	B21JN0301	Journalism - III (Audio-Visual Production)	HC	2	1	0	3	4
6	B21JN0302	Journalism Practical - III	HC	0	0	2	2	4
7		Open Elective	OE	2	1	0	3	4
8	B21AHM301	Skill Development Course – I	MC	Non-credit Mandatory Course				2
9	B21AHON01	MOOC	ON	0	0	2	2	4
		Total Credits		**9**	**5**	**6**	**20**	**33**
	FOURTH SEMESTER							
1	B21AHK401	Language II: Kannada-IV	FC	1	1	0	2	3
	B21AHH401	Language II: Hindi-IV						
	B21AHA401	Language II: Additional English-IV						
2	B21AB0401	Political Science – IV (Western	HC	2	1	0	3	4

		and Eastern Political Thought)						
3	B21AB0402	Political Science Practical – IV	HC	0	0	2	2	4
4	B21AB0403	Economics – IV (International Economics)	HC	2	1	0	3	4
5	B21JN0401	Journalism – IV (Fundamentals of Media Research)	HC	2	1	0	3	4
6	B21JN0402	Journalism Practical - IV	HC	0	0	2	2	4
7	B21PYS411	Interdisciplinary Elective 7 – Personality, Identity and Self-Presentation	SC	1	1	0	2	3
	B21JNS412	Interdisciplinary Elective 8 – Cyber Media Practices						
	B21ENS413	Interdisciplinary Elective 9 – Academic and Content Writing						
8	B21AHR401	Minor Research Project	HC	0	0	3	3	6
9	B21AHM403	Skill Development Course - II	MC	Non-credit Mandatory Course				2
		Total Credits		**8**	**5**	**7**	**20**	**34**
	FIFTH SEMESTER							
1	B21AB0501	Political Science – V (Public Administration and Core Concepts)	HC	2	1	0	3	4
2	B21AB0502	Economics – V (Indian Economy – I)	HC	2	1	0	3	4
3	B21JN0501	Journalism -V (Media Laws & Ethics)	HC	2	1	0	3	4
4	B21ABS411	Political Science – VI (A) (International Relations)	SC	1	1	0	2	3
5	B21ABS412	Political Science – VI (B) (Comparative Government and Politics)						
6	B21ABS413	Political Science Practical -VI (A) (International Relations)	SC	0	0	2	2	4
	B21ABS414	Political Science Practical -VI (B)(Comparative Government and Politics)						
7	B21ABS421	Economics – VI (A) (Mathematical Methods for Economics)	SC	1	1	0	2	3
	B21ABS422	Economics – VI (B) (Entrepreneurial Development)						
8	B21JNS511	Journalism -VI (A) (Brand Ecology)	SC	1	1	0	2	3
	B21JNS512	Journalism -VI (B) (Fundamentals of Photography)						

9	B21JNS513	Journalism Practical -VI (A) (Brand Ecology)	SC	0	0	2	2	4
	B21JNS514	Journalism Practical -VI (B) (Fundamentals of Photography)						
10	B21AH0501	Soft Skills Training – I	MC	0	0	2	2	4
		Total Credits		**9**	**6**	**6**	**21**	**33**
	SIXTH SEMESTER							
1	B21AB0601	Political Science – VII (Major Constitutional Systems)	HC	2	1	0	3	4
2	B21AB0602	Economics – VII (Indian Economy – II)	HC	2	1	0	3	4
3	B21JN0601	Journalism -VII (Advertising & Corporate Communication)	HC	2	1	0	3	4
4	B21ABS611	Political Science – VIII (A) (International Institutions and Foreign Policies)	SC	1	1	0	2	3
	B21ABS612	Political Science – VIII (B) (Personal and Public Administration)						
5	B21ABS613	Political Science Practical – VIII (A) (International Institutions and Foreign Policies)	SC	0	0	2	2	4
	B21ABS614	Political Science Practical – VIII (B) (Personal and Public Administration)						
6	B21ABS621	Economics – VIII (A) (Financial Economics)	SC	1	1	0	2	3
	B21ABS622	Economics – VIII (B) (Managerial Economics)						
7	B21ABS631	Journalism -VIII (A) (Political Communication)	SC	1	1	0	2	3
	B21ABS632	Journalism - VIII (B) (Business Journalism)						
8	B21ABS633	Journalism Practical – VIII (A) (Political Communication)	SC	0	0	2	2	4
	B21ABS634	Journalism Practical – VIII (B) (Business Journalism)						
9	B21AH0601	Soft Skills Training - II	MC	0	0	2	2	4
		Total Credits		**9**	**6**	**6**	**21**	**33**
		Total Credits of All Semesters		**53**	**34**	**33**	**120**	**195**

Note: FC= Foundation Course; HC=Hard Core; SC=Soft Core; OE=Open Elective; MC= Mandatory Course; ON=Online

Semester-wise Summary of Credit Distribution

Semesters	No. of Credits
First Semester	19
Second Semester	19
Third Semester	20
Fourth Semester	20
Fifth Semester	21
Sixth Semester	21
Total Credits	**120**

Distribution of Credits Based on Type of Courses

Semester	HC	SC	OE	FC	Credits
I	13	2	0	4	19
II	13	2	0	4	19
III	13	2	3	2	20
IV	16	2	0	2	20
V	9	12	0	0	21
VI	9	12	0	0	21
Total	**73**	**32**	**3**	**12**	**120**

Distribution of Credits Based on L:T:P

Semester	L	T	P	Credits
I	9	6	4	19
II	9	6	4	19
III	9	5	6	20
IV	8	5	7	20
V	9	6	6	21
VI	9	6	6	21
Total	**53**	**34**	**33**	**120**

TYPICAL CURRICULUM MAP

SL.NO.	Course	Effective Communication	Ethical Values and Social Responsibility	Critical Thinking, Analysis ,Problem solving	Global Exposure and cross cultural understanding	Domain Knowledge	Self Development, Leadership and Team work	Entrepreneurial thinking , creativity and Innovation	Research Orientation
1	Environmental Science		√						
2	Communicative English - I	√							
3	Language – II: Kannada I	√							
4	Language – II: Hindi I	√							
5	Language – II: Additional English I	√					√		
6	Political Science – I (Core Concepts of Political Science)				√	√	√		
7	Political Science Practical – I				√	√	√		
8	Economics – I (Principles of Micro Economics)				√	√			
9	Journalism - I (Introduction to Media & Communication)	√	√		√	√			
10	Journalism Practical – I	√						√	
11	Interdisciplinary Elective 1 - Comic and Graphic Narratives	√	√	√	√				
12	Interdisciplinary Elective 2 – Event Management	√	√	√		√		√	√

13	Interdisciplinary Elective 3 - Tourism Entrepreneurship	√					√	√	
14	Indian Constitution and Human Rights		√				√		
15	Communicative English – II	√					√		
16	Language – II: Kannada II	√							
17	Language – II: Hindi II	√							
18	Language – II: Additional English II	√			√				
19	Political Science-II (Understanding Political Theory)		√	√	√	√			
20	Political Science Practical - II		√	√	√	√			
21	Economics – II (Principles of Macro Economics)				√	√	√		
22	Journalism - II (Reporting & Editing)	√	√	√		√	√		
23	Journalism Practical - II	√	√	√		√	√		
24	Interdisciplinary Elective 4- Skill Acquisition and Training	√		√		√			

25	Interdisciplinary Elective 5 –Global Perspectives of Human Rights	√	√		√				
26	Interdisciplinary Elective 6 – Popular Culture	√	√	√		√			
27	Language – II: Kannada III	√							
28	Language – II: Hindi III	√							
29	Language – II: Additional English III	√							
30	Political Science - III (Indian Constitution and Institutional Framework)		√	√		√			
31	Political Science Practical - III		√	√		√			
32	Economics - III (Economic Growth and Development)			√	√	√	√		
33	Journalism - III (Audio-Visual Production)	√				√	√	√	
34	Journalism Practical - III	√				√	√	√	
35	Media Studies	√	√	√					

36	Life Skills and Personal Development			√			√		
37	Skill Development Course - I	√	√				√	√	
38	MOOC	√			√	√			
39	Language II: Kannada IV	√							
40	Language II: Hindi IV	√							
41	Language II: Additional English IV	√					√		
42	Political Science – IV (Western and Eastern Political Thought)			√	√	√			
43	Political Science Practical – IV			√	√	√			
44	Economics – IV (International Economics)			√	√	√			
45	Journalism – IV (Fundamentals of Media Research)		√	√		√			√
46	Journalism Practical - IV		√	√					√
47	Interdisciplinary Elective 7 – Personality, Identity and Self-Presentation	√	√				√		

48	Interdisciplinary Elective 8 – Cyber Media Practices		√	√	√	√			
49	Interdisciplinary Elective 9 – Academic and Content Writing	√	√	√		√			
50	Minor Research Project			√					√
51	Skill Development Course - II	√	√				√	√	
52	Political science – V- (Public Administration and Core concepts)		√	√	√	√			
53	Economics – V (Indian Economy - I)		√	√		√			
54	Journalism-V (Media Laws & Ethics)		√	√		√			
55	Political Science – VI (A) (International Relations)		√	√	√	√			
56	Political Science – VI (B) (Comparative government and Politics)		√	√	√	√			
57	Political Science Practical -VI (A) (International Relations)		√	√	√	√			
58	Political Science Practical -VI (B)(Comparative Government and Politics)		√	√	√	√			
59	Economics – VI (A) (Mathematical			√	√	√	√		

	Method for Economics**)** -								
60	Economics –VI (B) (Entrepreneurial Development- I)				√	√	√	√	
61	Journalism -VI (A) (Brand Ecology)	√		√		√	√		
62	Journalism -VI (B) (Fundamentals of Photography)	√	√			√		√	
63	Journalism Practical -VI (A) (Brand Ecology)	√		√		√	√		
64	Journalism Practical -VI (B) (Fundamentals of Photography)	√	√			√		√	
65	Soft Skills Training – I	√	√				√	√	
66	Political science - VII(Major Constitutional Systems)		√	√	√				√
67	Economics – VII(Indian Economy -II)			√	√	√	√		
68	Journalism -VII (Advertising & Corporate Communication)	√	√	√		√			
69	Political Science – VIII (A) (International Institutions and Foreign Policies)		√	√	√	√			
70	Political Science – VIII (B) (Personal and Public Administration)		√	√	√				√

71	Political Science Practical – VIII (A) (International Institutions and Foreign Policies)		√	√	√	√			
72	Political Science Practical – VIII (B) (Personal and Public Administration)		√	√	√				√
73	Economics – VIII (A) (Financial Economics)			√	√	√	√		
74	Economics – VIII (B) (Managerial Economics)			√	√	√	√		
75	Journalism -VIII (A) (Political Communication)	√	√	√	√				√
76	Journalism - VIII (B) (Business Journalism)	√			√	√	√	√	
77	Journalism Practical – VIII (A) (Political Communication)	√	√	√	√				√
78	Journalism Practical – VIII (B) (Business Journalism)	√			√	√	√	√	
79	Soft Skills Training - II	√	√				√	√	

BA – Political Science, Economics, Journalism Programme

DETAILED SYLLABUS
(Effective from 2021-2024)

FIRST SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ASM101	Environmental Science	MC	Non-credit Mandatory Course				2

Course Description:
This course caters to the students to engage in resolving the current environmental issues in the world and develop a positive approach towards environmental protection. Eventhough it does not have any credits as per the course curriculum it helps the students to understand the multidimensional nature of the issues and respond to the most important challenges that the world is facing today.

Pre-requisites: Basic knowledge of Environmental Science studied at higher secondary & school level.

Pedagogy: Direct instruction method

Course Objectives:

1. Graduates will be familiar with current and emerging environmental trends and global issues, and have an understanding of ethical and societal responsibilities.
2. Will find the need of various types of energy(conventional & non-conventional) resources and natural resources.
3. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem.
4. Explore the ways for protecting the environment.

Course Outcomes:

On completion of this course, the students will be able to:

1. Analyze the environmental conditions and protect it.
2. Examine the role of individual, government and NGO in environmental protection.
3. Analyze the ecological imbalances and protect it.
4. Design pollution controlled products.

Course Content:

Unit-I **7 Hours**

Multidisciplinary Nature of Environmental Studies: Introduction to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment

Environmental protection – Role of Government-Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Initiative and Role of Non-government organizations in India and world.

Self study: Need for public awareness on the environment, Gaia Hypothesis

Unit-II **6 Hours**

Environmental pollution, degradation & Waste management: Environmental Pollution – Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile pollution-Causes, Effects & control measures.

Self study: Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes.

Environmental degradation – Introduction, Global warming and greenhouse effect,
Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.

Solid Waste management – Municipal solid waste, Biomedical waste, Industrial solid waste and Electronic waste (E-Waste).

Self study: Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.

Unit-III **7 Hours**

Energy & Natural resources: Energy – Definition, classification of energy resources, electromagnetic radiation-features and applications,Conventional/Non-renewable sources – Fossil fuels based(Coal, petroleum & natural gas), nuclear energy.

Non-conventional/renewable sources – Solar, wind,hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Self study: Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster.

Natural resources –water resource (Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance), Mineral resources (Types of minerals, Methods of mining & impacts of mining activities),Forest wealth (Importance‟s, Deforestation-Causes, effects and controlling measures)

Self study: Hydrology & modern methods adopted for mining activities.

Unit-IV **6 Hours**

Ecology and ecosystem: Ecology-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem-Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity.

Biogeochemical cycles and its environmental significance – Carbon, nitrogen and phosphorus cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

Self study: Need for balanced ecosystem and restoration of degraded ecosystems.

References:

- Daniels, R.J. Ranjit, Krishnaswamy, Jagadish. *Environmental Studies*.Wiley India Private Ltd., 2009.
- Benny, Joseph. *Environmental Science and Engineering*. Tata McGraw Hill, 2006.
- Dr. Prakash, S.M. *Environmental Studies*. Elite Publishers, 2007.
- Rajagopalan, R. *Environmental Studies – from Crisis to cure*. Oxford University Press, 2005.
- Walia, Arvind. *Environmental Science*. Kalyani Publications, 2009.
- Dey, Anilkumar and Dey, Arnab Kumar. *Environmental Studies*. New Age International, 2007.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHE101	**Communicative English – I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course focuses on improving the spoken and written communication of the learners. The course develops personal, inter-personal and group skills among learners. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The widespread reach of this course makes it highly practical and applicable.
Pre-requisites: The student must have knowledge of intermediate English Grammar and LSRW skills.
Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.
Course Objectives:

1. To enhance functional communication skills.
2. To develop functional use of language in professional contexts.
3. To utilize oral presentations in multiple contexts.
4. To apply effective written skills in formal communication.

Course Outcomes:

On completion of the course, learners will be able to:

1. Identify pressing issues relating to society, environment and media.
2. Develop a process-oriented approach to writing.
3. Apply the grammatical skills developed during the course aptly.
4. Demonstrate a good command over language usage and refined interpersonal skills.

Course Content:

Unit-I: Functional English **7 Hours**
Remedial Grammar: Past Simple; Past Continuous; Irregular Verbs
Writing Skills: Paragraph Writing

Activities: Conversations; Leaving Phone Messages
Literature:Chief Seattle – The End of Leaving and Beginning of Survival

Unit-II: Interpersonal Skills **6 Hours**
Remedial Grammar: Present Simple & Present Continuous; Activity & State Verbs
Writing Skills: Official Letters
Activities: Making Apologies; Invitations & Making Arrangements
Literature: Ruskin Bond – Tiger in the Tunnel

Unit-III- Multitasking Skills **7 Hours**
Remedial Grammar: Present Perfect; For, Since & How Long; -ed & -ing adjectives; Prefix & Opposites of Adjectives
Writing Skills: Note Making
Activities: Agreeing & Disagreeing with Opinions
Literature: Jesse Owens - My Greatest Olympic Prize

Unit-IV: Communication Skills **6 Hours**
Remedial Grammar: Collocations; Prepositions
Writing Skills: Precise Writing
Activities: Offers, Suggestions & Requests
Literature: Avijit Pathak – Onscreen Magic41

References:

- Green, David. *Contemporary English Grammar Structures and Composition*. MacMillan, 2010.
- Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
- Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
- Murphy, Raymond. *Murphy"s English Grammar with CD*. Cambridge University Press, 2004.
- Rizvi, M. Ashraf. *Effective Technical Communication*. Tata McGraw-Hill, 2005.
- Riordan, Daniel. *Technical Communication.* New Delhi: Cengage Publications, 2011.
- Sen et al. *Communication and Language Skills*. Cambridge University Press, 2015.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHK101	**Language – II: Kannada-I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:
¨sÁµÉAiÀÄÀ£ÀÅß vÀiÁvÀ£ÁqÀÄvÀ §gÉAiÀÄÄvÀ PË±À®¡, uÁ»vÀåzÀ §UÉÎ uÀsÜ®vÁV ¥ÀjZÀ¬ÄuÀÄvÀ vÀÄs®PÀ «zÁ¡yðUÀ¼À vÀåQÛvÀé «PÁuÀ ºÁUÀÄ uÀàzsÁðvÀäPÀ ¥ÀjÃPëUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀåèlÄÖPÉsAqÀÄ, ¥ÀæuÀÄÛvÀ uÀAzÀ¨sÀðPÉÌ «zÁ¡yðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀ®Ä ¥ÀoÀ¡vÀ£ÀÄß gÀs¦uÀeÁVzÉ. uÁ»vÀå, PÀeÉ, vÁtÂdå, DqÀ½vÁvÀäPÀ vÀÄvÀÄ «eÁ£ÀzÀ «ZÁgÀUÀ½UÉ Mv¥£ÀÄß ¤ÃqÀeÁVzÉ. EzÀÄ vÉszÀ® JgÀqÀÄ uÉ«ÄuÀÖgï vÀÄsgÀÄ PÉærmïUÀ¼À£ÀÄß; vÀÄsgÀÄ vÀÄvÀÄ £Á®ÌÉÊÃ uÉ«ÄuÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉsA¢zÉ.

Pre-requisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉÎ ¥ÁæxÀ«ÄPÀ w¼ÀĪÀ½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄÛ §gÉAiÀĮ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥ÀsªÀð ²PÀëtzÀ9 PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives:

¸Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉsA¢zÉ. CzÀgÀAvÉ ªÉszÀ® ¸ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ ¸ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÌ ªÀiÁrPÉsAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀzÀ §UÉÎ ¸ÀzÀ©gÀÄaAiÀÄ£ÀÄß ªÀÄsr¸ÀeÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀĪÀ½PÉAiÀÄ eÉsvÉUÉ ªÀåQÛvÀ «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀeÁUÀÄvÀÛzÉ.

- ¨ÁµÉ, uÁ»vÀå, EwºÁuÀ vÀÄvÀÄÛ uÀAuÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£Áð1PÀPÉÌ uÀA§A¢¹zÀAvÉ ¥ÀjZÀ¬ÄuÀeÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À uÀvÀðvÉsÃvÀÄÄR ¨É¼ÀvÀtÂUÉUÉ C£ÀÄvÁUÀÄvÀAvÉ ºÁUÀs CvÀgÀå vÀiÁ£ÀvÀ uÀA§AzÀUÀ¼À §UÉÎ UËgÀvÀ, uÀvÀiÁ£ÀvÉ vÀÄsr¹, ¨É¼ÉuÀÄvÀ ¤nÖ£Àåè ¥ÀoÀåUÀ¼À DAiÉÌAiÀiÁVzÉ.
- CvÀgÀå uÀÈd£À²Ã®vÉ, ±ÀÄzÀ ¨ÁµÉ, GvÀvÀÄ «vÀıÁð UÀÄt, ¤gÀUÀð¼À uÀA¨ÁµÀuÉ, ¨ÁµÀt PÀeÉ ºÁUÀs §gÀºÀ PË±À®UÀ¼À£ÀÄß ¨É¼ÉuÀÄvÀçzÀÄ UÀÄjAiÀiÁVzÉ
- uÀàzÁðvÀåPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀs®vÁUÀÄvÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀå1ÄÖPÉsAqÀÄ uÀsPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÌ vÀiÁrPÉs¼ÀîeÁVzÉ.

Course Outcomes:

d£À¥ÀzÀ, ¥ÁaÃ£À, ªÀÄzsÀåPÁ°Ã£À ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ ¸ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄs®PÀ PÁ®zÀ ÀÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

- uÁvÀiÁfPÀ, gÁdQÃAiÀÄ, zÁ«ÄðPÀ, uÁAuÀÌøwPÀ, ¥ÀjuÀgÀ ºÁUÀs åAUÀuÀA§A¢ «ZÁgÀUÀ¼ÉqÉ UÀvÀÄ£À ºÀjuÀÄvÀçzÀgÉsA¢UÉ «zÁåyðUÀ¼Àå ZÀZÁð vÀÄ£ÉsÃ¨ÁvÀvÀç ¨É¼ÉAiÀÄÄvÀÛzÉ.
- fÃvÀ£ÀzÀå §gÀÄvÀ C©¥ÁæAiÀÄ ¨ÉÃzÀUÀ¼ÀÄ, uÀvÀÄuÉãUÀ¼À£ÀÄß DzÀÄ¤PÀ uÀAzÀ¨ÀðzÀå vÀiÁ£À«ÃAiÀÄvÉAiÉsA¢UÉ ¤vÀð»uÀÄvÀAvÉ ¥ÉæÃgÉÃ¦uÀÄvÀÛzÉ.
- GvÀÛvÀÄ uÀAvÀºÀ£À PÀeÉAiÀÄ£ÀÄß ¨É¼ÉuÀÄvÀ GzÉÝÃ±ÀvÀ£ÀÄß FqÉÃjuÀÄvÀÛzÉ.
- uÀA±ÉsÃzÀ£Á vÀÄ£ÉsÃ¨ÁvÀ vÀÄvÀÄÛ uÀàzÁðvÀåPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀÄvÀÛzÉ.

Course Content:

Unit I d£À¥ÀzÀ ªÀÄvÀÄÛ ¥ÁaÃ£À PÁªÀå **7 Hours**

1. uÀvÀåvÀAvÉ ºÀqÉzÀvÀé d£À¥ÀzÀ VÃvÉ
2. £É®QjvÉ£ÉAzÀÄ §UÉ«gÉ bÀ®QjvÉA gÀ£Àß
3. avÀævÀÄ¥ÁvÉæ gÀvÀÄvÉ £Áj d£Àß

Unit II ªÀÄzsÀåPÁ°Ã£À PÁªÀå **6 Hours**

1. C©ÞAiÀÄÄvÉsvÉÄð PÁ®vÀ±À¢A vÀÄgÁizÉAiÀÄA zÁAlzÉÀ ... £ÁUÀZÀAzÀ
2. vÀZÀ£ÀUÀ¼ÀÄ §uÀvÀtÚ
3. wgÀÄ¤Ã®PÀAoÀgÀ gÀUÀ¼É ºÀjºÀgÀ

Unit III ¸Àt PÀxÉUÀ¼ÀÄ **7 Hours**

1. PÀeÁärAiÀÄ PÉsÃt vÀiÁ¹Û
2. AiÀiÁgÀs CjAiÀÄzÀ «ÃgÀ PÀÄvÉA¥ÀÄ
3. uÀvÀÄuÉåAiÀÄ vÀÄUÀÄ wævÉÃtÂ

Unit IV ¤ÁlPÀ **6 Hours**

1. mÉs¼ÀÄîUÀnÖ n.¦. PÉÊeÁuÀA

References:

- vÀÄÄUÀ½ gÀA.²¬Å., PÀ£À®qÀ uÁ»vÀå ZÀjv£¬ ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºËuï, vÉÄÊuÀsgÀÄ. 2014
- uÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.Jeï., ZÁjw¬Ä d£À¥ÀzÀ PÀxÀ£À PÁvÀªÜÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀsgÀÄ. 2008
- ¹ÃvÀiÁwÃvÀ PÀ£À®qÀ uÁ»vÀå ZÀjv£¬ uÀA¥ÀÄl 1,2,3,4,5 vÀÄvÀÄÛ 6, PÀÄvÉA¥ÀÄ PÀ£À®qÀ CzÀiAiÀÄ£À uÀAuÉÜ, vÉÄÊuÀsgÀÄ «±Àé«zÁå¤®AiÀÄ, vÉÄÊuÀsgÀÄ. 2014
- uÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.Jeï., PÀ£À®qÀ d£À¥ÀzÀ PÀxÀ£À PÁvÀªÜÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀsgÀÄ. 2007
- £ÁgÁAiÀÄt ¦.«, ZÀA¥Às PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥À® §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2010
- PÁ¼ÉÃUËqÀ £ÁUÀvÁgÀ, wæ¥Àt, gÀUÀ¼É vÀÄvÀÄÛ eÁ£À¥ÀzÀ uÁ»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥À® §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2010
- uÀA. ¨É£ÀUÀeï gÁvÀÄ gÁvï vÀÄvÀÄÛ ¥Á£ÀåA uÀÄÄAzÀgÀ ±Á¹ÛçÃ, ¥ÀÄgÁt £ÁvÀÄ ZÀsqÁvÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥ÀæuÁgÁAUÀ, vÉÄÊuÀsgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
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- ²vÀgÀÄzÀæ¥ï f.Juï. PÀ£ÁßqÀ uÁ»vï uÀ«ÄÄPÉë, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥ï §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2013
- uÀA.f.Juï.CvÀÄsgÀ, PÀ£ÁßqÀ uÀtÚ PÀxÉUÀ¼ÀÄ, £ÁµÀ£Àeï §ÄPï ¸ïï, £ÀvÀzÉºÀå, 2000
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- uÀA. qÁ. gÁvÀÄåAUÀ¥ï n. ¨ÉÃUÀsgÀÄ, vÀvÀðvÀiÁ£ÀzÀ PÀxÉUÀ¼ÀÄ, PÀté ¥ÀæPÁ±À£À, ¨ÉAUÀ¼ÀsgÀÄ, 2013

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHH101	**Language – II: Hindi-I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description: अध्ययन वर्ण :

यह पाठ्यक्रम नौसिखिया, अपनी भाषा की क्षमता का सिकाि करने हेतु तथा सिसभन्न िासहखिक प्रसक्रयाओं द्वारा
िमाज, िंस्कृ सत एिं जीिन के मूल्यं कय िमझने हेतु असभकखित है |

Pre-requisites/Pre reading for the course: पूवापेक्षव:

- अध्येता, पी.यु.िी के स्तर पर सद्वतीय भाषा के रूप मेंं सहन्दी का अध्ययन करना चासहए |
- सहन्दी िासहि के इसतहाि का िंसक्षप्त ज्ञान की आिश्यकता है |
- सहन्दी व्याकरण का अिबयधन आिश्यक है |
- अंग्रेज़ी – सहन्दी अनुिाद िे िंबंसधत जानकारी जरुरी है |

Pedagogy: सिक्षशवस्त्र :

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives:पवठ्यक्रम उद्देश्य :

- िंदभानुिार उसचत भाषा का प्रययग करने की दक्षता कय छात्रं मेंं उत्पन्न करना |
- िासहि के माध्यम िे िमाज एिं मानिीय मूल्यं कय िमझाकर, उन मूल्यं की रक्षा हेतु प्रेरत करना |
- छात्रं मेंं पुस्तक पठन एिं लेि न की अकृ सतम प्रिृसि स्थासपत करना |
- अध्येताओं मेंं िासहि के माध्यम िे प्रभािी एिं कु शल िंचार का सिकाि करना |

Course Outcomes:असिगम पररवम :

अध्ययन की िमाखप्त पर अध्येता –

- िामासजक मूल् एिं नैसतक जिाबदे ही कय स्वीकार कर िकता है |
- िासहि की प्रािंसगकता कय जीिन मेंं िमझने की दक्षता रि ता है |

- िमाज मे◌ं अ◌ंतसनसहत पद्दसतय◌ा एि◌ं सिचारध◌ाराओ◌ं क◌ा व्य◌ाख्य◌ान करन◌े मे◌ं ि◌क्षम बन ि◌कत◌ा है |
- ि◌◌ासहि◌ के माध्यम ि◌े प्रभाि◌ी एि◌ं कु शल ि◌ंचार क◌ा सिक◌ाि◌ करिकत◌ा है |

Course Content: : <u>अध्ययन सवषय ि ूची /पवठ्यक्रम</u>

इकवई –1 :कहानी, ि ं **7 hours**
स्मरण
1.कहानी – नशा – प्रेमचंद
2.कहानी – ि ुि मय जीिन – चंद्रधर शमा गुलेरी
3.ि ंस्मरण – शरत के ि ाथ सबताया कु छ ि मय–अमृतलाल नागर

इकवई –2:कहानी, आत्मकथा **6 hours**
4.कहानी – मरने ि े पहले – भीष्म ि ाहनी
5.कहानी – लाल हिली – सशिानी
6.. रे ि ासचत् – घीि ा – महादे ि ी ि मा
इकवई –3:एकांकी, व्यंग्य रचना **7 hours**
7. एकां की – आिाज का नीलाम – धमि ीर भारती
8.व्यंग्य रचना – भेड़े और भेसियें – हररशंकर परिाई

इकवई –4:अनु ि ाद, ि ंक्षे पण **6 hours**
अनुवद : अंग्रेज़ी – सहन्दी(शब्द एि अनुच्छे द)
ि ंक्षे पर् : पररच्छे द का एक सतहाई भाग मे ं |
|

d) Suggested Text Books and References

Text book/s:पवठ्य पु स्तक :

1. सहन्दी पाठ्य पुस्तक – रे ि ा सिश्वसिद्यालय |

References:ि न्दर् ग्रन्थ :

1. ि ुबयध व्यि हाररक सहन्दी – ि ॉ. कु लदीप गुप्त
2. असभनि व्यि हाररक सहन्दी – ि ॉ.परमानन्द गुप्त
3. सहन्दी ि ासह ि का इसतहा ि - ि ॉ. नागेद्र
4. आधुसनक सहन्दी ि ासह ि का इसतहा ि - ि ॉ. बच्चन सि ं ह
5. सहन्दी ि ासह ि का नि ीन इसतहा ि - ि ॉ. लाल ि ाहब सि ं ह
6. शुद्ध सहन्दी कै ि े बोलें कै ि े सल ि े - पृथ्वीनाथ पाण्डे
7. कायालय अनु ि ाद स्नदे सशका
8. ि ंक्षे पण और पल्लिन - के .ि ी.भासिया&तुमन सि ं ग

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHA101	**Language – II: Additional English-I**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course designed to help the learner gain competency in language through the introduction of various genres of literature. The course aims to inculcate a critical view among learners while sensitizing them to the contemporary issues around. It facilitates creative learning and helps to appreciate, assimilate and research on the various dimensions of society, culture and life.

Pre-requisites: The student must possess fundamentals of language skills and be aware of social issues.

Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

Course Objectives:
1. To develop linguistic prowess of the students.
2. To appraise different genres of literature.
3. To illustrate the fundamentals of creative language.
4. To enhance consistent reading habits.

Course Outcome:
On completion of the course, learners will be able to:
1. Demonstrate a thorough understanding of sensitive and critical social issues.
2. Develop reading skills and a wide range of vocabulary.
3. Critically analyze a piece of prose or poetry.
4. Explain their opinion in a coherent and communicable manner.

Course Content:

Unit-I:Values & Ethics **7 hours**
Literature: Rabindranath Tagore - Where the Mind is Without Fear
Saki – The Lumber-room
William Shakespeare – Extract from *Julius Caesar* (Mark Antony‟s Speech)
Language: Vocabulary Building

Unit-II: Natural & Supernatural **6 hours**
Literature: John Keats – La Belle Dame Sans Merci
Charles Dickens – The Signal Man
Hans Christian Anderson - The Fir Tree
Language: Collective Nouns

Unit-III: Travel & Adventure **7 hours**
Literature: R.L. Stevenson – Travel
H.G. Wells – The Magic Shop
Jonathan Swift – Excerpt from Gulliver‟s Travels Book – I

Writing Skills: Travelogue

Unit-IV: Success Stories **6 hours**

Literature: Emily Dickinson – Success is Counted Sweetest
Dr. Martin Luther King - I Have a Dream
Helen Keller – Excerpt from The Story of My Life
Writing Skills: Brochure & Leaflet

References:

- Tagore, Rabindranath. *Gitanjali*. Rupa Publications, 2002.
- Wordsworth, William. *The Complete Works of William Wordsworth*. Andesite Press, 2017.
- Munro, Hector Hugh. *The Complete Works of Saki*. Rupa Publications, 2000.
- Chindhade, Shirish. *Five Indian English Poets: Nissim Ezekiel, A.K. Ramanujan, ArunKolatkar, DilipChitre, R. Parthasarathy.* Atlantic Publications, 2011.
- Dickens, Charles. *The Signalman and Other Horrors: The Best Victorian Ghost Stories of Charles Dickens: Volume 2*. Createspace Independent Publications, 2015.
- Swift, Jonathan. *Gulliver"s Travels*. Penguin, 2003.
- King, Martin Luther Jr. &James M. Washington. *I Have a Dream: Writings And Speeches That Changed The World*. Harper Collins, 1992.
- Keller, Helen. *The Story of My Life*. Fingerprint Publishing, 2016.
- Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
- Murphy, Raymond. *Murphy"s English Grammar with CD*. Cambridge University Press, 2004.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0101	**Political Science – I (Core Concepts of Political Science)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
The purpose of the course is to help the students understand the fundamental aspects of political theory. The course attempts to highlight the relevance of the core concepts in the context of modern governance. The course introduces the nature, scope and various approaches in political theory and engages with the aspects of state, nation and political system. The course also intends to generate some fruitful deliberations on the normative concepts like rights, liberty, equality, and justice to throw light on the problems confronted by the marginalized sections in the world.
Pre-requisites: Basic understanding of political science and keen interest in learning the concepts.
Pedagogy: Direct instruction and collaborative learning method
Course Objectives:

1. To outline with basic concepts of political science.
2. To develop a better understanding of current trends and emerging political issues in the State.
3. To identify and respond to socio- political injustices.
4. To demonstrate the innovative ideas to build an egalitarian welfare State.

Course Outcomes:

After the successful completion of the course, the students will be able to

1. Analyze basic concepts of political science.
2. Explain the current trends and emerging political issues in the State.
3. Solve the issues on socio- political injustices.
4. Develop the innovative ideas to build an egalitarian welfare State.

Course Content:

Unit 1-Political Science: **10 Hours**

Nature, Scope and Importance; Approaches: Historical and Normative; Behaviouralism and Post-Behaviouralism.

Unit II- State **10 Hours**

Elements of State; Theories of State: Historical, Divine Origin and Social Contract Theory; State in the age of Globalisation; Civil Society.

Unit III- Law and Justice: **10 Hours**

Meaning and Sources; Schools of Law–Historical, Philosophical, Comparative, Social and Marxian; Law and Morality. *Justice*: Meaning, Kinds -Social, Economic, Political and Legal

Unit IV- Equality and Rights & Duties **9 Hours**

Equality: Meaning, Kinds and Importance. Rights and Duties –*Rights:* Meaning, Kinds - Civil, Political, Social, Economic and Cultural; Human Rights; Duties towards the State.

References:

- Kapur, A C. *Principles of Political Science*. S Chand Publications, 1997.
- Johari, J.C. *Political Theory.* Sterling Publishers, 1987.
- Hardas, Hari and B.C. Choudhary. *Political Theory : Traditional and Modern Theory.* National Publishing House Jaipur, 1987.
- Ray, Amal &Mohit Bhattacharya. *Political Theory*. Eastern Publications, 1962.
- M.J.Vinod and Meena Deshpande. *Contemporary Political Theory*. PHI Learning, 2013.
- Ashirvatham, Eddy. *Political Theory*. The Upper Publishing House, 1936.
- George, Sabine. *A History of Political Theory*. Henry Halt and Company, 1937.
- Gauba, O.P.*An Introduction to Political Theory*. Macmillan Publishers India Ltd., 2011.
- Mahajan, V D. *Political Theory*. S Chand Publications, 2004.
- Andrew, Heywood. *Political Theory an Introduction*. Palgrave Macmillan, 2000.

Journals

1. Indian Journal of Political Science
2. Main Stream
3. Economic and Political Weekly
4. Political Theory

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0102	**Political Science Practical – I**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Debate on current political topics
- Group discussion on different political processes of different nations
- Seminar on current affairs
- Assignments on various political relevant topics
- Mock speech activity for election campaigning

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0103	**Economics – I (Principles of Micro Economics)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:

Principles of Microeconomics is an introductory undergraduate course that teaches the fundamentals of microeconomics. It provides a solid foundation for economic analysis and thinking that can last throughout their education and subsequent professional careers.

This course begins with an introduction to supply and demand and the basic forces that determine an equilibrium in a market economy. Next, it introduces a framework for learning about consumer behavior and analyzing consumer decisions.

Pre-requisites: Students should have the knowledge of basic economic concepts.

Pedagogy: Direct instruction and collaborative learning method

Course Objectives

1. To explain the ten principles of of economics
2. To demonstrate the role of prices in allocating scarce resources in market economies
3. To explain the consequences of government policies in the form of price controls
4. To compare positive and normative view points on concepts of market failure and the need for government intervention

Course Outcomes

After the completion of the course, the students will be able to

1. Interpret that economics is about the allocation of scarce resources and how that results in trade-offs
2. Illustrate the role of prices in allocating scarce resources in market economies and explain the consequences of government policies in the form of price controls
3. Identify positive as well as normative view points on concepts of market failure and the need for government intervention
4. Explain the different view points of market failure and identify the need for government intervention.

Course Content:

Unit-1- Micro Economics and the Theory of Consumption 10 Hours

Ten principles of economics: How people make decisions, how people interact and how the economy as a whole works- Role of observations and theory in economics- Role of assumptions- Role of Economic models- Wants and resources; Problem of choice, Production Possibility Frontier; Opportunity costs.

Unit-II: Demand and supply 10 Hours

Law of demand, Reasons for the downward slope of the demand curve. Exceptions to the law; Changes in demand; Elasticity of Demand- Degrees of price elasticity with diagrams; Factors determining price elasticity, methods of measurement. Income elasticity demand; Cross elasticity demand; Laws of supply, Changes in supply- Consumers, Producers and the Efficiency of the Markets: Consumer‟s surplus (Marshall), Producer surplus and Market efficiency- Externalities and Market inefficiency- Public goods and common resources.

Unit-III- Theory of Production and Cost 10 Hours

Production function; Law of Variable proportions; Laws of returns, Economies of scale; Producer's Equilibrium with the help of iso-quants and iso-cost lines. Cost function - Important cost concepts. Short run and long run cost analysis (traditional theory) Modern theory of cost- Long run and short run - Revenue analysis - AR and MR.

Unit-IV- Product Pricing and Factor Pricing 9 Hours

Market structure. Perfect competition, Price and output determination. Role of time element in market price determination. Monopoly- Price output determination, Price discrimination Monopolistic Competition. Price and Output determination. Selling costs. Product differentiation. Wastes in monopolistic competition. Oligopoly Price determination (collusive pricing, price leadership), Features of Duopoly and Monopsony

References:

- Mankiw, Gregory N. *Principles of Microeconomics*. 4th Edition, Cengage Learning India, 2012.
- Lipsey, R.G and Chrystal KA. *Principles of Economics.* 9th Edition, Oxford University Press,1999
- Ramsfield, E. *Micro Economics* 9th Edition, W.W Norton and Company, 1997.
- Pindyck and Rubinfield. *Micro Economics*. 7th Edition, Pearson Education, 2009.

- Ray, N.C. *An Introduction to Micro economics*. Macmillan company of India Ltd, 1975.
- Samuelson, P.A. and W.D. Hague. *A textbook of Economic Theory*. ELBS Longman group, 1972.
- Ahuja, HL. *Principles of Microeconomics*. S.Chand, 2016.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0101	**Journalism - I (Introduction to Media & Communication)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
The course titled Introduction to Media and Communication provides students the opportunity to explore the various elements in the communication process as well as get acquainted with communication models that explain how and why we communicate the way we do. Students explore the models that explain how communication influences our perspective of others, the world and ourselves. By examining media messages from print, electronic media and new media, students explore how the media create meaning and how technology shapes the ways we communicate.
Pre-requisites: Exposure to different types of media in daily life
Pedagogy: Direct instruction and collaborative learning method
Course Objectives:

1. To help the students explore the process of communication and study the various models of communication
2. To delve into the history and aspects of print, electronic and new media
3. To generate awareness of students about the media messages and their impact on everyday life.
4. To create an understading about the current issues in media.

Course Outcomes:
On completion of the course, learners will be able to:

1. Demonstrate detailed understanding about process and elements in communication
2. Explain the process, models and levels of communication
3. Relate to the various types of mass media
4. Discuss the issues in media in the present context

Course Content:

Unit I: Process and Elements of Communication **10 Hours**
Communication-Definition, nature, scope, process and elements of communication; Types of communications-verbal, non-verbal, intrapersonal, interpersonal, group, mass communication; Functions of communication; Models of communication: Aristotle‟s Rhetoric Model, The Lasswell model, Shannon and Weaver model, Osgood and Schramm circular model, Berlo‟s model; Gerbner‟s Model of Communication

Unit II: Folk and Print Media **10 Hours**

Folk media, Types of Folk Media; Print media; Content pattern and characteristics of dailies and periodicals, tabloids, magazines; Brief history of Indian Journalism; Language press; News Agencies in India; Kannada Journalism.

Unit III: Broadcast Media & Films **10 Hours**

Broadcast Media - Radio as a medium of communication- Brief history of radio; Programme pattern of Radio; FM Radio; Community radio; Television as a medium of communication- Brief history of TV; Satellite communication; DTH; Cinema – Cinema as a medium of communication; Types of cinema- Documentary, Commercial Cinema, Short Films; CBFC and FTII

Unit IV: Issues in Journalism **9 Hours**

Current Issues in Media - New Media – Blogs, websites and social media; Citizen Journalism; Media Convergence; Mobile Journalism; Role of Media in a Democracy- Yellow Journalism; Breaking News; Trial by media; Media Literacy; Fake News; Media and Children; Media and Youth; Media and Gender

References:

- John, Vivian. *The Media of Mass Communication*. PHI learning Private Limited, 2012.
- Kumar Keval, J. *Mass communications in India*. Jaico Publication, 2006.
- Meena, Devi. *Fundamentals Of Mass Media And Communication*. Alfa Publication, 2006.
- Denis, Mcquail. *Mass Communication Theory*. Sage Publication, 2004.
- Ramesh, Chandra. *Analysis of Media and CommunicationTrends*. Gyan Books Publishers Pvt. Ltd., 2004.
- Baran S, Stanly and K. Davis, Dennis. *Mass Communication Theory*: *Foundations Ferment and Future*. Thomson Wads Worth, 1999.
- Chatterji, PC . *Broadcasting in India*. Sage Publications, 1991.
- Ahuja, BN. *History of Indian Press*. Surjeeth Publication, 1988.
- Nadige, Krishnamurthy. *Indian Journalism*. University of Mysore Prasaranga, 1966.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0102	**Journalism Practical – I**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Coverage of local issues in the media- Print/TV/Radio
- Case Study
- Group Discussion on Current Affairs
- Basics of Photoshop
- Wall Magazine
- Collage Making

- Glossary Terms
- **Media Visit:** Theatre festival/ Film festival/ Literary festival/ Poets meet/ Political rally/ Seminars/ Museums.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ENS111	**Interdisciplinary Elective 1 - Comic and Graphic Narratives**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
The course is envisaged to provide the student an introduction to comic and graphic narratives. It aims at providing the basic theories of how the comic and graphic texts are closely read and analyzed. The course enables the student to understand the representation of society through the comic and graphic texts. It also equips the learner to explore the illustration of societies and their issues through the medium of comic and graphic narratives. This course intends to critically assess the various dimensions of culture and contribute to the spectrum of probable solutions to modern day problems.

Pre-requisites: Student must possess a fundamental knowledge of media, culture and society.

Pedagogy: ICT/ Flipped Classrooms/ Collaborative Learning/ Blended Learning

Course Objectives:

1. To develop a clear understanding of comic and graphic narratives.
2. To explore the various theoretical underpinnings involved in the making of comic and graphic narratives.
3. To discuss the involvement of cultural undercurrents of society in comic and graphic narratives.
4. To develop critical and analytical abilities by exploring the representation of various societies in comic and graphic narratives.

Course Outcomes:
On completion of this course, the student will be able to:

1. Distinguish between the comic and graphic narratives.
2. Identify the socio-cultural practices that contribute to the making of comic and graphic narratives through the theories.
3. Apply the illustration of cultural practices and their representations in texts in understanding societies.
4. Analyze the codes used in Asian comic and graphic narratives.

Course Content:

Unit I: World of Comics and Graphic Novels **7 Hours**

Evolution of Comic and Graphic Novel
Short-term strip comics (designed for newspapers) (1890s) – Web-based comics
Action-adventure and Superhero comics (1930s – 1960s)
Underground comix / alternative comics / comix – Graphic Novels
Comic & Graphic Novel vocabulary - Strips, Panels, Gutter, Tire, Splash, Balloons, Caption, Labels, Emanata, Signs, Sound effect, Bleed, Chiaroscuro, Cartoonist, Artist. (Ref: Scott McCloud: *Understanding Comics: The Invisible Art* (Chapter 2 – The Vocabulary of Comics)

Unit II: Theoretical Approach to Comic and Graphic Novels **6 Hours**

Jules Feiffer: Extract from Introduction to *The Great Comic Book Heroes* (1965)
Will Eisner: *A Contract with God and Other Tenement Stories* (Graphic Story - "A Contract with God")
Stephen Weiner - *Faster Than a Speeding Bullet: The Rise of the Graphic Novel* (Chapter 5 – "The Graphic Novel: Comics take themselves Seriously")

Unit III: Comic and Graphic Novels **7 Hours**

Art Spiegelman: Maus: A Survivor‟s Tale (Graphic Novel – (1980) – The Father Bleeds History (Part I) (Non-detail)
Zack Snyder: *Watchmen* (film text based on DC Comic series by Alan Moore and Dave Gibbons)
Richard West: "The Bill Watterson Interview," *The Comics Journal*, March 1989

Unit IV: Asian Representation in Comic and Graphic Novels **6 Hours**

Comics across Asia: Manga, Chitrakatha, Lianhuanhua and Manhua
John A Lent: *Asian Comics* (Introduction)
R. K. Laxman – *The Very Best of The Common Man* (2012) (extracts of comic strips)

References:

- Ed. Jeet Heer and Kent Worcester. *A Comic Studies Reader.* 2009
- Feiffer, Jules. *The Great Comic Book Heroes.* 1965.
- Wolk, Douglas. *Reading Comics. 2007.*
- McCloud, Scott. *Understanding Comics: The Invisible Art*. 1993.
- Eisner, Will. *Comics and Sequential Art* (first print – 1985 - latest edition – 2000)
- Weiner, Stephen. *Faster Than a Speeding Bullet: The Rise of the Graphic Novel.* 2012.
- Richard West: "The Bill Watterson Interview," *The Comics Journal*, March 1989, http://www.tcj.com/the-bill-watterson-interview/
- Lent, John A. *Illustrating Asia: Comics, Humor, Magazines and Picture Books*. 2001
- Laxman, R. K. *The Very Best of The Common Man.* Penguin. 2012
- Lent, John A. *Asian Comics.* 2015

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JNS112	**Interdisciplinary Elective 2 – Event Management**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This Interdisciplinary course is growing rapidly and now represents hundreds of professionals who are responsible for planning, coordinating and evaluating a wide range of events all year round. Event management is predominantly about creating an experience through organized communication, planning and implementation. This course will provide students with the practical skills and knowledge required to successfully plan, implement, organize, manage, monitor and evaluate special events.

Prerequisite: Basic organizational skills and positive personality towards learning
Pedagogy: Direct Instruction, Inquiry Based Learning, Collaborative learning

Course Objectives:

1. To help the students by providing them with a structured approach to operational and creative fundamentals, from inception to debrief
2. To help students plan, implement, organize and manage events
3. To teach the students how to develop and deliver successful events with a focus on meetings, incentives, conferences and exhibitions
4. To provide the students with the scope to develop budgets, work breakdown structures, and gain an insight into risk mitigation and contingency planning

Course Outcomes:
On completion of this course, the students will be able to:

1. Develop sense of responsibility for the multi-disciplinary nature of event management
2. Develop confidence and enjoyment from involvement in the dynamic industry of event management
3. Plan competently in the development and delivery of successful conference and corporate gatherings
4. Asses current market requirements

Course Content:

Unit-1: History and Evolution of Events **7 Hours**

History and evolution of Events, Nature, scope, significance and of event management, Interrelationship between events and tourism, Key stakeholders – their roles and responsibilities

Unit-2: The Event Planning Process **6 Hours**

The Process – An introduction, theory behind planning, Planning, Concept, Nature and Practices in Event Management: Organizing and planning events, Customer relationship management, Watching and managing events business, Event coordination; Planning – setting goals and objectives – Announcing the project, Defining communication channels and Resource specification

Unit-3: Execution and Implementation **7 Hours**

Execution and Implementation – Gantt Charts, Run sheets, Control, communication channels, Organizing Events, Planning Check lists, Monitoring and Evaluation, Managing Human resources, Event Management Team, Skills and Qualities required, Co-ordination; Raising Funds; Promotion and Marketing

Unit-4: Types of Events **6 Hours**

Film Festivals, Corporate Events, Trade shows, Conventions and Visitors Bureaus, Meeting planners, Celebrations; players in the event industry, Transportation, accommodation, logistics catering, human resources, civic amenities and other supporting services.

References:

- Page, Stephen, and Connell, Joanne eds. *The Routledge Handbook Of Events. Routledge*, 2014.
- Robinson,Peter, Wale,Debra and Dickson,Geoff eds. *Events Management*, CABI Head office, 2010.
- Ferdinand, Nicole, and Kitchin, Paul. *Events Management: An International Approach*. Sage, 2012.
- Goldblatt, Joe. *Special Events: Creating and Sustaining a New World for Celebration.* Wiley Global Education, 2013.
- Robertson, Martin. *Events and Festivals: Current Trends And Issues*. Routledge, 2013.
- Fox, Dorothy, et al. *Doing events research: From Theory To Practice*. Routledge, 2014.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21TMS113	**Interdisciplinary Elective 3 - Tourism Entrepreneurship**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
The purpose of this course is to equip the students to set up their own business especially in relate to travel and tourism industry and to acquire insights about the entrepreneurship development and to empower the students to be acquainted with the modus operandi and approaches prerequisite for a prosperous entrepreneur.

Pre-Requisite: Interest in learning startup business in tourism industry

Pedagogy: Direct Instruction, Collaborative Learning, Expeditionary Learning

Course Objectives:

1. To introduce the concept of entrepreneurship in tourism and instill the students with knowledge of entrepreneurship skills and Techniques.
2. To develop a quality business plan for a new tourism venture.
3. To analyze the business emerging trends in tourism industry.
4. To encourage the students to set up their own business.

Course Outcomes:

After the completion of the course, students will be able to:

1. Develop the understanding of the fundamental knowledge about the business trends in Tourism.
2. Acquaint about the types of entrepreneurship and tourism marketing planning in the context of tourism business.
3. Evaluate with the procedures for starting a Tourism business including corporate entrepreneurship in various levels of tourism development.
4. Integrate the knowledge of diverse roles and functions in the framework of tourism business venture.

Course Content:

Unit I: Entrepreneurship **7 Hours**

Definition and importance of entrepreneurship, Types of entrepreneurs, characteristics of an entrepreneur, Tourism industry and business ideas.

Unit II: Marketing and Understanding the competition **6 Hours**

Tourism marketing mix, Tourism marketing planning, Business strategy- Understanding customers and analyzing competition.

Unit III: Writing a Business Plan **7 Hours**

Writing a business plan-marketing, financial, operations people, etc.

Unit IV:Business Concept **6 Hours**

Setting up a tourism enterprise-steps, licenses and registration procedures etc.

References:

- Morrison, A., Rimmington, M. and Williams, C (2011)Entrepreneurship in the Hospitality, Tourism and Leisure Industries, Abingdon, Routledge
- Thomson. A. A., Stick land. A.J. &Cambel. J. E.,(2005), Crafting and Executing Strategy- the Quest for Competitive Advantage, New Delhi, Tata McGraw Hill.
- Peter F. Drucker (1985), Innovation & Entrepreneurship,New York, Harper & Row.
- Brookes, M., & Altinay, L. (Eds.). (2015). Entrepreneurship in hospitality and tourism: A global perspective. Oxford: Goodfellow Publishers Ltd.
- Deakins, D., & Freel, M. (2009). Entrepreneurship and small firms. (5th ed.). New York, NY: McGraw-Hill.
- Srinivasan. R , Strategic Management: the Indian Concept, 2nd Ed., New Delhi, Prentice Hall India.

SECOND SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21LSM201	Indian Constitution and Human Rights	MC	Non-credit Mandatory Course				2

Course Description:
This is a foundation course which gives a basic understanding about the various aspects of the Indian constitution. As the citizens, the students should understand the main philosophy of the constitution and the functions of the various organs of the democracy. Human Rights is the most debated issue in the world and the students will be able to gain a rudimentary knowledge about it.
Pre-requisites: A preliminary understanding of the constitution and human rights
Pedagogy: Direct instruction and collaborative learning method
Course Objectives:

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications
4. To create awareness on electoral process and its effects

Course Outcomes:
On completion of the course, learners will be able to:

1. Extend general knowledge and legal literacy and thereby can take up competitive examinations
2. Outline state and central policies, fundamental duties
3. Interpret Electoral Process, special provisions
4. Summarize powers and functions of Municipalities, Panchayats and Co-operative Societies, and have an awareness about basic human rights in India

Course Content:

Unit-I: Indian Constitutional Philosophy **7 Hours**
Features of the Constitution and Preamble
Fundamental Rights and Fundamental Duties
Directive Principles of State Policy

Unit-II: Union and State Executive, Legislature and Judiciary **6 Hours**
Union Parliament and State Legislature: Powers and Functions
President, Prime Minister and Council of Ministers
State Governor, Chief Minister and Council of Ministers
The Supreme Court and High Court: Powers and Functions

Unit-III: Concept and Development of Human Rights **7 Hours**
Meaning Scope and Development of Human Rights
United Nations and Human Rights- UNHCR
UDHR 1948, ICCR 1996 and ICESCR 1966

Unit-IV: Human Rights in India **6 Hours**
Protection of Human Rights Act, 1993 (NHRC& SHRC)

First, Second and Third Generations- Human Rights
Judicial Activities and Human Rights

References:

- Seervai .*Constitutional Law of India*. 4thEdition,Universal Publications, 2013.
- Basu, DD. *Introduction to the Constitution of India*. 21stEdition,Wadhwa Publications, 2013.
- Jain, MP. *Indian Constitutional Law*. 7th Edition, Lexis Nexis Wadhwa Publications, 2014.
- Pal Singh, Mahendra. *V.N. Shukla"s Constitution of India*. Eastern Book Company, 2020.
- Jain, MP. *Constitutional Law*. Lexis Nexis Wadhwa Publications, 2011.
- Rao, Mamta. *Constitutional Law.* Eastern Book Company, 2013.
- Malhotra, Anil. *India,Nrisand Law.*Universal Law Publishing Co., 2009.
- Bajwa, G.S and Bajwa DK. *Human Rights in India: Implementation and Violations.* D.K. Publishers, 1996.
- Basu, DD. *Human Rights in Constitutional Law*, Prentice Hall ,1994.
- Sehgal, B.PSingh, ed. *Human Rights in India: Problems and Perspectives*. Deep and Deep Publications, 1999.
- Avesti, S.K. and R.P.Kataria. *Law Relating to Human Rights.* Orient Publications, 2000.
- Kapoor, S.K *Human Rights under International and Indian Law*. Central Law Agency, 1999.
- Symmonides, J. H*uman Right: International Protection, Monitoring and Enforcement*. Rawat publications, 2005.
- Rao, Mamata. *Law Relating to Woman and Children*. Eastern Book Co., 2008.
- Reddy, G.B.*Woman and the Law*.Gogia Law Agency, 2001.
- Tripathi, S.C. *Law Relating to Woman and Children*. Central Law Publishers, 2001.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHE201	**Communicative English – II**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course focuses on enhancing written proficiency required for professional enhancement. It also polishes the spoken skills of the learners to make them effective and confident presenters. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The practical components discussed in this course enables a fruitful transition from academia to the industry of their choice.
Pre-requisites: The student must possess functional knowledge of LSRW skills.
Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.

Course Objectives:

1. To build skills essential for corporate communication.
2. To enhance context specific language skills.
3. To discover the creative linguistic potential through language and literature.
4. To develop communication skills necessary for employability.

Course Outcomes:

After the completion of the course, students will be able to:

1. Apply acquired skills to communicate effectively in a corporate scenario.
2. Demonstrate command over rhetoric of language.
3. Develop critical and creative thinking through assimilated language skills.
4. Utilize the communication skills learnt to match industry standards.

Course Content:

Unit-I: Language Acquisition **7 Hours**

Remedial Grammar: Questions & Negatives; Questions Tags
Writing Skills: Email Writing
Activities: Group Discussions
Literature: Alphonse Daudet - The Last Lesson

Unit-II: Persuasive Skills **6 Hours**

Remedial Grammar: Past Simple & Past Perfect
Writing Skills: Report Writing
Activities: Book & Movie Reviews
Literature: Lord Alfred Tennyson – Ulysses

Unit-III: Cognitive Skills **7 Hours**

Remedial Grammar: Present & Past Passive; Conditionals
Writing Skills: Creative Writing
Activities: Role Plays
Literature: O. Henry – The Gift of the Magi

Unit-IV: Employability Skills **6 Hours**

Remedial Grammar: Reported Speech; Idioms
Writing Skills: Cover Letter & CV
Activities: Exchanging Information
Literature: Saki – The Open Window

References:

- Bansal, R.K. and J.B. Harrison. *Spoken English*. Orient Blackswan, 2013.
- Raman, Meenakshi and Sangeeta Sharma. *Technical Communication*. Oxford University Press, 2015.
- Thorpe, Edgar and Showick Thorpe. *Objective English*. Pearson Education, 2013.
- Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt Ltd., 1988.
- Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.

- Samson, T. (ed.) *Innovate with English*. Cambridge University Press, 2010.
- Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.
- Goodale, Malcolm. *Professional Presentation*. Cambridge University Press, 2013.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHK201	**Language – II: Kannada-II**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:
¨sÁµÉAiÀÄ£ÀÄß vÀiÁvÀ£ÁqÀÄvÀ §gÉAiÀÄÄvÀ PË±À®, uÁ»vÀåzÀ §UÉÎ uÀsÜ®vÁV ¥ÀjZÀ¬ÄuÀÄvÀ vÀÄs®PÀ «zÁåyðUÀ¼À vÀåQÛvÀé «PÁuÀ ºÁUÀÄ uÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀåèlÄÖPÉsAqÀÄ, ¥ÀæuÀÄÛvÀ uÀAzÀ¨sÀðPÉÌ «zÁåyðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀ®Ä ¥ÀoÀåvÀ£ÀÄß gÀs¦uÀeÁVzÉ. uÁ»vÀå, PÀeÉ, vÁtÂdå, DqÀ½vÁvÀäPÀ vÀÄvÀÄ «eÁ£ÀzÀ «ZÁgÀUÀ½UÉ MvÀÄ£ÀÄß ¤ÃqÀeÁVzÉ. EzÀÄ vÉszÀ® JgÀqÀÄ uÉ«ÄuÀÖgï vÀÄsgÀÄ PÉærmïUÀ¼À£ÀÄß; vÀÄsgÀÄ vÀÄvÀÄ £Á®Ì£ÉÃ uÉ«ÄuÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉsA¢zÉ.

Pre-requisites:
- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉÎ ¥ÁæxÀ«ÄPÀ w¼ÀÄªÀ½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄ §gÉAiÀÄ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥Às ªð ²PÀëtzÀ9 PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives:
£Á®ÌÀÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸À¯ÁªÀ GzÉÝÃ±À«ÀÄß ºÉsA¢zÉ. CzÀgÀAvÉ ªÉszÀ® £ÁAiÀÄ ¸É«Ä¸ÀÖgï£À°è dA¥ÀzÀ, ¥ÁaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÌ ªÀiÁrPÉsAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©gÀÄaAiÀÄ£ÀÄß ªÀÄsr¸ÀeÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉsvÉUÉ ªÀåQÛvÀ «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀeÁUÀÄvÀÛzÉ.

- ¨ÁµÉ, uÁ»vÀå, EwºÁuÀ vÀÄvÀÄÛ uÀAuÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£Áð1PÀPÉÌ uÀA§A¢¹zÀAvÉ ¥ÀjZÀ¬ÄuÀeÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À uÀvÀðvÉsÃvÀÄÄR ¨É¼ÀvÀtÂUÉUÉ C£ÀÄvÁUÀÄvÀAvÉ ºÁUÀs CvÀgÀå vÀiÁ£ÀvÀ uÀA§AzÀUÀ¼À §UÉÎ UÉgÀvÀ, uÀvÀiÁ£ÀvÉ vÀÄsr¹, ¨É¼ÉuÀÄvÀ ¤nÖ£Àå ¥ÀoÀåUÀ¼À DAiÉÌAiÀiÁVzÉ.
- CvÀgÀå uÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ÁµÉ, GvÀvÀÄ «vÀÄ±Áð UÀÄt, ¤gÀUÀð¼À uÀA¨ÁµÀuÉ, ¨ÁµÀt PÀeÉ ºÁUÀs §gÀºÀ PË±À®UÀ¼À£ÀÄß ¨É¼ÉuÀÄvÀçzÀÄ UÀÄjAiÀiÁVzÉ
- uÀàzÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀs®vÁUÀÄvÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀå1ÄÖPÉsAqÀÄ uÀsPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÌ vÀiÁrPÉs¼ÀîeÁVzÉ.

Course Outcomes:
dA¥ÀzÀ, ¥ÁaÃ£À, ªÀÄzsÀåPÁ°Ã£À ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄs®PÀ PÁ®zÀ ÀÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

- uÁvÀiÁfPÀ, gÁdQÃAiÀÄ, zÁ«ÄðPÀ, uÁAuÀlÖwPÀ, ¥ÀjuÀgÀ ºÁUÀs åAUÀuÀA§A¢ «ZÁgÀUÀ¼ÉqÉ UÀvÀÄ£À ºÀjuÀÄvÀzÀgÉsA¢UÉ «zÁåyðUÀ¼Àå ZÀZÁð vÀÄ£ÉsÃ¨ÁvÀvÀç ¨É¼ÉAiÀÄÄvÀlzÉ.
- fÃvÀ£ÀzÀå §gÀÄvÀ C©¥ÁæAiÀÄ ¨ÉÀzÀUÀ¼ÀÄ, uÀvÀÄuÉâUÀ¼À£ÀÄß DzÀÄ¤PÀ uÀAzÀ¨ÀðzÀå vÀiÁ£À«ÃAiÀÄvÉAiÉsA¢UÉ ¤vÀð»uÀÄvÀAvÉ ¥Éæ¼gÉÃ ¦uÀÄvÀlzÉ.
- GvÀlvÀÄ uÀAvÀºÀ£À PÀeÉAiÀÄ£ÀÄß ¨É¼ÉuÀÄvÀ GzÉÝÃ±ÀvÀ£ÀÄß FqÉÃjuÀÄvÀlzÉ.
- uÀA±ÉsÃzÀ£Á vÀÄ£ÉsÃ¨Ávà vÀÄvÀÌÜ uÀæzÁðvæPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀÄvÀlzÉ.

Course Content:

Unit-I **ªÀÄzsÀåPÁ°Ãzsà PÁªÀi** **7 Hours**

1. ZÀAzÀævÀÄw «eÁ¥À — gÁWÀvÁAPÀ
2. ºAUÉUA¼A£AA »ArzA£AA vAA£AzEs¼AUE — PAAvAiAgAvAiuA
3. UÉsÃgÀPÀë ¥ÀæuÀAUÀ — ZÁvÀÄgÀuÀ

Unit II **ªÀÄzsÀåPÁ°Ãzsà PÁªÀi** **6 Hours**

1. wæ¥À¢UÀ¼ÀÄ — uÀvÀðdÕ
2. V½AiÀÄÄ ¥ÁAdgÁzÉs½®è — ¥ÁÄgÁAzÁgÁ zÁuÁgÁÄ
3. PÀgÉzÀÄ PÉslÖ£ÀÄ ±Á¥ÀvÀ£ÀÄ — PÀ£ÀPÀzÁuÀgÀÄ

Unit III **eÉÃR ÀªÜÀ¼ÀÄ** **7 Hours**

1. DvÀä²æÃUÁV ¤gÀAPÀÄ±ÀvÀÄwUÀ¼ÁV — PÀÄvÉA¥ÀÄ
2. vÀiÁ£À«ÃAiÀÄvÉ CAvÁgÀeÁ — zÉÃvÀ£ÀsgÀÄ vÀÄºÁzÉÃvÀ
3. ¨sÀsvÁ¬Ä vÀÄÄ¤zÁ¼ÀÄ — vÀÄÄgÁj §eÁ¼À

Unit IV **¥ÀªÁ¸À PÀxÀ£À** **6 Hours**

1. £À£ÉsÃ¼ÀV£À ºÁqÀÄ PÀs¡¨Á (uÀAUÀæºÀ) — f.J£ï. vÉsÀºÀ£ï

References:

- vÀÄÄUÀ½ gÀA.²æÃ., PÀ£ÀßqÀ uÁ»vÀ ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºËuï, vÉÆÃuÀsgÀÄ. 2014
- uÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.Jeï., ZÁjwæÀ d£À¥ÀzÀ PÀxÀ£À PÁvÀÌUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀsgÀÄ. 2008
- ¹ÃvÀiÁwÃvÀ PÀ£ÀßqÀ uÁ»vÀ ZÀjvÉ uÀA¥ÀÄl 1,2,3,4,5 vÀÄvÀÌÜ 6, PÀÄvÉA¥ÀÄ PÀ£ÀßqÀ CzÀiAiÀÄ£À uÀAuÉÜ, vÉÆÃuÀsgÀÄ «±Àé«zÁå¤®AiÀÄ, vÉÆÃuÀsgÀÄ. 2014
- uÀAUÀæºÀ. £ÁUÉÃUËqÀ JZï.Jeï., PÀ£ÀßqÀ d£À¥ÀzÀ PÀxÀ£À PÁvÀÌUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÁðlPÀ eÁ£À¥ÀzÀ ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀsgÀÄ. 2007
- £ÁgÁAiÀÄt ¦.«, ZÀA¥Às PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥ÀßqÀ §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2010
- PÁ¼ÉÃUËqÀ £ÁUÀvÁgÀ, wæÀ¢, gÀUÀ¼É vÀÄvÀÌÜ eÁ£À¥ÀzÀ uÁ»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥ÀßqÀ §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2010
- uÀA. ¨ÉÆÀUÀeï gÁvÀÄ gÁvï vÀÄvÀÌÜ ¥Á£ÀåA uÀÄÄAzÀgÀ ±Á¹ÛçÃ, ¥ÀÄgÁt £ÁvÀÄ ZÀsqÁvÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥ÀæuÁgÁAUÀ, vÉÆÃuÀsgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010

- qÁ. azÁ£ÀAzÀ vÀÄswð, vÀZÀ£À uÁ»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥Àð §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2013
- uÀA vÀÄgÀÄ¼À¹zÀ¥Àå PÉ, £ÁUÀgÁd Q.gÀA. vÀZÀ£À PÀvÀÄàl, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥Àð §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2016
- vÀÄgÀÄ¼À¹zÀ¥Àå PÉ, µÀlà¢ uÁ»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥Àð §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2010
- uÀA. uÉÃvÀÄgÁvÀÄ gÁvï C.gÁ., ²æà ®Që¬Ä±À£À eÉÊ«Ä¤ ¨ÁgÀvÀ(vÀÄs®–vÁvÀàAiÀÄð–uÀavÀæ), ¥ÀæPÁ±ÀPÀgÀÄ PÁvÀÄzsÉÃ£ÀÄ ¥ÀÄuÀPÀ ¨ÀvÀ£À, ¨ÉAUÀ¼ÀsgÀÄ. 2010
- uÀA. uÉÃvÀÄgÁvÀÄ gÁvï C.gÁ., ²±ÀÄ£Á¼À ±ÀjÃ¥Àgà £ÀsgÁgÀÄ vÀvÀé¥ÀzÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ PÁvÀÄzsÉÃ£ÀÄ ¥ÀÄuÀPÀ ¨ÀvÀ£À, ¨ÉAUÀ¼ÀsgÀÄ. 2007
- uÀA. f.Juï.¨Àmï., PÀÄvÀiÁgÀvÁåuÀ£À PÀuÁðl ¨ÁgÀvÀ PÀxÁvÀÄAdj ¥ÀævÉÃ±À, ¥ÀæPÁ±ÀPÀgÀÄ CPÀgà ¥ÀæPÁ±À£À, ºÉUÉsÎÀqÀÄ, uÁUÀgÀ. 2006
- gÀAeÁ£ï zÀUÁð, ±ÀgÀtgÀ uÀvÀÄUÀ PÁæAw, ¥ÀæPÁ±ÀPÀgÀÄ. eÉsÃ»AiÀiÁ ¥ÀæPÁ±À£À, §¼ÁÎj. 2015
- QÃvÀð£ÁxÀ PÀÄvÀðPÉsÃn, PÀ£ÀßqÀ uÁ»vÀå uÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉsÃn vÉÄvÉsÃjAiÀÄeï lñï, zÁgÀvÁqÀ. 2009
- ±ÁvÀÄgÁAiÀÄ vÀ.uÀÄ., PÀ£ÀßqÀ uÁ»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À vÉAPÀtÚAiÀÄå uÁägÀPÀ UÀæAxÀvÀiÁeÉ, vÉÄÊuÀsgÀÄ – 2014
- ²vÀgÀÄzÀæ¥Àå f.Juï. PÀ£ÀßqÀ uÁ»vÀå uÀ«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥Àð §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2013

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHH201	Language – II: Hindi-II	FC	1	1	0	2	3

Course Description: अध्ययन वर्ण :

यह पाठ्यक्रम नौसिखिया, अपनी भाषा की क्षमता का सिकाि करने हेतु तथा सिसभन्न िासहखिक प्रस्क्रयाओं द्वारा
िमाज, िंस्कृ सत एिं जीिन के मूल्यं कय िमझने हेतु असभकखित है।

Pre-requisites/Pre reading for the course:

- अध्येता,पी.यु.िीके स्तरपरसद्वतीयभाषाके स्वरूपमेंसहन्दीकाअध्ययनकरनाचासहए|
- सहन्दीिासहिके इसतहाि काि िंस्क्प्तज्ञानकीआिश्यकताहै।
- सहन्दीव्याकरणकाअिबयधनआिश्यकहै|
- सहन्दी-अंग्रेजीअनुिाददेिंबंसधतजानकारीजरुरीहै।

c) Pedagogy: सिक्षशवस्त्र :

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction

- Flipped Classroom

Course Objectives: पवठ्यक्रम उद्देश्य:

- ि ंदभानुिारउसचतभाषाकाप्रययगकरने ेंउत्पन्नकरना|
  कीदक्षताकयछात्यम
- िासहिके यिमझाकर, ीरक्षाहेतुप्रेररतकरना|
  माध्यमि ेिमाजएि ंमानिीय उनमूल्यक
  मूल्यक
- छातयमेंपस्तु कपठनएिंलि नकीअकृ सतमप्रिसिस्थासपतृ करना|
- अध्येताओमेंिासहिके माध्यमिप्रभािीएि े कु शलि ंचं ारकासिकाि करना|

Course Outcomes: अिसगम पररर्वम:

अध्ययनकीिमाखप्तपरअध्येता –

- िामासजकमूल्एिनैसतकजिाबदेहीकयस्वीकारकरिकताहै|
- िासहिकीप्राि ंसगकताकयजीिनमेंि ंमझनेकीदक्षतारिताहै|
- िमाजमेंअंतसनसहतपद्दक्षतयाएि ंसिचारधाराओकाव्याख्यानकरनेमिक्षें मबनिकताहै|
- िासहिके माध्यमि ेप्रभािीएि ंकु शलि ंचारकासिकाि करिकताहै|

Course Content: अध्ययन सवषय ि ूची /पवठ्यक्रम

इकवई – 1कसिता: प्राचीन एि आधुसनक **7 hours**

1.कबीर के दयहे

2.कसिता –जसलयाि ाला बाग मेंबि ंत- ि ुभद्राकु मारी चौहान

3.कसिता –ि ुभाष की मृि ु पर - धमि ीर भारती

इकवई – 2कसिता: प्राचीन एि आधुसनक **6 hours**

4.तुलि ीदि के पद

5.कसिता – पाषाणी – नागाजन

6.कसिता –चलना हमारा काम है- सशिमंगल सि ंह ि ुमन

इकवई – 3कसिता: प्राचीन एि आधुसनक **7 hours**

7.मीराबाई के पद

8.कसिता –मेरे िपने बहुत नहीं हैं-सगररराज कु मार माथुर

9.कसिता – अभी न हयगा मेरा अंत – सनराला

इकवई – 4 **6 hours**

अनुववद : शब्द एि अनुच्छे द (सहन्दी िे अंग्रेज़ी)

मीसियाि ेन

Suggested Text Books and References

Text book/s: पठ्य पुस्तक :

1. सहन्दी पाठ्य पुस्तक – रेिा सिश्वसिद्यालय|

References: ि न्दर् ग्रन्थ :

1. िबयध व्यिहारक सहन्दी – िॉ. कु लदीप गुप्त
2. असभनि व्यिहारक सहन्दी – िॉ.परमानन्द गुप्त
3. सहन्दी िासहि का इसतहास - िॉ. नागेद्र
4. आधुसनक सहन्दी िासहि का इसतहास - िॉ. बच्चन सिंह
5. सहन्दी िासहि का निीन इसतहास - िॉ. लाल िाहब सिंह

6. शुद्ध हिन्दी कैसे बोलें कैसे लिखें- पृथ्वीनाथ पाण्डेय
7. संक्षेपण एवं पल्लवन

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHA201	**Language – II: Additional English-II**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course designed to help the learner gain competency in language through an exploration to the various genres of literature. The syllabus is designed to encourage critical ability of the learner to guide them towards career opportunities. This course is intended to develop the capacity to appreciate and assess the various dimensions of society, culture and life.
Pre-requisites: The student must possess fair knowledge of language and literature.
Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.
Course Objectives:
- To assess ecological and environmental concerns through literature.
- To identify the unequal structures of power in society.
- To compare the position of men and women in society.
- To interpret the representation of society in popular culture.

Course Outcomes:
On completion of the course, learners will be able to:
- Demonstrate a thorough understanding of sensitive and critical ecological and environmental issues.
- Analyze the rigid structure of center and margin in our society.
- Criticize the subordinate position of women in society.
- Justify the depiction of society in popular culture.

Course Content:

Unit-I:Ecology & Environment **7 hours**
Literature: Toru Dutt - Casuarina Tree
Gordon J.L. Ramen – Daffodils No More
C.V. Raman – Water – The Elixir of Life
Language: Degrees of Comparison

Unit-II: Voices from the Margin **6 hours**
Literature: Tadeusz Rozewicz – Pigtail
Jyoti Lanjewar – Mother
Harriet Jacobs – Excerpt from Incidents in the Life of a Slave Girl
Language: Prefix and Suffix

Unit-III: Women & Society **7 hours**
Literature: Kamala Das – An Introduction
Rabindranath Tagore – The Exercise Book
Jamaica Kincaid – Girl

Writing Skills: Dialogue Writing

Unit-IV: Popular Culture **6 hours**

Literature: Rudyard Kipling – The Absent-minded Beggar
Sir Arthur Conan Doyle – The Adventure of Lion‟s Mane
Aldous Huxley – The Beauty Industry
Writing Skills: Story Writing

References:

- Agrawal, K.A. *Toru Dutt the Pioneer Spirit of Indian English Poetry - A Critical Study*. Atlantic Publications, 2009.
- Latham, Edward Connery (ed). *The Poetry of Robert Frost*. Holt Paperbacks, 2002.
- Basu, Tejan Kumar. *The Life and Times of C.V. Ram*an. Prabhat Prakashan, 2016.
- Rozewicz, Tadeusz. *New Poems*. Archipelago, 2007.
- Jacobs, Harriet. *Incidents in the Life of a Slave Girl*. Create space Independent Publication, 2014.
- Das, Kamala. *Selected Poems*. Penguin Books India, 2014.
- Tagore, Rabindranath. *Selected Short Stories of Rabindranath Tagore*. Maple Press, 2012.
- Gale, Cengage Learning. *A Study Guide for Jamaica Kincaid's Girl*. Gale, Study Guides, 2017.
- Doyle, Arthur Conan. *The Hound of the Baskervilles*. General Press, 2017.
- Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0201	**Political Science – II (Understanding Political Theory)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
This course aims at analysing fundamental topics of political theory from Ancient Greece to nowadays: "politics", "power", "political institutions", "the state", "political ideologies", "totalitarian, authoritarian and hybrid regimes", "world politics", etc. Through the analysis of different key topics, many schools and theories will be studied and compared. Students can recognize the need and importance of sovereignty in the present times.
Pre-requisites: Students should have a thorough understanding of the core political science concepts
Pedagogy: Direct instruction and flipped class method

Course Objectives:
1. To define the Meaning, Nature and Scope and the Traditions of Political Theory
2. To explain the Sovereignty theories of Monistic and Pluralistic and the Changing Dimensions of Sovereignty in the age of Globalisation
3. To elaborate the meaning, kinds and the theories of Democracy

4. To define the meaning, type, Neo-Colonialism and its Features and Dependency Theory.

Course Outcomes:

The students will be able to

1. Interpret the various political systems and processes
2. Analyse the theories of Sovereignity
3. Identify the specific political topics both in group and individually
4. Compare and evaluate different schools and authors of political theory

Course Content:

Unit I- Political Theory: 10 Hours

Meaning, Nature and Scope; Traditions of Political Theory–Liberal, Marxist, Conservative; Approaches to Political Theory – Normative, Historical and Empirical

Unit II- Sovereignty, Power, Authority and Legitimacy 10 Hours

Theories of Sovereignty: Monistic and Pluralistic; Changing Dimensions of Sovereignty in the age of Globalisation. Power, Authority andLegitimacy**:** Meaning, Nature, Kinds and Importance.

Unit III- Democracy: 10 Hours

Meaning and Kinds; Theories of Democracy: Classical, Pluralist, Marxist, Elitist; Challenges to Democracy in the Contemporary World.

Unit IV- Imperialism and Neo-Colonialism 9 Hours

Meaning and Types, Neo-Colonialism and its Features, Dependency Theory. .

References :

- Kapur, A C. *Principles of Political Science*. S Chand Publications, 1997.
- Johari, J.C. *Political Theory*. Sterling Publishers, 1987.
- Hardas, Hari and B.C. Choudhary. *Political Theory:Traditional and Modern Theory*, National Publishing House, 1987.
- Ray, Amal &Mohit Bhattacharya. *Political Theory.* Eastern Publications, 1962.
- Vinod, M.J. and Meena Deshpande. *Contemporary Political Theory*. PHI Learning, 2013.
- Ashirvatham, Eddy. *Political Theory*. The Upper Publishing House, 1936.
- George, Sabine. *A History of Political Theory.* Henry Halt and Company, 1937.
- Gauba, O.P. *An Introduction to Political Theory.* Macmillan Publishers India Ltd., 2011.
- Mahajan, V D. *Political Theory*. S Chand Publications, 2004.
- Heywood, Andrew. *Political Theory: An Introduction*. Palgrave Macmillan, 2000.

Journals

1. Indian Journal of Political Science
2. Political Theory
3. Economic and Political Weekly

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0202	**Political Science Practical - II**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Mock Parliament Session
- Documentary movie screening (Wars, Freedom struggle and speech by freedom fighters)
- Debate on current political relevant topics
- Model political campaigning
- Case studies on various issues which have political relevance

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0203	**Economics – II (Principles of Macro Economics)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
It aims at providing a systematic introduction to mainstream approaches to the study of macroeconomics in the current century. It has been designed in such a way that it stimulates awareness on macroeconomic challenges and policy management in progressive nations. It also aims at developing the ability for objective reasoning about macroeconomic issues.
Pre-requisites: Primary knowledge of microeconomic concepts.
Pedagogy: Direct instruction and Collaborative method
Course Objectives

1. To inspect Economy‟s Income and Expenditure byMeasuring a Nation's Income and Cost of Living
2. To explain Policy changes and the impact on the market and the Classical Theory of Inflation
3. To outline the three key facts about economic fluctuations and Stabilization of Policy
4. To influence macroeconomic challenges and policy management in progressive nations

Course Outcomes:
On completion of this course, the student would be able to:

1. Explain the various factorsof macroeconomics and identify the policy implications in emerging economies
2. Identify the contribution of various macroeconomic schools and evaluate their policy prescriptions
3. Summarize the concepts of aggregate demand and aggregate supply
4. Evaluate the pros and cons of different macroeconomic policies in real situations

Course Content:

Unit-1- Measuring a Nation's Income and Cost of Living **10 Hours**

Economy‟s Income and Expenditure: Measurement of GDP, components of GDP, real versus nominal GDP, the GDP Deflator. The Consumer Price Index: calculation of CPI, GDP deflator versus the CPI, correcting the economic variables for the effects of inflation, real versus nominal interest rates.

Unit-II- Goods and Money Market **10 Hours**

Saving and Investment in the National Income Accounts. The Market for Loanable Funds; Policy changes and impact on the market for loanable funds. Meaning and functions of Money. Banks and Money supply; Money creation with 100 per cent Reserve Banking and Fractional Reserve Banking. Central Bank tools of Monetary Control. Classical Theory of Inflation; Classical Dichotomy and Monetary Neutrality. Velocity and Quantity Equation; Fisher Effect. Costs of Inflation.

Unit-III- Aggregate Demand & Aggregate Supply **10 Hours**

Three key facts about economic fluctuations. Short run Economic Fluctuations: Aggregate Demand Curve, Aggregate Supply Curve and the two causes of economic fluctuations. Monetary Policy influence on Aggregate Demand. The Theory of Liquidity Preference. Fiscal Policy influence Aggregate Demand: The Multiplier Effect and Crowding – out Effect. Stabilization Policy and Active versus Automatic Stabilizers.

Unit-IV- Six Debates over Macroeconomic Policy **9 Hours**

Monetary and Fiscal Policy – pros and cons. Handling Recession: higher spending versus tax cuts. Monetary Policy: rule versus discretion; Central Bank: zero inflation. Balanced Budget debate. Tax Law reformation for savings debate.

References:

- Mankiw, Gregory N. *Principles of Macroeconomics*, 6th Edition, Cengage Learning India, 2012.
- Sloman, John. *Economics*, 6th edn., Pearson Education, 2006.
- Ackley, G. *Macroeconomics, Theory and Policy*. Macmillan Publishing Company, 1976.
- Day, A.C.L. *Outline of Monetary Economics.* Oxford University Press, 1960.
- Heijdra, B.J. and F.V.Ploeg. *Foundations of Modern Macro economics*, Oxford University Press, 2001.
- Lewis, M.K. and P.D. Mizan. *Monetary Economics*, Oxford University Press, 2000.
- Shapiro, E. *Macroeconomics Analysis*, Galgotia Publications, 1996.
- Dillard, D. *The Economics of John Maynard Keynes*, Crossby Lockwood and Sons, 1960.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0201	Journalism - II (Reporting & Editing)	HC	2	1	0	3	4

Course Description:
The course Reporting & Editing is structured to prepare students for careers in newspaper, magazine, convergence, or journalism education. It caters to students who want to gain proficiency on the content-providing side of the media. By offering hands-on, engaging courses such as Reporting, Interview, Press Conference, Computer Assisted Reporting and Design for Print media, the Reporting and Editing program readies students to be leaders in their chosen field upon graduation.
Pre-requisites: Good newspaper reading habits.
Pedagogy: Direct instruction and inquiry based learning
Course Objectives:

1. To help the students understanding the process of news gathering or print media
2. To impart skills in writing and editing media content- news story, press release, headlines, photo-captions
3. To gain knowledge about the various beats of journalism
4. To gain awareness of different issues of journalism

Course Outcomes:
On completion of this course, the student would be able to:

1. Develop skill in reporting for different beats and editing
2. Develop practical knowledge on editing and proof reading
3. Demonstrate the visual elements in print media
4. Compare the workings of the different print and publishing houses in India

Course Content:

Unit I: Attributes of Print Journalism **10 Hours**

Journalism- Definition, nature and scope; News- Definition, values, Structure of a news story- lead, body, tail; Methods of writing news; we will be discussing it in the methods of writing) Types of leads; Newsroom structure; Qualities of a reporter.

Unit II: Techniques of Reporting **10 Hours**

Techniques of Reporting: Types and techniques; Beats of reporting-crime investigative, development, politics, sports, court, legislature, environment, business; Sources of news: Attribution and verification; Interviews – preparation and Techniques

Unit III: Principles of Editing **10 Hours**

Introduction to editing; Principles of editing- Checking facts, correcting language, rewriting news stories, condensing stories; Headlines, Functions of headlines, Types of Headlines; Editorial page: structure, purpose, middles; Editorial Writing; Letters to the editor, Opinion pieces on OP. ED page; Style sheet.

Unit IV: Design Elements in Newspapers: **9 Hours**

Cartoons and Caricatures: Political and Social; Info-graphics; Photo journalism-Types of photography: news, sports, profiles; photo editing; Typography; Caption writing; Principles of Page Designing, Editing and Designing Software in Design Software.

References:

- Pandey, Desh, B.K. *Photo journalism*. Sonali Pubication, 2007.
- Rich, Carole. *Writing and Reporting news*. Wadsworth Thompson Learning Inc., 2005.
- John, Pilger (Ed.). *Tell me no lies*. London :Vintage Publishers, 2004
- Jon &Lawis (Eds). *The Mammoth Book of Journalism*. London:Robinsm Publishers, 2003.
- Smith R, Schumeman (Ed). *Photographic Communication: Principles Problem and challenges of Photo Journalism.* New York Hasing House, 2000.
- Kamath MV. *Professional Journalism*. Vikas Publication, 1991.
- Desai, M V and Ninan Sevanti. *Beyond Those Headlines*. Allied Publishers Limited, 1996.
- Westley, Bruce. *News Editing*, Oxford IBH, 1980.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0202	**Journalism Practical - II**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Reporting Exercise
- Interview
- Re-writing and Editing
- Photo Editing and caption writing
- Head Line writing
- Page Layout
- News Letter
- **Media Visit:** News paper/ Television channel offices.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21PYS211	**Interdisciplinary Elective 4- Skill Acquisition and Training**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

Achieving expertise in simple and complex tasks describes the building blocks of cognitive, motor, and teamwork skills, and the factors to take into account in training them. The basic processes of perception, cognition, and action that provide the foundation for understanding skilled performance are discussed in the context of complex task requirements, individual differences, and extreme environmental demands. The role of attention in perceiving, selecting, and becoming aware of information, in learning new information, and in performance is described in the context of specific skills. This course aims to introduce basic concepts of Skill acquisition and training.

Pre-requisites: Basic skills like listening, observation and keen interest in understanding human behaviour and exposure to real life situations.

Pedagogy: Direct learning, ICT, Case Studies.

Course Objectives:

1. Demonstrating knowledge and understanding basic concepts and research in the domains of skill acquisition and training methods.

2. Explore the perceptual learning process, and attention and skill aspects in acquiring skills.

3. Understanding the individual differences in skill acquisition and maintenance.

4. Understand the designing effective training systems for the students and other target groups.

Course Outcomes:

After the successful completion of the course, students will be able to

1. Learn the nature, aspects of skill acquisition, phases in skill acquisition, and modelling skill.
2. Articulate how humans tend to learn through perceptual process and importance of attention in acquiring skills.
3. Understand dynamics of individual differences in skill acquisition and maintenance.
4. Acquire the training requirements, structuring training, team training, implementing and evaluating training in organizations.

Course Content:

Unit 1: Skill Acquisition and Training in Context **7 hours**

Historical Overview of Skills Research, Information-Processing, Approach to Skill Acquisition, Phases of Skill Acquisition, Quantifying Performance Changes, Modelling Skill, Applications of Skills Research.

Unit 2: Perceptual Learning, Attention and Skill **6 hours**

Mechanisms of Perceptual Learning, Facilitating the Development of Perceptual Skill, Visual Search, Procedural Learning, Adaptive Perception. Conceptualizing Attention, Attention and Automaticity, Attentional Skill, Implicit Learning.

Unit 3: Individual Differences in Skill Acquisition and Maintenance **7 hours**

Intelligence and Aptitudes, Task Analysis Based on Individual Difference Variables, Dynamic Accounts of Abilities and Skill, Problems of Interpretation in Understanding the Relation between Abilities and Skill Level, Individual Differences in Reading Skill, Skill and Aging.

Unit 4: Designing Effective Training Systems **6 hours**

Assessing Training Requirements, Structuring Training, Team Training, Implementing and Evaluating Training in Organizations, Trainee Characteristics, Evaluating Training Effectiveness, Maximizing the Benefits of Training, National Culture and Training.

Reference:

- Addie Johnson and Robert W. Proctor (2017), Skill Acquisition and Training-Achieving Expertise in Simple and Complex Tasks, Routledge publishers, New York.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21PSS212	**Interdisciplinary Elective 5 –Global Perspectives of Human Rights**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

The aim of this course is to make the students to understand the basic aspects of human rights and its importance in the present world. This course will enable the students to understand the importance and relevance of human rights in the modern world. Students will come to know about the meaning, definitions, approaches of human rights through this course. This course also intends to make the students aware about the current developments in human rights by including some global case studies and famous human rights activists. Also, it offers an understanding of the role of international and national organizations working for the promotion and protection of human rights.

Pre-requisites: Basic understanding of rights and keen interest in learning and observing the current developments in the concept of right.

Pedagogy: Direct instruction and collaborative learning method

Course Objectives:

1. To outline with basic concepts of human rights.
2. To develop a better understanding of emerging trends in human rights issues at international and national level.
3. To focus and identify the violation of human rights at socio-economic, cultural and political level.
4. To understand the role of various organization, activists and movement in promoting and protecting human rights.

Course Outcomes:

After the successful completion of the course, the students will be able to

1. Analyse the basic concepts of human rights.
2. Explain the various types and scope of human rights.
3. Critical thinking of violation of rights at various levels
4. Develop an innovative approach towards various issues related to violation of rights.

Course Content:

Unit –I **7 Hours**

Human Rights: Origin, Meaning and Definitions, Universal Declaration of Human Rights1948, Rights protection in India

Unit - II **6 Hours**

Types of Human Rights: Political and Civil Rights; Social and economic rights; Cultural relativism, individual and group rights

Unit - III **7 Hours**

United Nations and Human Rights: United Nations Commission on Human Rights (Human Rights Council), Role of UN in Promotion and Protection of Human Rights, Applications of International Human Rights Law in India

Unit – IV **6 Hours**

Case Studies; Syria, Palestine, Sri Lanka, Kashmir, Myanmar and Afghanistan, Human Rights Activists – Nelson Mandela, Aung San Suu Kyi, Malala Yousafzai

References:

- Myneni, S.R, Human Rights, Asia Law House, 2012.
- Sinha, Manoj Kumar, Implementation of Basic Human Rights, LexisNexis, 2013.
- Jain, Rashee, Textbook on Human Rights Law and Practice, LexisNexis, 2013
- Gupta, D.N and Singh Chandrachur, Human rights, Acts, Statutes and Constitutional Provision, Kalpaz Publications, 2003
- Rao Bhaskaro, Digumati, Human Rights and United Nations, Discovery Publishing House, 2001
- Kumar,Vijay, Human Rights Dimensions and issues, Anmol Publications, 2003
- Donnelly Jack, Universal Human Rights in Theory and Practices, Manas Publication, 2005
- Baxi, Upendra, The Future of Human Rights, Oxford University Press, 2006
- Nandakumar, Menon Sandeep, Corporate Human Rights Accountability in India, Satyam Law International, 2019

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ENS213	**Interdisciplinary Elective 6 – Popular Culture**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

The course is envisaged to provide the student an introduction to cultural studies and affirm grounding in basic theories of the making of culture. The course exposes students to the dimensions of literary forms and genres. The course also intends to help students to learn and analyze the

production and consumption of culture. This course also examines the productions and consumptions of cultural practices around us. The cultural theories provide perspective to critically access the many trends and practices of culture.

Pre-requisites: Student‟s must possess a fundamental knowledge of media, culture and society.

Pedagogy: ICT/ Flipped Classrooms/ Collaborative Learning/ Blended Learning

Course Objectives:

1. To develop a clear grasp of the key concepts of cultural studies.
2. To discuss the cultural dynamics of society with the help of contemporary theory and to equip the students with analytical tools to study diverse culture and cultural practices.
3. To explore the various forms of cultural expression and to familiarize the student with the rich and complex cultures and cultural traits
4. To develop critical and analytical abilities through case studies focused on cultural sites and practices.

Course Outcome:

On completion of this course, the student will be able to:

1. Distinguish between power and cultural production in society.
2. Identify the socio-cultural practices through the theories provided in the course.
3. Analyze the influence of Geopolitics on cultural practice.
4. Apply a literary and critical vocabulary to view social constructs.

Course Content:

Unit-I: Background to Cultural Studies **7 Hours**

1. Aims and Objectives of Cultural Studies
2. Key Terms – (Power, Ideology, Hegemony & Counter-Hegemony, Representation, Positionality, Identity, Discourse, Structuralism, Marxism, Mass Deception)

Unit II: Cultural Theories **6 Hours**

1. Roland Barthes: “Soap-powders and Detergents”, “The Poor and the Proletariat”, (extract from *Mythologies)*
2. Partha Chatterjee: “Whose Imagined Community” (from *Mapping the Nation* 1991)
3. Laura Mulvey: extract from “Visual Pleasure and Narrative Cinema” (Part I & II) (from *Screen*, Vol. 16, Issue 3, Autumn 1975)

Unit-III: Trends and Practices **7 Hours**

1. Linguistic turn in Cultural Studies: Lacan (Psychoanalysis)
2. Globalization, Modernism and Race: Multiculturalism, Glocalization, Geopolitics, Race and Power in popular discourse

Unit-IV: Body, Sexuality and Media culture **6 Hours**

1. Post-humanism – *Her* (2013)
2. Body Politics: Sexuality, disability and deviance - *Margarita with a Straw* (2014)
3. Media Culture: Television culture, social media and questions of identity

References:

- Bowman, Paul. *Interrogating Cultural Studies: Interviews in Cultural Theory, Practice and Politics*. Pluto Press, 2003.
- Carey, John. *The Intellectuals and the Masses.* St. Martin's Press, 1993.
- Connor, Steven. *Cultural Sociology and Cultural Sciences.* Blackwell Publishers, 1992.
- Hall, S. "Cultural Studies: Two Paradigms", T.Bennett, G.Martin, C. Mercer and J.Woollacott (eds) *Culture, Ideology and Social Process: A Reader*, Open University Press, pp. 19–37. 1981.
- Hoggart, Richard. *The Uses of Literacy: aspects of working-class life with special reference to publications and entertainment*, Penguin. 1957.
- McCrakken, Scott: *Pulp: Reading Popular Fiction*, Manchester University Press, 1998.
- Mukherjee, Chandra and Schudson: *Rethinking Popular Culture: Contemporary Perspectives in Cultural Studies*.Berkeley: University of California Press, 1991.
- Storey, John. *Cultural Theory and Popular Culture: An Introduction*. Pearson Longman, 2009.
- Williams, R. *Culture and Society* 1780–1950, Chatto and Windus, 1958.

THIRD SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHK301	Language – II: Kannada-III	FC	1	1	0	2	3

Course Description:
¨sÁµÉAiÀÄ£ÀÄß vÀiÁvÀ£ÁqÀÄvÀ §gÉAiÀÄÄvÀ PË±À®å, uÁ»vÀåzÀ §UÉÎ uÀsÜ®vÁV ¥ÀjZÀ¬ÄuÀÄvÀ vÀÄs®PÀ «zÁåyðUÀ¼À vÀåQÛvÀé «PÁuÀ ºÁUÀÄ uÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀåèlÄÖPÉsAqÀÄ, ¥ÀæuÀÄÛvÀ uÀAzÀ¨sÀðPÉÌ «zÁåyðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀ®Ä ¥ÀoÀåvÀ£ÀÄß gÀs¦uÀeÁVzÉ. uÁ»vÀå, PÀeÉ, vÁtÂdå, DqÀ½vÁvÀäPÀ vÀÄvÀÄ «eÁ£ÀzÀ «ZÁgÀUÀ½UÉ MvÀÄ£ÀÄß ¤ÃqÀeÁVzÉ. EzÀÄ vÉszÀ® JgÀqÀÄ uÉ«ÄuÀÖgï vÀÄsgÀÄ PÉærmïUÀ¼À£ÀÄß; vÀÄsgÀÄ vÀÄvÀÄ £Á®Ì£ÉÃ uÉ«ÄuÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉsA¢zÉ.

Pre-requisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉÎ ¥ÁæxÀ«ÄPÀ w½ªÀ½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄß NzÀ®Ä ªÀÄvÀÄ §gÉAiÀ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥Àsªð ²PÀëtzÀ9 PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄß N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives:
ÉÁ®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄÄUÀæ PÀÉÀßqÀ ¸Á»vÀåªÀ ÉÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ ÉÀÄß ºÉsA¢zÉ. CzÀgÀAvÉ ªÉszÀ® ÉÀiÀÄ ¸É«Ä¸ÀÖgïÉÀ°è d£À¥ÀzÀ, ¥ÁaÃ À, ªÀÄzsÀåPÁ°Ã À PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ ÉÁlPÀ ¸Á»vÀåªÀÉÀÄß ¥ÀoÀåªÀÉÁßV DAiÉÌ ªÀiÁrPÉsAqÀÄ, «zÁåyðUÀ¼À°è ¸Á»vÀåzÀ §UÉÎ ¸ÀzÀ©gÀÄaAiÀÄ ÉÀÄß ªÀÄsr¸ÀeÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉsvÉUÉ ªÀåQÛvÀ «PÀ¸À ÉÀzÀ PÀqÉUÉ UÀªÀÄ ÉÀ ¤ÃqÀeÁUÀÄvÀÛzÉ.

- ¨ÁµÉ, uÁ»vÀå, EwºÁuÀ vÀÄvÀÄÛ uÀAuÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£Áð1PÀPÉÌ uÀA§A¢¹zÀAvÉ ¥Àj ZÀ¬ÄuÀeÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À uÀvÀðvÉsÃvÀÄÄR ¨É¼ÀvÀtÂUÉUÉ C£ÀÄvÁUÀÄvÀAvÉ ºÁUÀs CvÀgÀå vÀiÁ£ÀvÀ uÀA§AzÀUÀ¼À §UÉÎ UÉgÀvÀ, uÀvÀiÁ£ÀvÉ vÀÄsr¹, ¨É¼ÉuÀÄvÀ ¤nÖ£Àè ¥ÀoÀåUÀ¼À DAiÉÌAiÀiÁVzÉ.
- CvÀgÀå uÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ÁµÉ, GvÀÛvÀÄ «vÀÄ±Áð UÀÄt, ¤gÀUÀð¼À uÀA¨ÁµÀuÉ, ¨ÁµÀt PÀeÉ ºÁUÀs §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼ÉuÀÄvÀçzÀÄ UÀÄjAiÀiÁVzÉ
- uÀàzÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀs®vÁUÀÄvÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀå1ÄÖPÉsAqÀÄ uÀsPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÌ vÀiÁrPÉs¼ÀîeÁVzÉ.

Course Outcomes:
d£À¥ÀzÀ, ¥ÁaÃ À, ªÀÄzsÀåPÁ°Ã ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ ÉÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄs®PÀ PÀ®zÀ ÁÛvÀåAvÀgÀUÀ¼À ÉÀÄß CzÀgÀ M¼À ÉÆsÃlUÀ¼À ÉÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

- uÁvÀiÁfPÀ, gÁdQÃAiÀÄ, zÁ«ÄðPÀ, uÁAuÀÌøwPÀ, ¥ÀjuÀgÀ ºÁUÀs åAUÀuÀA§A¢ «ZÁgÀUÀ¼ÉqÉ UÀvÀÄ£À ºÀjuÀÄvÀçzÀgÉsA¢UÉ «zÁåyðUÀ¼Àå ZÀZÁð vÀÄ£ÉsÃ¨ÁvÀvÀç ¨É¼ÉAiÀÄÄvÀÛzÉ.

- fÃvÀ£ÀzÀå §gÀÄvÀ C©¥ÁæAiÀÄ ¨ÉÃzÀUÀ¼ÀÄ, uÀvÀÄuÉêÀUÀ¼À£ÀÄß DzÀÄ¤PÀ uÀAzÀ¨ÀðzÀå vÀiÁ£À«ÃAiÀÄvÉAiÉsA¢UÉ ¤vÀð»uÀÄvÀAvÉ ¥Éæ¼gÉÃ¦uÀÄvÀ¼zÉ.
- Gv¼vÀÄ uÀAvÀºÀ£À PÀeÉAiÀÄ£ÀÄß ¨É¼ÉuÀÄvÀ GzÁºÃ±ÀvÀ£ÀÄß FqéÃjuÀÄvÀ¼zÉ.
- uÀA±ÉsÃzÀ£Á vÀÄ£ÉsÃ¨ÁvÀ vÀÄvÀÀÛ uÀæzÁðv¼PÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀÄv¼zÉ.

Course Content:

Unit I **ÀªÉÇÃzÀAiÀÄ PÀ«vÉUÀ¼ÀÄ** **7 Hours**

1. ¨É¼ÀUÀÄ zÀ.gÁ. ¨ÉÃAzÉæ
2. PÀå PÀÄvÉA¥ÀÄ
3. PÀ£Á®qï ¥ÀzÀUÉs¼ï f. ¦. gÁdgÀvÀßA

Unit II **ÀªÉÇÃzÀAiÀÄ ºÁUÀÄ ÀªÁå PÀ«vÉUÀ¼ÀÄ** **6 Hours**

1. CvÀzsÀsvÀ uÀÄ.gÀA.JPÀÄÌAr
2. vÀÄ£É¬ÄAzÀ vÀÄ£ÉUÉ PÉ.Juï.£À
3. £À£Àß ºÀtvÉ f.Juï.Juï.

Unit III **¸Àt PÀxÉUÀ¼ÀÄ** **7 Hours**

1. zÁ½ £ÀqÉzÁvÀ CuÁ CvÀÄgÉÃ±À £ÀÄUÀqÉsÃtÂ
2. PÉs£ÉAiÀÄ VgÁQ ¤gÀAd£À
3. vÀiÁ¤Ãlgï vÉÃd¹

Unit IV **ÁlPÀ** **6 Hours**

1. «ÄÃrAiÀiÁ (uÀAUÀæºÀ) AiÀÄÄj¦rÃuï C£ÀÄvÁzÀ: PÉ. vÀÄgÀÄ¼À ¹zÀÞ¥À

References:

- vÀÄÄUÀ½ gÀA.²æÃ., PÀ£Á®qÀ uÁ»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºËuï, vÉÆÃêuÀsgÀÄ. 2014
- ¹ÃvÀiÁwÃvÀ PÀ£Á®qÀ uÁ»vÀå ZÀjvÉæ uÀA¥ÀÄl 1,2,3,4,5 vÀÄvÀÀÛ 6, PÀÄvÉA¥ÀÄ PÀ£Á®qÀ CzÀiAiÀÄ£À uÀAuÉÜ, vÉÆÃêuÀsgÀÄ «±Àé«zÁå¤®AiÀÄ, vÉÆÃêuÀsgÀÄ. 2014
- qÁ. CgÀ«AzÀ vÀiÁ®UÀwÛ, uÁ»vÀå uÀAuÀÌøw vÀÄvÀÀÛ zÀåvÀ ¥Àæëöä, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£Á®qÀ uÁ»vÀå ¥ÀjµÀvÀÀÛ, ¨ÉAUÀ¼ÀsgÀÄ. 2014
- qÁ. F.Juï. DvÀÄsgÀ, PÀ£Á®qÀ PÀxÀ£À uÁ»vÀå : PÁzÀAS j, ¥ÀæPÁ±ÀPÀgÀÄ uÀë¥À®ß §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2016
- zÉÃ±À¥ÁAqÉ Juï.Jeï., ¨ÉÃAzÉæ ±ÀjÃ¥ÀgÀ PÁvÁåAiÀiÁ£À, ¥ÀæPÁ±ÀPÀgÀÄ zÉÃ¹ ¥ÀÄuÀPÀ, ¨ÉAUÀ¼ÀsgÀÄ. 2013
- QÃvÀð£ÁxÀ PÀÄvÀðPÉsÃn, PÀ£Á®qÀ uÁ»vÀå uÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉsÃn vÉÅvÉsÃjAiÀÄeï lïÛ, zÁgÀvÁqÀ. 2009
- ±ÁvÀÄgÁAiÀÄ vÀ.uÀÄ., PÀ£Á®qÀ uÁ»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À vÉAPÀtÚAiÀÄå uÁägÀPÀ UÀæAxÀvÀiÁeÉ, vÉÆÃêuÀsgÀÄ – 2014

- uÀA. qÁ! ¹. Dgï. ZÀAzÀæÉÃRgï, vÀÄÄAzÁ¼ÀÄvÀ£ÀzÀ ®PÀëtUÀ¼À£ÀÄß ¨É¼É¹PÉs¼ÀÄîvÀçzÀÄ ºÉÃUÉ?, ¥ÀæPÁ±ÀPÀgÀÄ £ÀvÀPÀ£Áð1PÀ ¥À©PÉÃµÀ£ï ¥É ÊvÉmï å«ÄmÉqï. 2010
- DzÀÄ¤PÀ PÀ£ÀßqÀ PÁvÀå ¨ÁUÀ–2, PÀÄvÉA¥ÀÄ PÀ£ÀßqÀ CzÀåAiÀÄ£À uÀAuÉ, vÉÃÊuÀsgÀÄ «±Àé«zÁå¤®AiÀÄ, vÉÃÊuÀsgÀÄ. 2004
- ²vÀgÀÄzÀæ¥Àå f.Juï. PÀ£ÀßqÀ uÁ»vÀå uÀ«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥Àß §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2013

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHH301	Language – II: Hindi-III	FC	1	1	0	2	3

Course description:अध्ययन वर्न :

यह पाठ्यक्रम नौसिखिय‍ा, अपन‍ी भाषा क‍ी क्षमत‍ा क‍ा सिकाि करन‍े ह‍ेत‍ु तथा सिसभन्न ि‍ासहखिक प्रसक्रयाओ‍ं द्व‍ार‍ा
ि‍म‍ाज, ि‍ं स्कृ सत एि‍ं जीिन के म‍ूल्‍यं कय ि‍मझन‍े ह‍ेत‍ु असभकखित ह‍ै |

Pre-requisites/Pre reading for the course: प‍ूवापेक्षव:

- अध्य‍ेता कय, सहन्दी न‍ाि‍क ि‍ासहि क‍ा ि‍ं सक्षप्त ज्ञान आिश्यक ह‍ै |
- सहन्दी ि‍ासहि के इसतह‍ाि क‍ा ि‍ं सक्षप्त ज्ञान क‍ी आिश्यकत‍ा ह‍ै |
- सहन्दी व्याकरण का अिबयधन आिश्यक है |
- मीसिय‍ा ल‍ेि‍न क‍ी ब‍ुसनयाद‍ी जानक‍ारी च‍ासहए |
- अ‍ंग्र‍ेज़ी – सहन्दी अन‍ुि‍ाद ि‍े ि‍ं ब‍ंसधत जानक‍ारी जरुर‍ी ह‍ै|

c) Pedagogy:सिक्षशवस्त्र :

- Direct method
- ICT and Digital support
- Collaborative and Cooperative learning
- Differentiated Instruction
- Flipped Classroom

Course Objectives: पवठ्यक्रम उद्देश्य :

- ि‍ं दभ‍ान‍ुि‍ार उसचत भाषा क‍ा प्रययग करन‍े क‍ी दक्षता कय छात‍्यं म‍ें उत्पन्न करना |
- ि‍ासहि के माध्यम ि‍े ि‍म‍ाज एि‍ं मानिीय म‍ूल्‍यं कय ि‍मझाकर, उन म‍ूल्‍यं क‍ी रक्ष‍ा ह‍ेत‍ु प्र‍ेररत करना |
- छात‍्यं म‍ें प‍ुस्तक पठन एि‍ं ल‍ेि‍न क‍ी अक‍ृ सतम प्रि‍ृसि स‍्थ‍ासपत करना |
- अध्य‍ेताओ‍ं म‍ें ि‍ासहि के म‍ाध्यम ि‍े प्रभाि‍ी एि‍ं क‍ु शल ि‍ं चार क‍ा सिकाि करना |

Course Outcomes :**असिगम पररर्वम :**

अध्ययन की िमाखप पर अध्येता –

- िवामासजक मूल् एिं नैसतक जिाबदेही कय स्वीकार कर िकता है |
- िवासहि की प्राि ंसगकता कय जीिन मेंं िमझने की दक्षता रिता है |
- िमाज मेंं अंतसनसहत पद्दसतया एिं सिचारधाराओं का व्याख्यान करने मेंं िक्षम बन िकता है |
- िवासहि के माध्यम िे प्रभाि ी एिं कु शल िंचार का सिकाि करिकता ह ै |

इकवई –1:नाि क **:** एक और द्रयणाचाय – िॉ. शंकर शेष **7 hours**
लेिक
पररचय प्रथम दृश्य
सद्वतीय दृश्य
इकवई –2 :नाि क **:** एक और द्रयणाचाय **6 hours**
तृतीय दृश्य
चतुथ
दृश्य
इकवई –3:नाि क **:** एक और द्रयणाचाय **7 hours**
पंचम दृश्य
छठा दृश्य
इकवई –4: **6 hours**
अनुवद : अंग्रेजी - सहन्दी-िमाचार पत् िंबंध
भारत मेंं सहन्दी मीसिया की िमस्याए, ररपयसिग, िाक्षात्कार

Text book:पाठ्य पुस्तक :

एक और द्रोर्वचवय – डॉ. शंकर शेष

References:िन्दर् ग्रन्थ :

- मीसिया लेिन एिं जनिंचार – िॉ.िंजीि कु मार
- .सहन्दी िवासहि का इसतहाि - िॉ. नागेद्र
- आधुसनक सहन्दी िवासहि का इसतहाि - िॉ. बच्चन सिंह
- सहन्दी िवासहि का नि ीन इसतहाि - िॉ. लाल िाहब सिंह
- शुद्ध सहन्दी कै िे बयले कै िे सलिे- पृथ्वीनाथ पाण्डे
- कायालय अनुिाद सनदेशका
- मीसिया सिमश – रामशरण जयशी
- िंस्कृ सत– बाजार और जनिंचार , नन्द भरद्वाज

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHA301	Language – II: Additional English-III	FC	1	1	0	2	3

Course Description:
This 2-credit course allows the learners to explore the various socio-political aspects represented in literature. The concepts discussed in the course provide learning exposure to real life scenarios. The course is designed to develop critical thinking ability among learners, through the socio-political aspects discussed in literature. Thus, the aim is to produce responsible and sensitive individuals.

Pre-requisites: The student must possess fair knowledge of language, literature and society.

Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

Course Objectives:
1. To outline the global and local concerns of gender and identity.
2. To identify the complexities of human emotions through literature.
3. To assess the struggles of human survival throughout history.
4. To compare and contrast between the various dimensions of childhood.

Course Outcomes:
On completion of the course, learners will be able to:
1. Evaluate the pressing gender issues within our society.
2. Criticize human actions through a humane and tolerant approach.
3. Perceive the human conflicts with an empathetic perspective.
4. Disprove the assumption of a privileged childhood.

Course Content:

Unit-I:Gender & Identity **7 hours**
Anne Sexton – Consorting with Angels
Eugene Field – The Doll‟s Wooing
Vijay Dan Detha – Double Life
Charlotte Perkins Gilman – The Yellow Wallpaper 12 Hours

Unit-II: Love & Romance **6 hours**
Alfred Noyes – The Highway Man
William Shakespeare – Sonnet 116
Frank Richard Stockton – The Lady or the Tiger?
Oscar Wilde – The Nightingale and the Rose

Unit-III: War & Trauma **7 hours**
Lord Alfred Tennyson – The Charge of the Light Brigade
TaufiqRafat – The Medal
Guy de Maupassant – Two Friends
Sadaat Hasan Manto – Toba Tek Singh

Unit-IV: Children‟s Literature **6 hours**

William Blake – The Chimney Sweeper
D.H. Lawrence – Discord in Childhood
Anna Sewell – The Black Beauty (Extract)
Rudyard Kipling – The Jungle Book (Extract)

References:

- Sexton, Anne. *The Complete Poems*. Houghton Mifflin, 1999.
- Namjoshi, Suniti. *Feminist Fables*. Spinifex Press, 1998.
- Vanita, Ruth &Saleem Kidwai (ed.) *Same Sex Love in India*. Penguin India, 2008.
- Gilman, Charlotte Perkins. *The Yellow Wallpaper*. Rockland Press, 2017.
- Gale, Cengage Learning. *A Study Guide for Alfred Noyes's "The Highwayman"*. Gale, Study Guides, 2017. (Kindle Edition Available)
- Shakespeare, William. *Poems and Sonnets of William Shakespeare*. Cosimo Classics, 2007.
- Stockton, Frank Richard. *The Lady, or the Tiger?* Create Space Independent Publications, 2017.
- Wilde, Oscar. *The Collected Works of Oscar Wilde*. Wordsworth Editions Ltd., 1997.
- Tennyson, Lord Alfred. *The Complete Works of Alfred Tennyson*. Forgotten Books, 2017.
- Blake, William Erdman, David V. (ed.). *The Complete Poetry and Prose* (Newly revised ed.). Anchor Books, (1988).
- Maupassant, Guy de. *Guy de Maupassant-The Complete Short Stories*. Projapati, 2015.
- Manto, Sadaat Hasan. *Manto: Selected Short Stories*. RHI, 2012.
- Ricks, Christopher. *Metaphysical Poetry*. Penguin, 2006.
- Sewell, Anna. *The Black Beauty*. Maple Press, 2014.
- Kipling, Rudyard. *The Jungle Book*. Amazing Reads, 2018.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0301	**Political Science – III (Indian Constitution and Institutional Framework)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
The course will introduce you to the idea of political system and the account of the making and working of constitutional institutions. This course responds to the curiosity about why a particular arrangement in the constitution was adopted and why not some other, how the institutions grow in the company of actual politics. That is why the Content of the course do not stop at 1950, in fact start off at 1950 and take you to some instances drawn from the political history of the last fifty years or more.
Pre-requisites: The fundamental knowledge of Indian constitution is essential.
Pedagogy: Direct instruction and collaborative method
Course Objectives:

1. To explain a systematic analysis of all the major dimensions of Indian Political System.
2. To elaborate the way Indian political system works and shapes the institutions in India
3. To demonstratethe nature, structure and working of the Indian Political System.
4. To infer the dynamics of the Indian Political System

Course Outcomes:

The students will be able to

1. Analyse all the major dimensions of Indian Political System.
2. Examine the way Indian political system works and shapes the institutions in India
3. Evaluate the nature, structure and working of the Indian Political System.
4. Analyze the new dynamics of the Indian Political System

Course Content:

Unit I- Framing of the Constitution and Major Features **10 hours**

Constituent Assembly at Work, Preamble and Salient Features, Amendment Procedure, Citizenship, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties.

10 hours

Unit II- Federal System

Federal and Unitary Features; Center- State Relations; Legislative, Administrative and Financial; State Autonomy

Unit III- Union and State Legislatures: **10 hours**

Union and State Legislatures: Composition, Powers and Functions; Presiding Officers, Law Making Process, Committees of Parliament, Working of Indian Parliament.

Unit IV- Union and State Executive **9 hours**

President and Vice-President – Elections, Powers and Functions; Prime Minister and Council of Ministers – Powers and Functions; Governor, Chief Minister and Council of Ministers – Powers and Functions.Judiciary:Supreme Court and High Courts – Composition, Jurisdiction and Functions; Judicial Activism, Public Interest Litigation.

References :

- Granville, Austin. *Working of a Democratic constitution: a History of theIndian Experience.* Oxford University Press, 2010.
- Niraja, Gopal Jayal and Pratap Bhanu Mehta. *The Oxford Companion to Politics in India.* Oxford University Press, 2012.
- Subhash, Kashyap. *Our Parliament*. New Delhi, National Book Trust, 2011.
- Shibani Kinkar, Chaube. *The Making and Working of the Indian Constitution.*NBT, 2010.
- Pylee MV. *An introduction to the Constitution of India.* Vikas Publishing House, 1984.
- Rajni, Kothari. *Politics in India.* Orient Longman Pvt. Ltd. 2013.
- Granville, Austin. *Indian Constitution: Cornerstone of a Nation*. Bombay, Oxford University Press, 1990.
- Basu, DD. *Introduction to the Constitution of India.* 24th Edition, Lexis Nexis,.1990.

- Siwach, JR. *Dynamics of Indian Government & Politics.* Sterling Publishers, 1990.
- Gupta, DC. *Indian Government and politics*. Vikas Publishing House, 1988.
- Johari, JC. *Indian Government and Politics.* Vishal Publishers, 1981.
- Hans J, Raj. *Indian Government and Politics.* Surjeet Publications, 1990.
- Pratap Bhanu Mehta, Niraja Gopal Jayal, *The Oxford Companion to Politics in India.* 2011.
- Bakshi, PM. *The Constitution of India.* Universal Law Publishing, 2017.

Journals

1. Indian Journal of Political Science
2. Political Theory
3. Economic and Political Weekly

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0302	**Political Science Practical - III**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Presentations on various legal cases
- Story telling process on various political ideologies and political leaders
- Newspaper collage activity on current affairs
- Seminar
- Group discussion

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0303	**Economics – III (Economic Growth and Development)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:

The course is intended to give an understanding of the theoretical perceptions of economic growth and development together with the forces bringing about them. It also helps to broaden the awareness of the challenges in the developmental process and thus motivate the students towards the thought process of alternative solutions.

Pre-requisites: A general understanding of economic development is desired.

Pedagogy: Direct instruction and flipped classroom method

Course Objectives

1. To explain conceptual base in Economic Development and Growth
2. To prioritize the key models and theories in Economic Development and Growth

3. To elaborate Contemporary Models of Development and Underdevelopment
4. To predict economic growth and income inequality Causes and effects of urbanization

Course Outcomes:

The students will be able to

1. Illustrate the conceptual base in Economic Development and Growth
2. Identify the key models and theories in Development and Growth
3. Inspect in to the key issues of economic development
4. Identify the approaches to development efforts.

Course Content:

Unit I- Meaning of Development and Relevant Concepts 10 Hours

Distinction between growth and development, PQLI, Human Development Index, Gender Development Index, Sen‟s capabilities approach, environmental sustainability and development, Market and State as agencies of development, Common characteristics of developing nations

Unit II- Classical Theories of Development 10 Hours

Contributions of Adam Smith, Ricardo, Karl Marx, Schumpeter and Rostow; Growth Models: Harrod and Domar: Instability of equilibrium; Neo Classical Growth Models: Solow and Meade; Growth Models of Joan Robinson, Kaldor and Pasinetti

Unit III- Contemporary Models of Development and Underdevelopment 10 Hours

Theories of endogenous growth with special reference to Romer‟s model, underdevelopment as coordination failure, multiple equilibria, the big push theory and Lebenstence Theory of Critical Minimum Efforts. Balanced and Unbalanced Growth; Low Income Equilibrium Trap; Dual Economy Models of Lewis, Fei-Ranis, Jorgensen, Dixit and Marglin, Kelly et.al

Unit IV-Poverty, Inequality and Development and Urbanization 9 Hours

Measurement of poverty – absolute and relative, Head-Count Index and Poverty Gap Indices, policy options for alleviation of poverty, measurement of income inequality, economic growth and income inequality – Kuznet„s inverted Hypothesis, impact of inequality on development. Causes and effects of urbanization, Harris-Todaro model of rural-urban migration, migration and development, policies for the urban informal sector, women in the informal sector, the microfinance revolution

References :

- Lekhi, R. K. *The Economics of Development and Planning*. 15th Edition, Kalyani Publishers, 2013.
- Todaro Michael, P. and Stephen C, Smith. *Economic Development*. Pearson Education, (Singapore) Pvt. Ltd., Indian Branch, 2004.
- Abhijit Banerjee, Roland Benabou and Dilip Mookerjee. *Understanding Poverty*. Oxford University Press, 2006.
- Sen, Amartya. *Development as Freedom*. Oxford University Press, 2000.

- Basu, K. *Analytical Development Economics: The Less Developed Economy Revisited*. Cambridge, MIT Press, 1997.
- Daron, Acemoglu and James Robinson, *Economic Origins of Dictatorship and Democracy*. Cambridge University Press, 2006.
- Partha, Dasgupta. *Economics: A Very Short Introduction.* Oxford University Press, 2007.
- Ray, Debraj. *Development Economics, Seventh impression*. Oxford University Press, New Delhi 2004.
- Robert, Putnam. *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton University Press, 1994.
- Thirlwall, A.P. *Growth and Development with Special Reference to Developing Economies.* Basingstoke, Palgrave Macmillan, 2006.
- Basu, K. ed. *The New Oxford Companion to Economics in India*. Oxford University Press, 2012.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0301	**Journalism - III (Audio-Visual Production)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
The course Audio-Visual Production is devised for students to become trained in the nuances of electronic media. Students acquire skill in various media types like radio, television, film, etc. By gaining theoretical exposure with hands on demonstration of the practical components, the students will become proficient Radio Jockey, Script-writer for TV and Radio, film-maker for short-films, etc.

Pre-requisites: Exposure to different programmes of Ausio-Visual media.

Pedagogy: Direct instruction, Collaborative and Kinesthetic method

Course Objectives

1. To help the students understanding the process of generating content for electronic media
2. To impart skills in script-writing, radio jockeying, conceptualizing and producing audio-visual packages
3. To impart the aspects of aesthetics and visual grammar alongside the technicalities of producing the content.
4. To communicate the role and functions of various film organizations in India.

Course Outcomes:
On completion of this course, the student would be able to:

1. Apply skill in script-writing for radio and television
2. Outline the aesthetics and visual grammar in the audio-visual medium
3. Assess the various genres of film
4. Discuss the role and progress of different organizations related to cinema in India

Course Content:

Unit I: Radio Production **10 Hours**

Introduction to radio production; Writing for radio, Programme formats news, talk, features, interviews, discussions, documentaries, plays; Audio recording – types of microphones; Studio set up.

Unit II: Script-writing for Radio and TV **10 Hours**

Scripting: Scripting for radio and television programs – storyboard; logging the shots; Screen play: Classical, A/v script.

Unit III: Basics in TV Production; **10 Hours**

Visual Grammar: Composition, subject, light; Camera control devices- Attributes of a good picture; Different types of shots- shot composition- scenes- sequence; Camera perspectives camera angles- camera movements; Electronic News Gathering

Unit IV: Introduction to Film Studies **9 Hours**

Introduction to Film - Film as an art form; aesthetics of film; Types of films; documentary; newsreel; Educational film; Animation film; Feature film; Mainstream cinema; Cinema and society.

References:

- Singhal, Arvind and Rogers, Everett M. *India's Communication Revolution*. Sage publishers, 2007.
- Kumar, Keval J. *Mass Communication in India*. Jaico Publishing House, 1994.
- Chatterji, P.C. *Broadcasting in India.* New Delhi, Sage publishers, 1987.
- Hasan, Seema. *Mass Communication: Principles And Concepts*. CBS Publishers & Distributors, 2010.
- Shamsi, Nayyar. *Encyclopedia of Electronic Media*. Anmol Publications Pvt. Limited, 2006.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0302	**Journalism Practical - III**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Know Your camera
- Script writing- Radio news, Television news
- TV script/Radio Script/ Film Script
- Short Movie/Documentary Making

*** Note:** Media Studies as an Open Elective Course is offered to III Sem UG Non- Engineering students except III BA JEP/PEJ/THJ/JMC

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
	Media Studies*	**OE**	**2**	**1**	**0**	**3**	**4**

Course Description:
This course serves to provide an introduction to the various facets of media studies. Students will examine the significance and impact of media in the society. They will understand and assess current scientific debates in the field and appreciate the relationships between communication, media, culture and evolution of humankind. Students will understand the wide-ranging influences of media and thereby critically analyze how it is shaping the society of present times.
Prerequisite: Basic understanding of communication and media.

Pedagogy: Direct Method, ICT and Collaborative Method.

Course Objectives:
1. To introduce the students to the field of media studies
2. To familiarize the students with the concepts of media and freedom.
3. To know how the different kind of pressures and controls influence the media functioning.
4. To make the students understand the different concepts of media.

Learning Outcomes:
On completion of the course, the students will be able to:
1. Appraise the basic concepts related to Communication and media studies
2. Determine the relationship between media and freedom.
3. Analyze the functioning of media considering the threats and pressures on media.
4. Interpret the different concepts of media.

Course Content:

Unit I: **Communication and Mass media** **10 Hours**
Communication meaning, definition and process; principles and functions; Importance of media, Kinds of Mass Media, New Media Technology; functions of media; Mass Media and Culture; social responsibility of media

Unit II: **Media and Freedom** **10 Hours**
Freedom of speech and expression: Article 19(1)a and Reasonable restrictions 19(2); Article 21; Right to information, functions of media in Indian Democracy and other political systems.

Unit III: **Controls and Issue** **10 Hours**
Ownership of media, controls: Internal and external threats, pressures on media; Scams, Page-3, Paid News, Sting Operation, fake news

Unit IV: Concepts of Media **9 Hours**
Media and Public Sphere, Media Convergence, Media and development; Media credibility, digital divide, online journalism, citizen journalism, Influence of social media

References:

- Richard, Campbell. *Media and culture an introduction to mass communication*. Bedford/st Martins, 12th edition, 2019
- An AMIC compilation - *Media and Democracy in Asia*, 2000. Singapore : Asian Media Information and Communication Centre, 2000.
- Joseph, Dominick. *Dynamics of mass communication: Media in Transition.* McGraw-Hill Education, 2012
- Arthur, Asa Berger. *Media and Society*. Rowman & Littlefield, 2012.
- Vir, Bala Aggarwal. ed. *Media and Society: challenges and opportunities*. Concept Publishing Co., 2002.
- Nicholas, Jankowski. *New Media and Society*. Sage Publications. N Jankowski, S Jones, D Park - 2012 - journals.sagepub.com

**** Note:** Life Skills and Personal Development as an Open Elective Course is offered to III Sem UG Non- Engineering students except III BA JEP/PEJ/THJ/JMC

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
	Life Skills and Personal Development**	**OE**	**2**	**1**	**0**	**3**	**4**

Course Description:

Life skills have been defined by the World Health Organization (WHO) as "abilities for adaptive and positive behavior that enable individuals to deal effectively with the demands and challenges of everyday life". They represent the psycho-social skills that determine valued behavior and include reflective skills such as problem-solving and critical thinking, personal skills such as self-awareness, and interpersonal skills. Practicing life skills leads to qualities such as self-esteem, sociability and tolerance, competencies to take action and generate change, and the capability to have the freedom to decide what to do and who to be.

Pre-requisites: Keen interest to Self-development

Pedagogy: Direct learning, Activities, ICT, Kinesthetic method, games, discussion and interactions.

Course Objectives:

1. To develop self-awareness
2. To improve Interpersonal communication
3. To learn goal setting and strategizing to reach them
4. To learn team work and leadership roles.

Course Outcomes:

After the completion of this course, a student will be able to:

1. Discover One‟s Self and explores abilities and skills
2. Develop better Interpersonal skills
3. Interpret and understand the skills required for goal setting and learns the skills of reaching them.
4. Apply the skills required for team building and leadership skills.

Course Content:

Unit-I: Personal Development **10 hours**

Me and My Assets, Stages of Adolescence, Self, awareness, Building Self-Confidence, Self Esteem, Self image, Self Concept, Choosing Positive Values, Understanding Mental Models, Stress and Emotions, Surviving Tough Times.

Unit-II: Interpersonal Development **10 hours**

Active Listening, Assertive communication, Problem solving, Decision making, Critical thinking, Interpersonal Skills, Time management, Coping with Emotions, Conflict management, Coping with stress.

Unit-III: Goal Setting and Action Planning **10 hours**

Goal setting-the basics, SMART goals, steps for action, setting priorities, Short term goals, Long term goals, Time management.

Unit-IV: Team work and Leadership **9 hours**

Team building, Team cycle, Team leadership, My leadership role, The project cycle, Celebration and reflection, Negotiation skills, Conflict management, Entrepreneurship skills.

References:

- Adkins, W.R. Life skills counseling. In R. Herink (Ed.) The Psychotherapy Handbook., NY: New American Library.l980.
- Adkins, W. R. Life skills education: A video-based counseling/ learning delivery system. In D. Larson (Ed.) Teaching Psychological Skills: Models for giving psychology away. Monterey, CA: Brooks/ Cole.l984.
- Burton, J. Career development series at the Ft. George Head Start Center. NY: Institute for Life Coping Skills.1996.
- www.education.gov.uk
- www.tes.co.uk/ks1-citizenship-primary-teaching-resources

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHM301	**Skill Development Course – I**	**MC**	**Non-credit Mandatory Course**				**2**

Note: The students will have to undergo Skill Development Course being conducted by Training and Placement cell of the University or by any internal faculty

Course Code	Course Title	Course Type	L	T	P	C	Hrs. / Wk.
B21AHON01	**MOOC**	**ON**	**0**	**0**	**2**	**2**	**4**

Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses. There are many other international agencies, foreign universities offering MOOC courses.

A student shall register and successfully complete any of the courses available on any reputed online platform. Student shall inform the MOOC coordinator of the school about the course to which he/she has enrolled. The minimum duration of the course shall be not less than 30 hours for 2 credits. The student should submit the certificate issued by the respective online platform to the MOOC coordinator of the school.

FOURTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHK401	Language II: Kannada-IV	FC	1	1	0	2	3

Course Description:
¨sÁµÉAiÀÄ£ÀÄß vÀiÁvÀ£ÁqÀÄvÀ §gÉAiÀÄÄvÀ PË±À®, uÁ»vÀåzÀ §UÉÎ uÀsÜ®vÁV ¥ÀjZÀ¬ÄuÀÄvÀ vÀÄs®PÀ «zÁyðUÀ¼À vÀåQÛvÀé «PÁuÀ ºÁUÀÄ uÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀåèlÄÖPÉsAqÀÄ, ¥ÀæuÀÄÛvÀ uÀAzÀ¨sÀðPÉÌ «zÁyðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀ®Ä ¥ÀoÀåvÀ£ÀÄß gÀs¦uÀeÁVzÉ. uÁ»vÀå, PÀeÉ, vÁtÂdå, DqÀ½vÁvÀäPÀ vÀÄvÀÄ «eÁ£ÀzÀ «ZÁgÀUÀ½UÉ Mv£ÀÄß ¤ÃqÀeÁVzÉ. EzÀÄ vÉszÀ® JgÀqÀÄ uÉ«ÄuÀÖgï vÀÄsgÀÄ PÉærmïUÀ¼À£ÀÄß; vÀÄsgÀÄ vÀÄvÀÄ £Á®Ì£ÉÃ uÉ«ÄuÀÖgï JgÀqÀÄ PÉærmïUÀ¼À£ÀÄß ºÉsA¢zÉ.

Pre-requisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉU ¥ÁæxÀ«ÄPÀ w¼Äª½PÉ CUÀvÀå..
- ¨sÁµÉAiÀÄ£ÀÄ NzÀ®Ä ªÀvÀÄ §gÉAiÀ®Ä w½¢gÀ¨ÉÃPÀÄ.
- ¥ÀzÀ« ¥Àsªð ²PÀëtzÀ9 PÀ£ÀßqÀ ¨sÁµÉAiÀÄ£ÀÄ N¢gÀ¨ÉÃPÀÄ.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom.

Course Objectives:
¤Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±À«zÉ. CzÀgÀAvÉ ªÉszÀ® ¤ÃAiÀÄ ¸É«Ä¸ÀÖgï£À°è d£À¥ÀzÀ, ¥ÁaãÀ, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ ¤ÁlPÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀoÀåªÀ£ÁßV DAiÉÌ ªÀiÁrPÉsAqÀÄ, «zÁyðUÀ¼À°è ¸Á»vÀzÀ §UÉÎ ¸ÀzÀ©gÀÄaAiÀÄ£ÀÄß ªÀÄsr¸ÀeÁUÀÄvÀÛzÉ. ¸ÁA¸ÀÌøwPÀ w¼ÀÄªÀ½PÉAiÀÄ eÉsvÉUÉ ªÀåQÛvÀ «PÀ¸À£ÀzÀ PÀqÉUÉ UÀªÀÄ£À ¤ÃqÀeÁUÀÄvÀÛzÉ.

1. ¨ÁµÉ, uÁ»vÀå, EwºÁuÀ vÀÄvÀÄÛ uÀAuÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£Áð1PÀPÉÌ uÀA§A¢¹zÀAvÉ ¥ÀjZÀ¬ÄuÀeÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À uÀvÀðvÉsÃvÀÄÄR ¨É¼ÀvÀtUÉUÉ C£ÀÄvÁUÀÄvÀAvÉ ºÁUÀs CvÀgÀå vÀiÁ£ÀvÀ uÀA§AzÀUÀ¼À §UÉÎ UËgÀvÀ, uÀvÀiÁ£ÀvÉ vÀÄsr¹, ¨É¼ÉuÀÄvÀ ¤nÖ£Àå ¥ÀoÀåUÀ¼À DAiÉÌAiÀiÁVzÉ.
3. CvÀgÀå uÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨ÁµÉ, GvÀÛvÀÄ «vÀÄ±Áð UÀÄt, ¤gÀUÀð¼À uÀA¨ÁµÀuÉ, ¨ÁµÀt PÀeÉ ºÁUÀs §gÀºÀ PË±À®UÀ¼À£ÀÄß ¨É¼ÉuÀÄvÀçzÀÄ UÀÄj AiÀiÁVzÉ
4. uÀàzÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀs®vÁUÀÄvÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀvÀÄ£ÀzÀå1ÄÖPÉsAqÀÄ uÀsPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÌ vÀiÁrPÉs¼ÀîeÁVzÉ.

Course Outcomes:
d£À¥ÀzÀ, ¥ÁaãÀ, ªÀÄzsÀåPÁ°Ã£À ÀzÀ ««zsÀ ¥ÀæPÁgÀzÀ PÁªÀåUÀ¼ÀÄ, ºÉs¸ÀUÀ£ÀßqÀzÀ ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ ¤ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄÄ ªÀÄs®PÀ PÁ®zÀ AÛvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉsÃIUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. uÁvÀiÁfPÀ, gÁdQÃAiÀÄ, zÁ«ÄðPÀ, uÁAuÀÌøwPÀ, ¥ÀjuÀgÀ ºÁUÀ s åAUÀuÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀvÀÄ£À ºÀjuÀÄvÀçzÀgÉsA¢UÉ «zÁåyðUÀ¼Àå ZÀZÁð vÀÄ£ÉsÃ¨ÁvÀvÀç ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃvÀ£ÁzÀå §gÀÄvÀ C©¥ÁæAiÀÄ ¨ÉÃzÀUÀ¼ÀÄ, uÀvÀÄuÉåUÀ¼À£ÀÄß DzÀÄ¤PÀ uÀAzÀ¨ÀðzÀå vÀiÁ£À«ÃAiÀÄvÉAiÉsA¢UÉ ¤vÀð»uÀÄvÀAvÉ ¥ÉæÃgÉÃ¦uÀÄvÀÛzÉ.
3. GvÀÛvÀÄ uÀAvÀºÀ£À PÀeÉAiÀÄ£ÀÄß ¨É¼ÉuÀÄvÀ GzÉÝÃ±ÀvÀ£ÀÄß FqÉÃj uÀÄvÀÛzÉ.
4. uÀA±ÉsÃzÀ£Á vÀÄ£ÉsÃ¨ÁvÀ vÀÄvÀÄÛ uÀàzÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ «zÁåyðUÀ¼À£ÀÄß uÀdÄÓUÉs½uÀÄvÀÛzÉ.

Course Content:

Unit I **ªÀÄ-AÛçÃªÁ¢ PÀ«vÉUÀ¼À** **7 Hours**

1. §Ä¢ÞvÀAvÀjUÉ PÀ£ÀuÀÄ ©zÀÝgÉ J.PÉ.gÁvÀÄ£ÀÄd£ï
2. PÀÄjUÀ¼ÀÄ uÁgï PÀÄjUÀ¼ÀÄ PÉ.Juï.¤uÁgï CºÀvÀÄzï
3. CPÀÌ ºÉÃ½zÀÄÌ uÀ. GµÁ

Unit II **zÀºvÀ-§AqÁAiÀÄ** **6 Hours**

1. £À£Àß PÀvÀ£ÀUÀ¼Àåè ºÀÄqÀÄPÀ¢gÀÄ £À£Àß ZÀA¥Á
2. zÀåvÀgÀÄ §gÀÄvÀgÀÄ zÁj©r ¹zÀÞåAUÀAiÀÄå
3. PÀlÖqÀzÀ PÉ®uÀUÁgÀgÀÄ JZï Juï ²vÀ¥ÀæPÁ±À

Unit III **eÉÃR ÀÆUÀ¼ÀÄ** **7 Hours**

1. ºÀ¹gÀÄ ºÉsuÀPÀÄvÀ UÀtÂUÀ¼ÀÄ AiÀÄ®¥Àà gÉrØ
2. eÁUÀwÃPÀgÀtzÀ »£ÉßeÉAiÀÄåè UÁA¢üÃ ƒAiÀÄ ¥ÀæÀÄÛvÀvÉ ¹. £ÁUÀtÚ
3. ZÁvÁðPÀgÀÄ : MAzÀÄ n¥ÀàtÂ ¦ J£ï gÀAUÀ£ï

Unit IV **PÁzÀA§j** **6 Hours**

1. uÀAuÁÌgÀ (DAiÀÄÝsÁUÀ) AiÀÄÄ.Dgï. C£ÀAvÀvÀÄswð

References:

- vÀÄÄUÀ½ gÀA.²æÀ., PÀ£ÀßqÀ uÁ»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºËuï, vÉÄÊuÀsgÀÄ. 2014
- ¹ÃvÀiÁwÃvÀ PÀ£ÀßqÀ uÁ»vÀå ZÀjvÉæ uÀA¥ÀÄl 1,2,3,4,5 vÀÄvÀÄÛ 6, PÀÄvÉA¥ÀÄ PÀ£ÀßqÀ CzÀåAiÀÄ£À uÀAuÉÜ, vÉÄÊuÀsgÀÄ «±ÀéªzÁå¤®AiÀÄ, vÉÄÊuÀsgÀÄ. 2014
- qÁ. CgÀ«AzÀ vÀiÁ®UÀwÛ, uÁ»vÀå uÀAuÀÌøw vÀÄvÀÄÛ zÀåvÀ ¥ÀæeÉ, ¥ÀæPÁ±ÀPÀgÀÄ PÀ£ÀßqÀ uÁ»vÀå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀsgÀÄ. 2014
- qÁ. F.Juï. DvÀÄsgÀ, PÀ£ÀßqÀ PÀxÀ£À uÁ»vÀå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ uÀéÀß §ÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2016
- zÉÃ±À¥ÁAqÉ Juï.Jeï., ¨ÉÃAzÉæ ±ÀjÃ¥ÀgÀ PÁvÁåAiÀiÁ£À, ¥ÀæPÁ±ÀPÀgÀÄ zÉÃ¹ ¥ÀÄuÀPÀ, ¨ÉAUÀ¼ÀsgÀÄ. 2013
- QÃvÀð£ÁxÀ PÀÄvÀðPÉsÃn, PÀ£ÀßqÀ uÁ»vÀå uÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉsÃn vÉÄvÉsÃj AiÀÄeï læïÖ, zÁgÀvÁqÀ. 2009
- ±ÁvÀÄgÁAiÀÄ vÀ.uÀÄ., PÀ£ÀßqÀ uÁ»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À vÉAPÀtÚAiÀÄå uÁägÀPÀ UÀæAxÀvÀiÁeÉ, vÉÄÊuÀsgÀÄ – 2014

- uÀA. qÁ! ¹. Dgï. ZÀAzÀæ±ÉÀRgï, vÀÄÄAzÁ¼ÀÄvÀ£ÀzÀ ®PÀëtUÀ¼À£ÀÄß ¨Él¼É¹PÉs¼ÀÄîvÀqzÀÄ ºÉÃUÉ?, ¥ÀæPÁ±ÀPÀgÀÄ £ÀvÀPÀ£ÁðlPÀ ¥À©PÉÃµÀ£ï ¥É ÊvÉmï å«ÄmÉqï. 2010
- DzÀÄ¤PÀ PÀ£ÀßqÀ PÁvÀ ¨ÁUÀ–2, PÀÄvÉA¥ÀÄ PÀ£ÀßqÀ CzÀAiÀÄ£À uÀAuÉ, vÉÃÉuÀsgÀÄ «±Àé«zÁ¤®AiÀÄ, vÉÃÉuÀsgÀÄ. 2004
- ²vÀgÀÄzÀæ¥À f.Juï. PÀ£ÀßqÀ uÁ»vÀ uÀ«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ uÀé¥ÀßSÄPï ºËuï, ¨ÉAUÀ¼ÀsgÀÄ. 2013

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AHH401	Language II: Hindi-IV	FC	1	1	0	2	3

Course Description:अध्ययन वर्ण :

यह पाठ्यक्रम नौसिखिया, अपनी भाषा की क्षमता का सिकाि करने हेतु तथा सिसभन्न िासहखिक प्रसक्रयाओं द्वारा
िमाज, िंस्कृ सत एिं जीिन के मूल्यं कय िमझने हेतु असभकखित है |

Course Objectives: पवठ्यक्रम उद्देश्य :

- िंदभानुिार उसचत भाषा का प्रययग करने की दक्षता कय छात्यं मेंं उत्पन्न करना |
- िासहि के माध्यम िे िमाज एिं मानीय मूल्यं कय िमझाकर, उन मूल्यं की रक्षा हेतु प्रेररत करना |
- छात्यं मेंं पुस्तक पठन एिं लेिन की अकृ सतम प्रिृसि स्थासपत करना |
- अध्येताओं मेंं िासहि के माध्यम िे प्रभािी एिं कु शल िंचार का सिकाि करना |

Course Outcomes :असिगम पररर्वम:

अध्ययन की िमाखप्त पर अध्येता –

- िामासजक मूल् एि नैसतक जिाबदेही कय स्वीकार कर िकता है |
- िासहि की प्राि िंगकता कय जीिन मेंं िमझने की दक्षता रिता है |
- िमाज मेंं अंतसनसहत पद्दसतया एिं सिचारधाराओं का व्याख्यान करने मेंं िक्षम बन िकता है |
- िासहि के माध्यम िे प्रभािी एिं कु शल िंचार का सिकाि करिकता है |

Pedagogy:सिक्षशवस्त्र : Direct method/ICT and Digital support/Collaborative and Cooperativelearning/Flipped Classroom

Pre-requisites:पूवपेक्षव:

- अध्येता कय, सहन्दी िंिि काव्य का िंसक्षप्त ज्ञान आिश्यक है |

- सहन्दी िासहि के इसतहाि का िंक्षप्त ज्ञान की आिश्यकता है |
- सहन्दी व्याकरण का अिबयधन आिश्यक है |

Course Content:अध्ययन सवषय िूची / पवठ्यक्रम

इकवई –1: ि◌ंि◌-क◌ाव्य – नहुष – म◌ैसथलीशरण ग◌ुप्त **7 Hours**

कसि पररचय

काव्य पररचय

शच◌ी ि◌ग

नहुष ि◌ग

इकवई –2: ि◌ंि◌-क◌ाव्य – नहुष – म◌ैसथलीशरण ग◌ुप्त **6 Hours**

उ◌ि◌श◌ी

ि◌ग

स्वगभयग

ि◌ग

इकवई –3: ि◌ंि◌-क◌ाव्य – नहुष – म◌ैसथलीशरण ग◌ुप्त **7 Hours**

ि◌न्दे

श ि◌ग

मं◌त्◌ण◌ा

ि◌गपतन

ि◌ग

इकवई –4: **6 Hours**

अलंकवर

सिसनमव ररव्य◌ू :

ि◌ू पर 30, समशन मं◌गल, थप्पड़,आस◌िकल 15

Text book: पवठ्य पुस्तक:

- ि◌ंि◌-क◌ाव्य – नहुष – म◌ैसथलीशरण ग◌ुप्त

References: ि◌न्दर◌् ग्रन्थ :

- रि – छं◌ द – अलं◌कर - कृ◌ ष्णदे ि◌ शमा & ि◌ुरे◌श अग्रि◌ाल
- सहन्दी ि◌ासहि◌ क◌ा इसतह◌ाि◌ - ि◌◌ॉ. नागे◌द्र
- आध◌ुसनक सहन्दी ि◌ासहि◌ क◌ा इसतह◌ाि◌ - ि◌◌ॉ. बच्चन सि◌ं◌ह
- सहन्दी ि◌ासहि◌ क◌ा नि◌ी◌न इसतह◌ाि◌ - ि◌◌ॉ. ल◌ाल ि◌◌ाहब सि◌ं◌ह
- श◌ुद्ध सहन्दी कै ि◌े बयले◌ कै ि◌े सल ि◌े- प◌ृथ्वीनाथ पाण्ड◌े
- मीसिय◌ा सिमश – रामशरण जयशी

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AHA401	**Language II: Additional English-IV**	**FC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This 2-credit course helps the learner explore various socio-cultural issues through literature. The

course provides insight on matters like education and culture that are pertinent in the contemporary society. The course also offers multi-dimensional perspective in the genres of literature and contributes for language enrichment.

Pre-requisites: The student must possess fair knowledge of language, literature, culture and society.

Pedagogy: Collaborative Method, Flipped Classroom, Blended Learning

Course Objectives:

1. To infer the myths from the contemporary perspective.
2. To outline the idea of family represented in literature.
3. To interpret horror and suspense as a genre of literature.
4. To assess the impact of education in building a society.

Course Outcome:

On completion of the course, learners will be able to:

1. Examine the relevance of myths and mythology.
2. Demonstrate family values and ethics essential to live in the society.
3. Analyze horror and suspense as a significant genre of literature.
4. Evaluate the applicability of academic contribution in building a society.

Course Content:

Unit-I:Myths & Mythology **7 hours**

John W. May – Narcissus
W.B. Yeats – The Second Coming
Devdutt Pattanaik - Shikhandi and the Other Stories they Don‟t Tell you (Extracts)

Unit-II: Family & Relationships **6 Hours**

Nissim Ezekiel – Night of the Scorpion
Langston Hughes – Mother to Son
Kate Chopin – The Story of an Hour
Henrik Ibsen – A Doll‟s House (Extract)

Unit-III: Horror & Suspense **7 Hours**

Edgar Allan Poe – The Raven
Bram Stoker – A Dream of Red Hands
Satyajit Ray – Adventures of Feluda (Extract)

Unit-IV: Education **6 Hours**

The Dalai Lama – The Paradox of Our Times
Kamala Wijeratne – To a Student
Sudha Murthy – In Sahyadri Hills, a Lesson in Humility
Frigyes Karinthy – Refund

References:

- Finneran, Richard J. *The Collected Works of W.B. Yeats*. Volume I, The Poems, Revised Second Edition. Simon & Schuster, 1996.
- Pattanaik, Devdutt. *Shikhandi: Ánd Other „Queer" Tales They Don"t Tell You*. Penguin Books, 2014.

- Ezekiel, Nissim. *Collected Poems*. OUP, 2005.
- Hughes, Langston. *The Collected Poems of Langston Hughes*. Vintage, 1995.
- Chopin, Kate. *The Awakening and Selected Stories of Kate Chopin*. Simon & Schuster, 2004.
- Ibsen, Henrik. *A Doll"s House*. Maple Press, 2011.
- Poe, Edgar Allan. *The Complete Poetry of Edgar Allan Poe*. Penguin USA, 2008.
- Stoker, Bram. *Dracula*. Fingerprint Publishing, 2013.
- Ray, Satyajit. *The Complete Adventures of Feluda*. Vol. 2, Penguin Books Ltd., 2015.
- Lama, Dalai. *Freedom In Exile: The Autobiography of the Dalai Lama of Tibet*. Little, Brown Book Group, 1998.
- Murthy, Sudha. *Wise and Otherwise: A Salute to Life*. Penguin India, 2006.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0401	**Political Science – IV (Western and Eastern Political Thought)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
The purpose of this course is to introduce Western and Eastern political thought in order for the student to make sense of current trends in politics in an informed way. It looks at issues and conflicts within the political realm that have for ever been of interest in making sense of current politics, while noting the breaks and departures through which contemporary politics is comprehended and negotiated.

Pre-requisites: Thorough understanding of the basic political theories is required.

Pedagogy: Direct instruction and Collaborative method

Course Objectives

1. To explain Plato–Ideal State, Justice, Education, Communism and Philosopher King
2. To define Kautilya‟sArthasastra, Shanti Parva of Mahabharata
3. To show the identity of Medieval and Social Contractualists
4. To demonstrate the political thinkers‟s autobiographies

Course Outcomes

The Students will be able to

1. Summarize the ideologies of Plato–Ideal State, Justice, Education, Communism and Philosopher King
2. Interpret the Kautilya‟sArthasastra, Shanti Parva of Mahabharata
3. Analyze the history of Medieval and Social Contractualists
4. Compare the political thinker‟s autobiographies

Course Content:

Unit I: Ancient Greek Political Thought: **10 Hours**

Greek City States; Plato–Ideal State, Justice, Education, Communism and Philosopher King; Aristotle – State, Citizenship, Classification of Constitutions and Revolution.

Unit II: Indian Political Thought **10 Hours**

Kautilya"sArthasastra, Shanti Parva of Mahabharata,Raja Ram Mohan Roy, Jyothiba Phule, PanditaRamabhai, Swami Vivekananda

Unit III: Medieval and Social Contractualists **10 Hours**

St. Augustine, St. Thomas Aquinas, Machiavelli, Thomas Hobbes, John Locke and J.J.Rousseau

Unit IV: Select Political Thinkers **9 Hours**

Karl Marx, Ram Manohar Lohia, M.K. Gandhi, B.R. Ambedkar, Jaya Prakash Narayan, Rabindranath Tagore

References :

- Sharma, S.K and Urmila, Sharma. *Western Political Thought*. Volumes1&2, Atlantic Publishers, 2013.
- Stephen, Tromble. *Fifty Thinkers Who Shaped the Modern World*. London, Atlantic Books, 2012.
- Shefali, Jha. *Western Political Thought: From Plato to Marx*. Pearson, 2012.
- Brian R, Nelson. *Western Political Thought: From Socrates to the Age of Ideology*. Pearson Education, 2007.
- Kangle RP. *Kautilya"sArthasastra*. New Delhi Motilalal Banarsidass Publishers, 2010.
- Wayper, CL. *Political Thought*. Bombay, BI Publishers, 1979.
- George, Sabine. *A History of Political Thought.* Oxford, 2019.
- Bhandari, DR. *History of European Political Philosophy.* Lahore, Zahid Publishers, 1987.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0402	**Political Science Practical – IV**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Role Play Activity
- Presentations on current and ancient political scenarios
- Debate sessions
- Group discussion
- News paper article collection and presentation

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21AB0403	Economics – IV (International Economics)	HC	2	1	0	3	4

Course Description:

The aim of this course is to provide students with strong foundation in the principles of international economics which will help them to know the trade policies at the national and international levels and the impact of the globalization on income, employment and social standards in the current international scenario. The Course also covers the pure theory of trade and extensions thereof, customs union, and balance of payments adjustment policies under alternative exchange-rate regimes including the determination of the exchange rate.

Pre-requisites: Skills to observe the International economic developments through consumption of international business news.

Pedagogy: Direct instruction and collaborative method

Course Objectives:

1. To explain the principles of international economics
2. To demonstrate the trade policies at the national and international levels
3. To infer the impact of the globalization on income, employment and social standards in the current international scenario
4. To outline the trade policies

Course Outcomes:

The students will be able to

1. Identify the principles of international economics
2. Interpret the trade policies at the national and international levels
3. Outline the impact of the globalization on income, employment and social standards in the current international scenario
4. Identify the importance of the trade policies

Course Content:

Unit-I : Introduction and Essentials **10 Hours**

The Subject Matter of International Economics; Trade Based on Absolute Advantage; Trade Based on Comparative Advantage; Comparative Advantage and Opportunity Costs; Empirical Tests of the Ricardian Model. The Basis for and the Gains from Trade with Increasing Costs; Trade Based on Differences in Tastes; The Equilibrium Relative Commodity Price with Trade – Partial Equilibrium Analysis; Offer Curves; General Equilibrium Analysis; the terms of trade.

Unit-II : The Heckscher - Ohlin Theory, Economies of Scale, Imperfect Competition and International Trade **10 Hours**

Factor Endowments and Heckscher-Ohlin Theory; Factor-Price Equalization and Income Distribution; Empirical Tests of the Heckscher-Ohlin Model–The Leontief Paradox; Heckscher-Ohlin Model and New Trade Theories; Economies of Scale and International Trade; Imperfect

Competition and International Trade. The Rybczynski Theorem; Technical Progress; Growth and Trade: The Small Country Case; Growth and Trade: The Large Country Case – Immiserizing Growth.

Unit-III: Trade Restrictions: Tariffs and Nontariff Trade Barriers 10 Hours

Partial Equilibrium Analysis of a Tariff; General Equilibrium Analysis of a Tariff in a Small Country – The Stolper - Samuelson Theorem; Import Quotas; Other Non-tariff Barriers. Trade-Creating Customs Unions; Trade-Diverting Customs Unions; The Theory of the Second Best and Other Static Welfare Effects of Customs Unions; History of Attempts at Economic Integration – The European Union; Multilateralism –WTO.

Unit-IV: Balance of Payments, Foreign Markets and Exchange Rate Determination 9 Hours

Balance of Payments–Principles; Functions of the Foreign Exchange Markets; Foreign Exchange Rates; Purchasing Power Parity Theory; Stable and Unstable Foreign Exchange Markets.The International Monetary System and Macroeconomic Policy Coordination:

The Evolution of the Breton Woods System; The IMF; Policy Coordination with Floating Exchange Rates; Optimum Currency Area Theory; The Single Currency and Economic Integration; The European Monitory Union.

References:

- Dominick, Salvatore. *International Economics: Trade and Finance*, John Wiley International Student Edition, 10th Edition.2011
- Bowen H, Hollander A. and Viaene J. *Applied International Trade Analysis*, Macmillan Publication, 2012.
- Charles, Van Marrewijk. *International Economics: Theory, Application and Policy*. Oxford University Press, 2007.
- Dornbusch, R. *Open Economy Macroeconomics*. Basic Books: New York, International Students Edition, 1980.
- Gregory, N Mankiw. *Principles of Macroeconomics*. 6th Edition, Cengage Learning India, 2012.
- Paul Krugman, Maurice Obstfeld, and Marc Melitz. *International Economics: Theory and Policy*. Addison-Wesley (Pearson Education Indian Edition), 9th Edition, 2012.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0401	**Journalism – IV (Fundamentals of Media Research)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:

The course is aimed at acquainting and initiating the student to the nuances – theoretical & practical – involved in research. Each student is assigned a supervisor who will supervise and guide the project/dissertation of not less than 35 - 40 pages which the student is required to submit at the end of semester in the prescribed format. This will aid the students in gaining a proper insight into research in communication studies and devising the project will impart clarity in the nuances of doing research.

Pre-requisites: Inquisitive nature to identify the problems.

Pedagogy: Direct instruction and flipped class method

Course Objectives:

1. To expose students to the theory and mechanics of conducting research
2. To provide students with knowledge on the fundamental aspects of research
3. To make the students to apply the research techniques in media studies
4. To empower the students to conduct the research study independently

Course Outcomes:

On completion of the course, the student will be able to

1. Outline the process of research
2. Relate the methods of research with the perspective of industry research in media
3. Discuss the significance of research to build the branch of Media Studies
4. Propose a research topic independently

Course Content:

Unit I: Introduction to Media Research **10 Hours**

Introduction to research concepts- Definition, types & need for research; Basic principles of „Scientific" research: empiricism, verifiability, generalization; Fundamental vs. Applied Research; Quantitative vs. Qualitative data; Role of research in the media; Steps in research

Unit II: Elements of Research **10 Hours**

Review of Literature-Significance of Review of Literature; Research Approaches or designs: Experiment Designs- Posttest, Pretest & Posttest, Solomon Four Group Design, Factorial Analysis ; Survey, Content Analysis; Case Study; Data collection techniques: Questionnaire, Interview, Schedule; Sampling techniques.

Unit III: Research Presentation **10 Hours**

Data processing, Analysis, presentation and interpretation of data; Use of graphics in data presentation; Research writing - Research proposal; Chapterization of thesis: Components and style- APA, MLA; Preparation of Bibliography, Index"

Unit IV: Research in media audiences and the „effects" debate **9 Hours**

Magic bullet to limited effects; Two-Step Flow of Communication; Users and Gratifications model; Cultivation analysis; Audience reception.

References:

- Berger, J. *Media and Communication Research Methods: An Introduction To Qualitative And Quantitative Approaches*. Sage Publication, 2000.

- Wimmer, Roger D. and Dominick, Joseph R. *Mass Media Research: An Introduction*. Singapore Wadsworth Publishing, 2000.
- Kothari, C.R. *Research Methodology: Methods and Techniques*. New age International Ltd. Publishers, 1990.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0402	**Journalism Practical - IV**	**HC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Research Proposal/ Synopsis Presentation
- Bibliography Chapter

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21PYS411	**Interdisciplinary Elective 7 – Personality, Identity and Self-Presentation**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

Personality, identity and self-presentation are some of the most important psychological concepts in the contemporary world due to constant changes. The course explores the modern view of the personality as a process, which involves both conscious and unconscious phenomena. Among these personality phenomena we are likely to meet all psychological spheres, that is, the sphere of cognition, emotion, motivation and behavior. In the cognitive sphere there is learning of certain behaviors, copying behaviors from others and creating one‟s own behavioral scenarios. Among emotional sphere we have emotions elicited by current situation, as well as emotions linked to the genetic traits of personality. In motivational sphere there are tendencies to certain behaviors, produced by the person‟s needs, energetic resources and possibilities. Among behavioral sphere, these different tendencies take effect, leading to various outcomes and, in addition, affecting personality in return.

Pre-requisites: None.

Pedagogy: Direct learning, ICT, Case Studies.

Course Objectives:

1. Understand different views of personality in psychology: cognitive view, psychodynamic view, humanistic theory of personality, behavioral proposition and the view of personality as a set of traits.
2. Understand the ability to name and analyze different psychological spheres playing roles among personality: the sphere of cognition, emotion, motivation and behavior
3. Understanding of the phenomena of self, self-knowledge and self-esteem
4. Explore the competence to analyze different personal identities with their different values and different forms (private and social identity).

Course Outcomes:

After the successful completion of the course, students will be able to

1. Learn about different views of personality in psychology: cognitive view, psychodynamic view, humanistic theory of personality, behavioral proposition and the view of personality as a set of traits
2. Acquire the ability to name and analyze different psychological spheres playing roles among personality: the sphere of cognition, emotion, motivation and behavior
3. Gain understanding of the phenomena of self, self-knowledge and self-esteem
4. Acquire the competence to analyze different personal identities with their different values and different forms (private and social identity)

Course Content:

Unit 1: Introduction to Personality, identity and self-presentation 7 Hours

The process approach to the personality, identity and self-presentation. Introducing the experiment with recording films about self-presentation. Film analysis: cross-cultural context of defining the matters of personality, identity and self-presentation. Approaches to personality. The interaction of emotional and personality spheres.

Unit 2: Emotional intelligence, Motivation and personality 6 Hours

Emotional intelligence: can we develop efficient use of emotion in daily basics?, Motivation and personality, Cognitive process and cognitive intelligence among personality, Personality as a process of interaction between different psychological spheres.

Unit 3: Self-knowledge and self-esteem **7 Hours**

Self-knowledge and self-esteem – how do they differ? Identity and values among different generations.

Unit 4: Self-presentation **6 Hours**

The characteristics of the phenomenon, Mechanisms of the internalization of self-presentation, The moral and competence-related interpretation of behavior, The potential of creating and managing one‟s own self-presentation, identity and personality.

References:

- Bandura, A. (1977). Social learning theory.
- Kosslyn, S. M., Rosenberg, R. S. (2011). Introducing Psychology: Brain, Person, Group. London: Pearson Custom Publishing.
- John, O. P., Robins R. W., Pervin L. A. (Ed.) (2008). Handbook of personality: theory and Research. New York: Guilford Press.
- Mroczek, D. K., Little, T. D. (2006). Handbook of Personality Development. Milton Park, Abingdon: Taylor & Francis.
- Rogers, C. (1979). The Foundations Of The Person-Centered Approach. Education, 100(2), 98-107.
- Tice D. M. (1992). Self-Concept Change and Self-Presentation: The looking Glass Self Is Also a Magnifying Glass. Journal of Personality and Social Psychology, 60, 435-451.
- Wojciszke B., Dowhyluk M., Jaworski M. (1996). Moral and competence – related traits: How do they differ? Polish Psychological Bulletin, 37, 213-220.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JNS412	**Interdisciplinary Elective 8 – Cyber Media Practices**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course, Cyber Media Practices offers a critical introduction to emerging "wired" or "cyber" technologies. In this course, the students will learn about the historical development of the Internet and other forms of new media and examine the repercussions of the digital revolution for our communities, our identities and our daily lives. Students will learn how to create a blog site and also master the art of blogging and vlogging.

Pre-requisite: Basic knowledge to work with ICT
Pedagogy: Direct Instruction, Inquiry Based Learning, Collaborative learning, ICT Based Learning

Course Objectives:

1. Through a variety of online and offline projects, students will develop the skills needed to be an active participant in the new media culture
2. Students will be prepared to spearhead change in emerging digital journalism tools in continuously evolving integrated newsroom practices
3. Students will learn trends relating to production, delivery or dissemination and consumption of news in innovative multimedia digital formats across multiple platforms
4. To enable the students to develop a critical, sociologically and historically informed perspective on the digital communication revolution and the Internet

Course Outcomes:
On completion of this course, the students will be able to-

1. Define and discuss key theoretical concepts related to new media studies
2. Acquire requisite technical proficiency to be an active participant in the new media culture.
3. Assess the social, cultural and political implications of new media production and consumption process.
4. Relate to upcoming digital evolution

Course Content:

Unit:1- Introduction to Cyber Space 7 Hours

What is cyber space?; Information Super Highway; Internet and information revolution; Cyber Media: Fundamentals of Cyber Media; Marshall McLuhan, Global Village and Electronic Age; Internet & New Media: use and its significance, advantages and disadvantages

Unit II: Cyber Journalism **6 Hours**

Cyber Journalism: concept, definition and its advantages and disadvantages; Impact and future of cyber journalism; Writing for Web Media –Guidelines, Planning, Structure and Style- Headlines, Blurbs, Lead

Unit III: Writing for the Web & Blogging **7 Hours**

Technical Writing – Copywriting; Blogs –Types of blogs –Personal blogs, Collaborative or Groupblogs, Corporate or Organisational blogs, Photo blog– Micro blogging; how to create a blog with Wordpress- site-set-up, design, writing posts, choosing photos, writing titles; Different types of Social Media and which work in different types of blogs; Usage of social media to promote your blog; Measuring analytics

Unit IV: Vlogging **6 Hours**

Creating your Vlog: Determine your niche. The first step to becoming a vlogger is defining the type of content you want to create; Watch other creators; Find your voice; Invest in gear; Define your content; Edit your videos; Build an online presence; Optimize your content.

References:

- Feldman, Tony. *An Introduction to Digital Media*. Sujeeth Publications, 1989.
- Hassan, Seema. *Mass communication Principles and Concepts* (second edition) CBS Publishers and Distributors, 2013.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ENS413	**Interdisciplinary Elective 9 – Academic and Content Writing**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

Academic writing is an essential part of academics, facilitates success in career prospects. It is pivotal to demonstrate our knowledge and insights through writing whether we are students or scholars. The transition from creative writing to academic and content writing requires utmost practice and diligence. This Course helps the students to refine their academic writing so that they can do well in their academics, publish research papers in national and international journals, and make themselves more expedient to society. In addition, the focus on content writing equips the students to write in accordance with the industry expectation on a variety of topics.

Pre-requisites: Students must possess a flair for reading and basic writing skills.

Pedagogy: ICT/ Flipped Classrooms/ Collaborative Learning/ Blended Learning.

Course Objectives:

1. To familiarize the learners to different types of formal writing.
2. To examine the several challenges of academic writing.
3. To enhance the skills in content writing.
4. To comprehend the process of search engine, documenting and acknowledging the sources.

Course Outcomes:

On completion of the course, the students will be able to:

1. Appraise the relevance of good writing in academics and research
2. Develop a strategic approach to academic writing
3. Identify various types of content writing and analyze the competition in the field.
4. Create content and enhance research skills

Course Content:

Unit I: Academic Writing & Research Process **7 Hours**

1. Academic Writing as a part of Research
2. Various Terms used in Academic Research
3. Types of Academic Writing

Unit II: Good Academic Writing **6 Hours**

1. Different Kinds of Writing –
   (Journalistic Writing, Creative Writing, Academic Writing)
2. The Role of Grammar and Usage
3. The Structure of a Paragraph

Unit-III: Content writing **7 Hours**

1. Importance and types of content writing
2. Principles of non-fiction writing
3. Competition analysis

Unit-IV: SEO, Blogging and Plagiarism **6 Hours**

1. SEO – Meaning, SEO of web content
2. Blogging – Meaning and writing for blog
3. Plagiarism in academic and content writing

References:

- Bailey, Stephen. *Academic Writing: A Handbook for International Students*. Routledge, 2018.
- Felder, Lynda. *Writing for the Web: Creating Compelling Web Content Using Words, Pictures, and Sound*. Pearson Education India. 2011.
- Gáliková, Silvia. *Academic Writing*. Peter Lang Publishing Group, 2016.
- Godfrey, Jeanne. *Academic Writing*. Macmillan Education/Palgrave, 2015.
- Oladejo, James. *Academic Writing*. Lighthouse Publishing Company, 2004.

- Purposes), Bailey, Stephen (Freelance writer of materials for English for Academic. *Academic Writing*. Taylor & Francis Ltd, 2017.
- Robinson, Joseph. *Content Writing: Step-by-Step*. Amazon Digital Services LLC - KDP Print US, 2020.
- Soukup, Ruth. *How to Blog for Profit Without Selling Your Soul*. Life Well Lived Publications, 2014.
- Thonney, Teresa. *Academic Writing: Concepts and Connections*. Oxford University Press, 2016.
- Zemach, Dorothy E., and Lisa A. Rumisek. *Academic Writing: from Paragraph to Essay*. Macmillan, 2019.

Course Code	Course Title	CourseType	L	T	P	C	Hrs./ Wk.
B21AHR401	**Minor Research Project**	**HC**	**0**	**0**	**3**	**3**	**6**

Course Description:
Project work/Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.
Pre-requisites: Student must have knowledge of Research methodology
Pedagogy: ICT/ Flipped Classrooms/ Collaborative Learning/Guiding and supervising
Course Objectives:

1. To carry out research under the guidance of supervisor and in the process learn the techniques of research.
2. To explore new and fruitful ideas in the chosen field of the programme
3. To develop a perspective and to design and execute a research
4. To experience how the research is performed and to investigate an identified problem

Course Outcomes:
On successful completion of the project, the student shall be able to:

1. Infer with the literature search
2. Demonstrathe experiments related to research and formulate computational techniques
3. Interpret the data and to demonstrate their domain knowledge
4. Apply and write report and defend the research findings.

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21AHM403	**Skill Development Course - II**	**MC**	**Non-credit Mandatory Course**				**2**

Note: The students will have to undergo Skill Development Course being conducted by Training and Placement cell of the University or by any internal faculty.

FIFTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0501	**Political Science – V (Public Administration and Core Concepts)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
Public Administration prepares the students for posts in the public and private sectors. This includes positions in government institutions and municipal administrative units, as well as nonprofit organizations such as social service agencies, consulting firms and private institutions which are engaged in public affairs and public policy.

Pre-requisites: A primary understanding of the administrative concepts.

Pedagogy: Direct instruction and ICT method

Course Objectives:
1. To define the meaning, scope and the theories of Public Administration
2. To explain the Dynamics of Management
3. To elaborate on thePersonnel Administration
4. To demonstrate the Financial Administration

Course Outcomes:
After the successful completion of the course, the Students will be able to:
1. Interpretthe meaning, scope and the theories of Public Administration
2. Identifythe Dynamics of Management
3. Analyse the procedures ofPersonnel Administration
4. Inferthe basics of Financial Administration

Course Content:

Unit I- Public Administration: 10 Hours
Meaning, Scope and Importance of Public Administration; Private and Public Administration – Differences, Public-Private Partnership; Organization – Theories and Principles, Line, Staff, Auxiliary Agencies, Departments.

Unit II-Dynamics of Management: **10 Hours**

Meaning and Functions of Management, Chief Executive – Powers and Functions; Leadership – Qualities; Good Governance

Unit III- Personnel Administration 10 Hours

Meaning and Importance; Recruitment, Training, Promotion, Morale, Discipline, Retirement.

Unit IV - Financial Administration: 9 Hours

Budget–Meaning and Principles, Budgetary Process–Preparation, Enactment and Execution; Performance Budget, Zero based Budgeting.

References:

- Jos C.N, Raadschelders. *Public Administration: The Interdisciplinary Study of Government*. Oxford University Press, 2013.
- Avasthi and Maheshwari. *Public Administration*. Lakshmi Narain, 2017.
- Sharma, M.P. et al. *Public Administration in Theory and Practice*. Kitab Mahal, 2012.
- Polinaidu, S. *Public Administration*. Galgotia, 2013.
- Siuli Sarkar, *Public Administration in India*. PHI Learning, 2010.
- Henry, N. *Public Administration and Public Affairs*. PHI Learning, 2012
- Fadia, B.L. and Fadia, K. *Public Administration: Administrative Theories and Concepts*. 2011.
- Basu, R. *Public Administration: Concepts and Theories*. Sterling, 2005.
- Bhagwan, V. and Bhushan V. *Public Administration*. S. Chand, 2005.
- Goel, S L. *Public Administration: Theory and Practice*. Deep and Deep, 2003.
- Bhattacharya, M. *New Horizons of Public Administration*. Jawahar Publication, 2011.

Journals

1. Indian Journal of Public Administration
2. Indian Journal of Political Science
3. Administrative Changes
4. Management in Government

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AB0502	**Economics – V (Indian Economy – I)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:

Using appropriate analytical frameworks, this course reviews major trends in economic indicators and policy debates in India in the post-Independence period, with particular emphasis on paradigm shifts and turning points. Given the rapid changes taking place in India, the reading list will have to be updated annually.

Pre-requisites: Primary knowledge about the economic developments in India.

Pedagogy: Direct instruction, Collaborative and ICT method

Course Objectives:

1. To explain the structure of Indian Economy
2. To outline the achievements and failures of India's Five-year Plans (broad outline)
3. To demonstrate the trends and pattern of population
4. To elaborate Dualism in the Indian Economy

Course Outcomes:

The students will be able to

1. Analyse the structure of Indian Economy

2. Interpret the achievements and failures of India's Five-year Plans (broad outline)
3. Identify the trends and pattern of population
4. Examine the Poverty Eradication Programmes in India

Course Content:

Unit I: Indian Economy –An Overview **10 Hours**

The structure of Indian Economy – its sectoral composition, rural- urban dimension –India‟s per capita income – relative position relation to developed and underdevelopedeconomies; Features and Causes of Underdevelopment of the Indian Economy.

Unit II: NI Trends and Indian Planning **10 Hours**

National Income of India: Trend, Estimation and Distribution.Background for Indian Planning and Planning process and institutions; Objectives, achievements and failures of India's Five-year Plans (broad outline)

Unit III: Demography **10 Hours**

The trends and pattern of population growth –age distribution – demographic rates and population projection; The nature of population problem in India and government policies related to population

Unit IV: Dualism **9 Hours**

Dualism in the Indian Economy: Poverty Line-Poverty Eradication Programmes in India.

References:

- Dutta, R. & K.P.M. Sundaram.*Indian Economy.* S. Chand & Co. 2016.
- Agarwal, A.N. *Indian Economy*, Vikash Publishing Co. 2014.
- Misra, S.K. & V.K. Puri. *Indian Economy*, Himalayas Publishing Co. 2012.
- Gupta, S.B. *Monetary Planning in India.* Oxford University Press, 2009.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JN0501	**Journalism -V (Media Laws & Ethics)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:

The purpose of this course is to provide students with a model by which to analyze, understand, and act upon the law and ethical considerations which journalists face. The course will consist of the writings of the Supreme Court, the Ethical rules of the Society of Professional Journalists, and actual events to build an analytical model. There is no profession more important to a democracy than journalism -when vigilant and diligent and resolute. In order to perform that role, the students are required to understand both the law and the ethics that govern it.

Pre-requisites: Primary understanding of the requirement of laws in society.

Pedagogy: Direct instruction, Collaborative and ICT method

Course Objectives:

1. To provide students with knowledge on the laws and ethics in journalism

2. To equip the students with legal understanding of legal issues impacting them on the field.
3. To make students aware of the legal limits when reporting on sensitive and controversial issue of the day
4. To familiarize with the different kinds of media laws that a journalist will encounter in the field.

Course Outcomes:

After the successful completion of the course, the students will be able to-

1. List best contemporary ethical and professional journalism practices
2. Define basic legal terminology.
3. Explain the workings of the Indian civil and criminal justice system.
4. Define the limits of legal rights.

Course Content:

Unit I: Indian Constitution **10 Hours**

Preamble; Directive principles; Fundamental Rights and duties; Article 19-1(a) and (b) - with reference to Freedom of the Press- reasonable Restrictions

Unit II: Media Laws **10 Hours**

Press and Registration of Books Act; Working Journalist Act; Defamation - Civil and criminal defamation-Libel & Slander; Judicial Reporting & Contempt of Court; Right to Information Act; Legislative privileges and contempt of legislature; Copy right Act; Intellectual Property Rights- Copyright, Trademarks, Patents & GI; IT Act 2000 & Cyber Laws; cable network Resolution; Film Censorship; Cinematograph Act 1952; Prasar Bharathi Act

Unit III: Issues in Media **10 Hours**

Information Society; ICT revolution-Information & Knowledge society; NWICO; Media and Globalization- Implications; Sensationalism, Paid News; Sting Operations, Obscenity; Pressures on media

Unit-IV: Ethics in Media **9 Hours**

Control; Press commission‟s (I&II) recommendations; Prasar Bharathi Act; Press council- code of conduct for journalists; Broadcasting Code-Right to privacy-Self Regulatory Bodies – IBF, NBA, Broadcast Content Compliance Council (BCCC), Ombudsman

References:

- Singh, Sanjay Kumar. *Press Laws and Ethics of Journalism*. Anmol Publication Pvt Ltd. 2013.
- Malar and M, Neela. *Media laws and ethics*. New Delhi, PHI Learning private limited. 2012.
- Sharma, Kumar Ajay. *Journalism laws*. New Delhi, Random Publications, 2012.
- Singh, Yatindara Justice. *Cyber Laws*. Delhi Universal Law Publishing, 2005.
- Basu, DD. *Law of the Press*. New Delhi, Prentice Hall, 2002.
- Seib, Philip & Fitzpatrick, Kathy. *Journalism Ethics*. New York, Harcourt Brace College Publishers, 2000.
- Mecluskey, Matha, T. *Feminism, Media and The Law*. New York, Focus Press, 1997.

- Venkateshwaran, KS. *Mass Media Laws and Regulations in India*. Singapore AMIC,1993.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS411	**Political Science – VI (A) (International Relations)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This Course is designed to give students a sense of some important theoretical approaches to understand international relations; a history from 1945 onwards to the present; and an outline of the evolution of Indian foreign policy since independence and its possible future trajectory

Pre-requisites: Students should have primary knowledge of relationships between the countries.

Pedagogy: Direct instruction and ICT method

Course Objectives:

1. To define thenature, scope and the theories of International Relations
2. To explain the concept of national power, foreign policy, human rights and approaches to international peace
3. To elaborate on the approaches of International Peace
4. To demonstrate the International Law and Human Rights

Course Outcomes:
After the successful completion of the course, the students will be able to-

1. Outline the nature, scope and the theories of International Relations
2. Analyze the concept of national power, foreign policy, human rights and approaches to international peace
3. Examine the approaches of International Peace
4. Utilize the International Law and Human Rights

Course Content:

Unit I: International Relations **7 Hours**
Nature, Scope and Importance; Theories - World Systems theory and Game theory.

Unit II- National Power, National Interest and Foreign Policy **6 Hours**
Elements of National Power; National Interest; Formulation of Foreign Policy; Diplomacy- Functions and Types.

Unit III- Approaches to International Peace **7 Hours**
Balance of Power; Collective Security; Disarmament and Arms Control – Problems and Issues.

Unit IV- International Law and Human Rights **6 Hours**
Sources of International Law; Universal Declaration of Human Rights- Issues and Concerns

References:

- Bhupinder S Chimni and Siddharth Mallavarapu.*International Relations: Perspective form the Global South*, Pearson, New Delhi, 2013.
- RumkiBasu.*International Politics: Concepts, Theories and Issues*. New Delhi: Sage, 2012.
- Peu Ghosh.*International Relations*. New Delhi: PHI Learning, 2009.
- Palmer, N.D. and Perkins, H.C. International Relations. New Delhi: AITBS, 2007
- Malhotra, V.K. International Relations. New Delhi: Anmol, 2001.
- Ghai, K.K. International Relations: Theory and Practice of International Politics. New Delhi: Kalyani, 2005.
- Joshua Goldstein. S.*International Relations*. Delhi: Pearson Education, 2004.
- Noam Chomsky. *Understanding Power: The Indispensable Chomsky* – edited by peter R. Mitchell & John Schoeffel, New Delhi: Penguin Books, 2003.
- JozefGoldblat.*Arms Control: The New Guide to Negotiations andAgreements.* London: Sage Publications. 2002.
- Karen Mingst.*Essentials of International Relations*. New York: W.W.Norton& Co, 1999.
- Bruce Russett and Harvey Starr.*World Politics: The Menu For Choice,* 1986.

Journals

1. International Affairs
2. World Politics
3. India Quarterly
4. Foreign Affairs
5. World Focus

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS412	**Political Science – VI (B) (Comparative Government and Politics)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

Comparative Government and Politics introduces students to the rich diversity of political life outside the United States. The course uses a comparative approach to examine the political structures; policies; and the political, economic, and social challenges among six selected countries: Great Britain, Mexico, Russia, Iran, China, and Nigeria. Additionally, students examine how different governments solve similar problems by comparing the effectiveness of approaches to many global issues.

Pre-requisites: Basic idea of different types of political systems.

Pedagogy: Direct instruction, ICT method

Course Objectives:

1. To define and describe major comparative political concepts

2. To explain relevant factual information pertaining to the governments and politics of China, Great Britain, Iran, Mexico, Nigeria, and Russia.
3. To analyze typical patterns of political processes and behavior and their consequences.
4. To compare and contrast political institutions and processes across countries.
5.

Course Outcomes:

After the successful completion of the course, the students will be able to-

1. Analyze a broad perspective of the comparative politics subfield.
2. Interpret democratic political institutions, democratization, and international political economy.
3. Applythe comparative method andanalyze politics in a diverse set of countries from developing world to advanced industrialized democracies.
4. Identify the changing nature of nation-state in various contexts.

Course Content:

Unit I: Introduction to Comparative Politics **7 Hours**

Importance of political change, integration of political and economic systems

Unit II: Sovereignty, Authority, and Power **6 Hours**

Nations, and Regimes, Political Culture/Ideologies

Unit III: Political Institutions **7 Hours**

Levels of Government, Executive, Legislatures, Bureaucracies, Judiciaries, Electoral Systems, Linkage Institutions, Interest Groups

Unit-IV: Themes of Comparative Politics **6 Hours**

A comparative study of constitutional developments and political economy in the following countries: Mexico, Russia, Iran, China, and Nigeria

References:

- Strong C.F., Comparative Governments, The English Language Book Society and Sidgwick & Jackson limited London.
- Wheare K.C., Modern Constitutions, Oxford University Press, New Delhi.
- Padmanabhan V.K, Outlines of Comparative Governments, PothigaiPathippaham, Pondicherry.
- Kapur A.C., Select Constitution, S. Chand & Co, New Delhi.
- Mahajan V.D., Select Modern Governments, S. Chand & Co. New Delhi.
- Apppadurai A, Substance of Politics, Oxford University Press, Atlas Publications Pvt. Ltd., Madras

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS413	**Political Science Practical -VI (A) (International Relations)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Case studies
- Presentations on various countries political processes
- Seminar on various political processes all over the world
- Video screening of Parliament sessions of various countries
- Debate
- Group Discussion

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS414	**Political Science Practical -VI (B) (Comparative Government and Politics)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Model Nation Presentation
- Debate
- News paper article collection
- Group discussion on happening issues
- Seminar

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS421	**Economics – VI (A) (Mathematical Methods for Economics)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

The course emphasizes on the the recent global economic crisis, economics is more important and relevant than ever. Decisions on money, banking, interest rates, taxation and government spending affect us all, with global consequences. The course will explain complex data in simple terms to different audiences. It develops excellent mathematical, statistical and problem-solving skills.

Pre-requisites: Mid level knowledge of Mathematics is essential.

Pedagogy: Direct instruction, ICT method

Course Objectives:

1. To develop the basic skills in applied mathematics
2. To explain the skills in the field of economic analysis and reasoning
3. To develop skills in the presentation of data.
4. To demonstrate Cobb - Douglas and CES production functions and their properties

Course Outcomes :

After the successful completion of the course, the students will be able to-

1. Formulate a dynamic economic problem in mathematical terms
2. Applytheir knowledge of the subject content of mathematical economics, specifically in the area of dynamic methods
3. Build the skills in the data presentation
4. Make use relevant mathematical techniques

Course Content:

Unit-1: Economic Science **7 Hours**

Introduction: The changing scenario in economic science-Advantages and Disadvantages of using mathematics in economics.

Functions: Meaning-Distinction between a relation and a function-Functional notations: general, exact and specific forms-Explicit and Implicit forms-Inverse from-Types of functions: Linear, quadratic, cubic, exponential and logarithmic functions-Exponential functions as applied in interest compounding-Their simple uses in Economics- Market equilibrium-Effects of taxes and subsidy on equilibrium price and quantity-Simple macro model (Keynesian macro equilibrium model).

Unit-II: Calculus & Elasticity **6 Hours**

Differential Calculus: Meaning-Simple derivative rules (one independent variable)-Application of derivatives in Economics.

Elasticity - Definition - Elasticity theorems - Methods of measuring elasticity- Applications of elasticity in Economics: Price elasticity - Substitutes and complements - Income elasticity - Engel's Law - Cost elasticity.

Unit-III: Functions **7 Hours**

Maxima and Minima of functions (One independent variable): Unconstrained and constrained models - Applications of maxima and minima in Economics: Theory of consumption (numerical problems of utility maximization) - Theory of production: production function, Producer‟s equilibrium: output, revenue and profit maximization and cost minimization problems under perfect competition, monopoly, duopoly and oligopoly markets.

Unit-IV: Homogeneous functions **6 Hours**

Homogeneous functions: Cobb - Douglas and CES production functions and their properties - Euler's theorem and adding up controversy; Market Equilibrium: Effects of specific and advalorem taxes on price and output - Effects of subsidies; Walrasian and Marshallian static stability condition.

References:

- Allen, R.G.D. "Mathematical Analysis for Economists".Harold Hotelling, 1939.
- R. Veerachamy. *Quantitative Methods for Economists*. New Age International Publishers, 2002.
- Chiang, A.C. *Fundamental Methods of Mathematical Economics*.McGraw-Hill Education, 2005.
- Yamane,Taro. *Mathematics for Economists - An Elementary Survey*,Prentice Hall India Learning Private Limited; 2nd edition, 1981.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS422	**Economics – VI (B) (Entrepreneurial Development)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This course introduces the principles and practices of Entrepreneurial Development. During the course, the students will examine to develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

Pre-requisites: Preliminary exposure to different kinds of entrepreneurial opportunities

Pedagogy: Direct instruction, ICT and collaborative method

Course Objectives:

1. To developan entrepreneurial business opportunities
2. To demonstrate the dynamic role of entrepreneurship and small business
3. To explain the Business Planning Process
4. To outline Financial Planning and Control

Course Outcomes:

On successful completion of this course, students will be able to:

1. Distinguish the distinct entrepreneurial traits
2. Examine the parameters to assess opportunities and constraints for new business ideas
3. Identify the systematic process to select and screen a business idea
4. Design strategies for successful implementation of ideas

Course Content:

Unit I: **Entrepreneur & Entrepreneurship:** **7 Hours**

Meaning of entrepreneur - Evolution of the concept - Functions of an Entrepreneur - Types of Entrepreneur - Intrapreneur- an emerging class - Concept of Entrepreneurship - Entrepreneurial Culture - Stages in entrepreneurial process.

Unit II: **Business Planning Process:** **6 Hours**

Meaning of business plan - Business plan process - Advantages of business planning - Marketing plan -

Production/operations plan - Financial plan - Final Project Report with Feasibility Study - preparing a model project report for starting a new venture.

Unit III: **Institutions supporting Entrepreneurs** **7 Hours**

Small industry financing developing countries - A brief overview of financial institutions in India - Central level and state level institutions - SIDBI - NABARD - IDBI - SIDCO - Indian Institute of Entrepreneurship - DIC - Single Window - Latest Industrial Policy of Government of India

Unit IV: International Entrepreneurship Opportunities **6 Hours**

The nature of international entrepreneurship - International versus domestic entrepreneurship - Stages of economic development - Entrepreneurship entry into international business - exporting - Direct foreign investment.

References:

- Dr. Vasant Desai. *Small scale industries and entrepreneurship*, Himalayan Publishing House, 2011.
- Dr. Vasant Desai, *Management of small scale industries*, Himalayan Publishing House, 2010.
- .C.SabooMeghaBiyani, *Management of small scale industries*, J. Himalayan Publishing House, 2015.
- Dr. Vasant Desai, *Dynamics of entrepreneurial development and Management*, Himalayan Publishing, 2011.
- Moharanas and Dash C.R. *Entrepreneurship development*,Moharanas and Dash C.R., RBSA Publishing, Jaipur. 1983.
- Collins and Lazier W, *Beyond entrepreneurship*, Prentice Hall, New Jersey, 1992
- Hisrich Peters Sphephard, *Entrepreneurship*. Tata McGraw Hill, 2002.
- S.K. Mohanty, *Fundamentals of entrepreneurship*, Prentice Hall of India, 2011.
- David Oates, *A Guide to Entrepreneurship*, Jaico Publishing House, Mumbai, Edn 2009.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JNS511	**Journalism -VI (A) (Brand Ecology)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

The course Brand Ecology is structured to prepare students to have an understanding on how brands communicate with consumers. It gives a deeper insight to students about brand communication methods from traditional forms like guerilla marketing to modern ways that have opened up in electronic and social media. It familiarizes students in understanding effective brand communication by use of new media technologies towards new types of consumers and media users. Students will also learn to design and implement brand communication strategies, measure brand effectiveness and cater the internal and external stakeholders. The course will be a combination of inform lecture and involve group discussion activities, case analysis and exercises.

Pre-requisites: A basic idea about the concept of brands.

Pedagogy: Direct instruction, inquiry based and Collaborative method

Course Objectives:

- To introduce the students to the concepts of Branding, Brand image, Brand value and equity.
- To understand how brands are created, managed and sustained.
- To plan and implement brand marketing programs.
- To familiarize with the concepts of managing brands.

Course Outcomes:

At the conclusion of this course, students will be able to:

- Identify the brand management concepts in the real world.
- Examine how Brands function and sustain.
- Interpret the Planning, designing and implementing brand communication strategies.
- Make use of the new media technologies as a medium to communicate to stakeholders.

Course Content:

Unit-I : Introduction to Brand Management **7 Hours**

The importance of Branding. Brand versus Product; Brand image, Brand Value, Brand Equity, Brand Position, Product Life Cycle, Market Segmenting, Targeting.

Unit-II : **Brand Management** **6 Hours**

Identifying and establishing brand positioning. Positioning guidelines, Brand Associations, Internal Branding, Branding challenges and opportunities, Brand-Product Matrix.

Unit-III: **Strategic Brand Management** **7 Hours**

New product Branding and Introduction process; Brand Extensions, Advantages and disadvantages and Opportunities, How consumers evaluate Brand Extensions, Developing Brand Plans, Measuring and Interpreting Brand performance, Sustaining Brand Equity.

Unit-IV: Managing Brands **6 Hours**

Managing Brand Portfolio, Reinforcing Brands, Revitalizing brands, Maintaining Brand Consistency, Protecting Sources of Brand Equity, Acquiring New customers, Global Brand Positioning.

References:

- Arnold: (1993), The Handbook of Brand Management, Perseus Books, Massachussetts.
- Jean – Noel Kapferer: (2004). Strategic Brand Management- Creating and Sustaining Brand Equity, Kogan Page India Pvt Ltd, New Delhi
- Barnd Van Auckers. (2002). The Brand Management Check List- proven tool and techniques for creating winning brands, Kogan Page Ltd
- Ulrich and Eppinger (McGraw-Hill 1995, 2000, 2004, 2008) Product Design and Development, McGraw Hill International.

- Jones, John Philip. (1998). Whats in a Brand? Tata McGraw Hill Publishing Co Ltd
- Majumdar: Product Marketing in India-2nd edition, Prentice Hall of India Pvt ltd
- Crawford: New Products Management- 5th edition, Irwin Publication, USA.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JNS512	**Journalism -VI (B) (Fundamentals of Photography)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course will introduce students to the basic principles and techniques of b/w and color digital photography. Hands-on class demonstration and training will be ranging from the technical to the artistic, employing both straightforward and creative camera and computer procedures.
The teaching style will incorporate several formats including seminar-type presentations, hands-on practice, group discussions, critiques, and independent research.

Pre-requisites: Keen interest in photography

Pedagogy: Direct Method, Kinesthetic, ICT and Collaborative method

Course Objectives:
1. To make the students concentrate on building the fundamental skills needed to produce images for publication in today‟s media.
2. To ensure that students successfully acquire a basic knowledge of how to operate their cameras
3. To equip students with skills that allow the use of technology to the advantage as visual storytellers.
4. To understand thbe issues in Photojournalism.

Course Outcomes:
At the conclusion of this course, students will be able to:
1. Demonstrate a competent mastery of using a digital camera to produce images that are ready for publication in professional media.
2. Create compelling images that communicate the intended message with accurate captions which are publishable in professional publications.
3. Plan to gather and use audio to enhance the communicative value of a visual package.
4. Critically analyse the issues in Photojournalism.

Course Content:

Unit-I: Introduction to Photography **7 Hours**
Photography, its role & importance.

Types of camera- TLR, SLR, Polaroid, Underwater Camera & Digital Camera, mirrorless camera.
Parts & functions of camera- Aperture, Shutter speed, ISO, Focal No. & Focal Length, Depth of Field, Shallow Depth of Field.

Unit-II: Aspects of Photography **6 Hours**

Lens- Definition, Concept & Characteristics of lens
Types of lens- wide angle, normal & Tele; Special lens- zoom, fish eye & macro Lens;
Filter- definition & concept; Characteristics and types of filters.

Unit-III: Principles of Photography **7 Hours**

Lighting: Sources of light: Natural & Artificial
Elements of composition- Rule of Third, Rule of Thumb, Diagonal and S-shaped compositions, Repetition and Rhythm.

Unit-IV: Issues Related to Photojournalism **6 Hours**

Various types of photography: Portrait, Wildlife, Nature, Human Interest, Sports, Night photography; street photography
Advertising Photography: Studio and Outdoor,
Text vs. Photograph.
Qualities of a good photojournalist
Visual story telling - Photo-features, Photo – essays
Writing captions

References:

- Sharma, O.P. (2013). Practical Photography, Hind Pocket Books
- Langford, Michael, et al. (2007). Basic Photography, Focal Press
- Folts, James, Lovell, Ronald P. & Zwahlen, Jr. Fred. (2005). Handbook of Photography, Thompson Delmar Learning
- Lee Frost. (1993). Photography, Hodder & Stoughton Publisher

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JNS513	**Journalism Practical -VI (A) (Brand Ecology)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Submit a case analysis of any Indian brand of your choice
- Prepare a brand plan to brand yourself
- Prepare a brand plan for a new product to be introduced

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21JNS514	**Journalism Practical -VI (B) (Fundamentals of Photography)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Shooting exercise in artificial lights and natural light
- Photo feature on a specific topic by using self-clicked photographs with Digital Camera.
- Photographs should be of postcard size. A photo feature must comprise of 10 – 12 photographs.
- Each student shall be required to take photographs in the following categories:
    - Night Photography
    - Architecture
    - Portrait
    - Landscape
    - Fashion
- Create and design a photo album with text, captions; Individual assignment; minimum 12 prints in A4 pages in multi color, spiral binding

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AH0501	**Soft Skills Training – I**	**MC**	**0**	**0**	**2**	**2**	**4**

Course Description:
Soft skills incorporate a wide variety of personality traits, communication and people skills, social attitudes and emotional intelligence. These qualities also known as core skills are increasingly important for success in the workplace – and not just for those in leadership positions. The Course is offered in two parts – Soft skills Training – I and Soft Skills Training–II. Soft Skills Training – I is offered in the fifth semester and Soft Skills Training – II in the sixth semester. While the two components are to take as a whole, for sheer logistic reasons, the course is spread over two semesters.

Pre-requisites: Students must possess a flair for reading and basic writing skills.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom

Course Objectives:
1. To help the students in building interpersonal skills.
2. To develop skill to communicate clearly.
3. To enhance team building and time management skills.
4. To learn active listening and responding skills.

Course Outcomes:

On completion of the course, learner will be able to:

1. Make use of techniques for self-awareness and self-development.
2. Apply the conceptual understanding of communication into everyday practice.
3. Understand the importance of teamwork and group discussions skills.
4. Develop time management and stress management.

Unit I: Self Awareness & self-Development 7 Hours

a) Self-Assessment, Goal setting - Personal & career - Self-Assessment, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Personal Goal setting.

b) Career Planning, Personal success factors, Handling failure, Depression and Habit, goal setting, prioritization.

Unit II: Communication Skills 6 Hours

a) Importance of communication, types, barriers of communication, effective communication

b) Speaking Skills, Presentation skills, Group discussion- Importance of speaking effectively, body language phonetics, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

Unit III: Corporate / Business Etiquettes 7 Hours

a) Corporate grooming & dressing, Email etiquette, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business setting.

b) Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquettes

Unit IV: Interpersonal relationship 6 Hours

a) Team work, Team Communication. Team, Conflict Resolution, Team Motivation Team Problem Solving, Building the team dynamics Multicultural team activity.

b) Group Discussion- Preparation for a GD, Introduction, Purpose of a GD, Types of GD, and Strategies in a GD, Conflict management, Do‟s and Don‟ts in GD

References:

- Pushpa Lata, Sanjay Kumar. *Communication Skills*, Oxford University Press,2002.
- Krishna Mohan, Meera Banerji. *Developing Communication Skill* , McMillan India
- Ltd,1998
- Simon Sweeney. *English for Business Communication*, Cambridge University Press,2005
- E. H. McGrath. *Basic Managerial Skills* , Eastern Economy Edition, 2001.
- Mitra Buran. *Personality Development and Group Discussions* Oxford University
- Press,

- Priyadarshi Patnaik ,*Group Discussions and Interview Skills* , Foundation Books ,
- Cambridge University Press,1999.
- Khera Shiv. *You can win*, Macmillan, 2008.
- Ramesh Gopalaswamy, Ramesh Mahadevan. *The Ace of Soft Skills by Attitude, Communication and Etiquette for Success:*2006.

SIXTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21AB0601	**Political Science – VII (Major Constitutional Systems)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:
The course will introduce the idea of political system and the account of the making and working of constitutional institutions. This course responds to the curiosity about why a particular arrangement in the constitution was adopted and why not some other, how the institutions grow in the company of actual politics. That is why the Content of the course do not stop at 1950, in fact start off at 1950 and take you to some instances drawn from the political history of the last fifty years or more.

Pre-requisites: Inqusitiveness to know about the constitutions of different countries.

Pedagogy: Direct instruction, ICT and collaborative method

Course Objectives :
1. To familiarize with the House of Lords and House of Commons of United Kingdom
2. To outline House of Representatives and Senate of United States
3. To demonstrate the features of the 1982 Constitution of China
4. To elaborate Features of the Swiss Confederation Switzerland

Course Outcomes:
The students will be able to
1. Compare constitutions and systems of governance
2. Identify the strengths, weaknesses and potential of the major constitutional system
3. Analyse the features of the 1982 Constitution of China
4. Interpret the features of the Swiss Confederation Switzerland

Course Content:

Unit I- United Kingdom **10 Hours**
Features; House of Lords and House of Commons - Composition, Powers and Functions; Prime Minister and Council of Ministers - Powers and Functions; The King and The Crown – Powers and Functions; Courts –Civil and Criminal Courts; Rule of Law; Party system.

Unit II- United States **10 Hours**
Features; Congress: House of Representatives and Senate - Composition, Powers and Functions; President - Powers and Functions; Supreme Court - Composition, Jurisdiction and Judicial Review; Party system.

Unit III- China **10 Hours**

Features of the 1982 Constitution ; The National People‟s Congress - Composition, Powers and Functions; The State Councils –Powers and Functions; President and Premier - Powers and Functions; Judicial Systems-Types of Courts; Cultural Revolution; The Communist Party

Unit IV- Switzerland **9 Hours**

Features of the Swiss Confederation; Federal Legislature -National Council and Council of States - Composition, Powers and Functions; Federal Executive: Features, Powers and Functions; Federal Court - Composition and Jurisdiction; Direct Democratic Devices- Referendum, Initiative and Recall; Features of Party System.

References:

- Neil, Schlagler and Jayne Weisblatt. *World Encyclopedia of Political Systems and Parties*. Viva Books, 2013.
- Daniele, Caramani. *Comparative Politics.* Oxford University press, 2012.
- Kapur, A.C. *Select Constitutions.* S Chand, 16th Edn. 2006.
- KhannaV.K. *Comparative Study of Government and Politics.* Vikas Publishing,6th edition, 2020
- Johari,J.C. *Major Modern Political systems*. Shoban Lal & Co. 5th edition, 2012.
- Ghai,K. K *Select Political Systems*. Kalyani, 2017.
- Ghai, K. K *Modern Governments*. Kalyani, 2017.

Journals:

1. Indian Constitutional Law Review
2. The Journal of Comparative Politics
3. Presidential Studies Quaterly
4. The Comparative Constitutional Law and Administrative Law Quarterly

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21AB0602	**Economics – VII (Indian Economy – II)**	**HC**	**2**	**1**	**0**	**3**	**4**

Course Description:

This course examines sector-specific polices and their impact in shaping trends in key economic indicators in India. It highlights major policy debates and evaluates the Indian empirical evidence. Given the rapid changes taking place in the country, the reading list will have to be updated annually.

Pre-requisites: Basic knowledge regarding structure of Indian Economy.

Pedagogy: Direct method, inquiry based and collaborative method

Course Objectives:

1. To explain the characteristics of Indian Agriculture
2. To outline the structure of Indian industry
3. To demonstrate the Financial Markets and Financial system inIndia

4. To elaborate on Indian Public Finance

Course Outcomes:

After the successful completion of the course, the students will be able to-

1. Summarize the characteristics of Indian Agriculture
2. Outline the structure of Indian industy
3. Compare the Financial Markets and Financial system in India
4. Analyze the apects of Indian Public Finance

Course Content:

Unit I: Indian Agriculture **10 Hours**

Characteristics of Indian Agriculture: Causes of LowProductivity. Land Reforms: Meaning, importance. Evaluation of theProgrammes. New technology and Green Revolution and itseffects. Effects of Economic Reforms on IndianAgriculture.

Unit II- Indian Industry **10 Hours**

Structure of Indian industry -Role of Cottage, Small-scale and Large- scale Industries in India'sdevelopment. Problems and strategies of industrial development Economic Development - Problems and Solutions Industrial Labor, Industrial Finance, Industrial Policy

Unit III- Finance in India **10 Hours**

Financial Markets and Financial system inIndia; Banking: Role of Indian Commercial Banks - Credit Control Policy of Reserve Bank of India;India‟s Foreign Trade: Importance of foreign trade for IndianEconomy, India's Foreign Trade: Change in volume and direction of trade in the post liberalization period

Unit IV- Indian Public Finance **9 Hours**

Central and state budgets – revenue account and capital account - Sources of Revenue of Union and State Governments –direct and indirect tax – major heads of expenditures – plan vs. non-plan expenditures, Union-State Financial Relation – Role of Finance Commission of India.

References :

- Dutta, R. & K.P.M. Sundaram. *Indian Economy*. S. Chand & Co. 1998.
- Misra, S.K. & V.K. Puri. *Indian Economy*. Himalayas Publishing Co.2012.
- Agarwal, A.N. *Indian Economy.* Vikash Publishing Co. 1988.
- Gupta, S.B. *Monetary Planning in India.*Oxford University Press, 1998.
- Dhar, P.N. *Indian Economy*. Oxford University Press, 2001.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B21JN0601	Journalism -VII (Advertising & Corporate Communication)	HC	2	1	0	3	4

Course Description:
The course Advertising and Corporate Communication will make the students aware of the advertising environment in the 21st Century, agency and client relationships, consumer behavior, ethics, and the role of research, creative appeals, and media selection in advertising effectiveness. Within corporate communications classes, students focus on the management, strategic planning, and implementation of marketing, communication, and public relations techniques all to resolve corporate dilemmas. The course focuses on researching problems, setting objectives, identifying audiences, designing messages, choosing communication channels, and evaluating results for all types of organizations. Ethical decision making, online communication, and career opportunities are also analyzed via case studies in the field.

Pre-requisites: A preliminary exposure to the advertisements

Pedagogy: Direct method, inquiry based and collaborative method

Course Objectives:
1. To introduce the students to the Concepts and Principles of Advertising, Ad Agency Management and Brand Management
2. To take the students through the roles and scopes of PR in management, its various tools and the emerging importance of the discipline in varying areas.
3. To look at the evolution of Corporate Communication and its expanded role in organizational and marketing communication
4. To prepare the students to equip themselves to suit to the needs of various roles in advertising, PR and Corporate Communication sectors.

Course Outcomes:
At the conclusion of this course, students will be able to:
1. Outline the process of producing advertisements
2. Construct and analyze audience research, media research, and environmental scanning
3. Develop public relation strategy for the organization image and well-being
4. Formulate corporate communication strategy for crisis management, brand management, etc.

Course Content:

Unit-I : Introduction to Advertising **10 Hours**
Advertising- Definition, Nature and scope
Origin and development of advertising
Social and Economic Effects of Advertising
Ethical & Regulatory Aspects of Advertising
Ad Agency- structure and Function

Unit-II : Elements in Advertising **10 Hours**

Mediums of advertising: Print, Radio and television
New trends in advertisement; Designing advertisement: Copy writing, elements of ad copy, layout
Ethics in advertising; Types of advertising; Advertising appeals
Campaigns- Media planning strategy, media mix, Media selection, Ad budgeting.

Unit-III: Introduction to Public Relations **10 Hours**

Public Relations- Meaning &Definition, nature, scope; Functions
Origin and development of public relations in India
Differences between Public opinion, Publicity, Propaganda and PR
Role and responsibility of a public relation practitioner

Unit-IV: Aspects of Public Relations **9 Hours**

PR Tools - House Journals, Press Conferences, Press releases, Exhibitions, Advertising, Media Tour.
Corporate Communication. Corporate Social Responsibility.
Ethical issues in PR- Employee relations, shareholder relations, distributor-dealer relations, community relations, consumer relations
Lobbying and fundraising
Professional organizations in PR

References:

- Vilanilam, J.V. *Public Relations in India*. Sage Publications, 2011.
- Choonawala, S A and Sethia, K C (Edt). *Foundations of Advertising theory & Practice. Bangalore*, Himalaya Publishing, 2005.
- Wells and Morlaty, Burfert (Edt). *Advertising: Principle &Practice*. Prentice Hall, 2003.
- Chandrakandan. *Public Relations.* Authors press, 2002.
- Percy, Larry. *Strategic Advertisement Management.* Europe Prentice Hall, 2002.
- Staffer, Marla R (Edt). *Advertising Promotion and New Media.* USA ,Times Mirror Co., 2001.
- Wells, William. *Advertising, Principles and Practice*. London, Prion Books Ltd.2001.
- Ahuja &Chabra. *Public Relations*. New Delhi , Surjit Publications, 2001.
- Arens, Williams F. *Contemporary Advertisement*. USA, Times Mirror Education Group, 2000.
- Singh, Bir. (Edt). *Advertising Management*. New Delhi, Anmol Publications. 2000.
- Percy, Larry (Edt). *Strategic advertisement Management*., Suraj Publications, 2000.
- Pandey, Meena. *Foundation of Advertising Theory and Practice*. Bombay, Himalaya Publishing house, 1989.
- Scott, M Cutlip. *Effective Public relations*. Prentice Hall, 1985.

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21ABS611	**Political Science – VIII (A) (International Institutions and Foreign Policies)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
The purpose of this course is to give students a basic understanding of what is meant by the phenomenon of globalization, its sources and forms. In addition, students will obtain a familiarity with both key global actors and certain urgent problems that require solutions at global level.

Pre-requisites: An initial idea about foreign policy and some major international institutions.

Pedagogy: Direct method, inquiry based and collaborative method

Course Objectives:

1. To explain the evolution and growth, purposes, achievements, environmental and developmental issues of the United Nations
2. To outline the international organisations and issues
3. To elaborate the foreign policies of select powers
4. To demonstrate the foreign policy of India

Course Outcomes:
After the successful completion of the course, the students will be able to-

1. Examine the working of international institutions
2. Interpret the foreign policy of select countries and foreign policy of India
3. Contrast and compare the foreign policies of USA, Russia and China.
4. Make inferences about the foreign policies of India.

Course Content:

Unit I : United Nations: **7 Hours**
Evolution and Growth, Purposes, Organs, Achievements, Shortcomings; UN and Environmental and Developmental Issues; Millennium Development Goals.

Unit II: International Organisations and Issues **6 Hours**
W.T.O, European Union, ASEAN and SAARC, BRICS; New International Economic Order

Unit III: Foreign Policies of Select Powers **7 Hours**
United States, Russia and China.

Unit IV: Foreign Policy of India **6 Hours**
Evolution and Principles; West Asia; India and the United Nations; India and her Neighbours.

References:

- Bhupinder S Chimni and Siddharth Mallavarapu.*International Relations: Perspective form the Global South*, Pearson, New Delhi, 2013.
- Bimal Prasad. *The Making of India"s Foreign Policy: The Indian National Congress and World Affairs, 1885-1947*. New Delhi: Vitasta, 2013.
- Shashi Tharoor. *PaxIndica: India and the World in the 21st Century*, New Delhi: Penguin Books, 2012.
- Mohanan B. Pillai and L.Premashekhara, eds. *Foreign Policy of India: Continuity and Change*, New Delhi: New Century Publications, 2010.
- Rajiv Sikri. *Challenges and Strategy: Rethinking India"s Foreign Policy* (New Delhi: Sage, 2009.
- Raja Mohan C. *Crossing the Rubicon: The Shaping of India"s New Foreign Policy*. New Delhi: Viking, 2003.
- Fareed Zakaria. *The Post-American World*, New Delhi: Penguin Books, 2008.
- Vinay Kumar Malhotra. *International Relations*, Surjeet Publications, 2019.
- V.P. Dutt Indian Foreign Policy. National Book Trust, 2011.

Journals

1. International Affairs
2. World Politics
3. India Quarterly
4. Foreign Affairs
5. World Focus

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21ABS612	**Political Science – VIII (B) (Personal and Public Administration)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:

This course introduces the principles and practices of Public Administration and Development. During the course, the students will examine to develop and strengthen public administration.

Pre-requisites: A brief knowledge about public administration

Pedagogy: Direct instruction, ICT and collaborative method

Course Objectives:

1. To understand the citizen centric functioning of governments.
2. To realize the different types of controls by the three estates of the democracy.
3. Togain more knowledge on integrity in administration.
4. To demonstrate the emerging issues of India

Course Outcomes:

On successful completion of this course, the students will be able to:

1. Evaluate the various functions of the government.
2. Analyze the accountability factor and identify the controls by the organs of public administration.

3. Identify the need for integrity in administration.
4. Interpret the issues related to good governance.

Course Content:

Unit I: **Citizen Centric Administration:** **7 Hours**
Concept of Citizen Centric Administration: Evolution, Concept, Features and Significance.

Unit II: **Public Administration:** **6 Hours**
Accountability in Public Administration: Parliamentary, Executive and Judicial Control over Administration.

Unit III: **Administration** **7 Hours**
Integrity in Administration: Means and Agencies for checking Corruption at Union and State Level.

Unit IV: Emerging Issues **6 Hours**
Emerging Issues: Good Governance, Right to Information. Consumer Protection Act, 2005.

References:

- Basu, Durga Das, *Introduction to the Constitution of India*, Twelth Edition; Prentice Hall of India: New Delhi, 2004.
- Battacharya Mohit. *Public Administration: Structure, Process and Behaviour*, The World Press Pvt. Ltd., Calcutta, 1987.
- Bhambri C.P. *Public Administration*, Educational Publishers: Meerut, 1985.
- Chanda, Ashok. *Indian Administration,*Allen & Unwin, 1968.
- G. Allen and Unwin: London. Chaturvedi, T.N. *Secrecy in Government*, IIPA, New Delhi, 1980.
- Jabbra, Joseph G. and Dwivedi, O.P. (ed). *Public Service Accountability*, Kumarian Press Inc., Bloonfield CT, U.S.A, 1998.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS613	**Political Science Practical – VIII (A) (International Institutions and Foreign Policies)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Discussion on foreign policies of various nations
- Case studies on various wars
- Seminars on Diplomatic relations of various countries
- Movie screening
- Debate
- Group discussion

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS614	**Political Science Practical – VIII (B) (Personal and Public Administration)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Model United Nations General Assembly Session
- Video Play
- Debate
- Group Discussion
- News Paper article collage activity

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21ABS621	**Economics – VIII (A) (Financial Economics)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course aims to introduce the students to the conceptual and practical operations of the financial markets, institutions and instruments in Indian context. Provide an in-depth understanding of the operational issues of capital and money market along with their regulatory framework.

Pre-requisites: Preliminary idea of working of financial institutions in India

Pedagogy: Direct method, inquiry based and collaborative method

Course Objectives:

1. To explain the basic introduction to the Financial Economics
2. To outline the Financial Regulations and Financial Sector reforms
3. To demonstrate the Equity Market & Stock Evaluation
4. To analyze the Stock Risk & Derivative Security Market

Course Outcomes:

On completion of the course the students will be able to:

1. Evaluate the performance of financial instrument
2. Analyse the trends in the financial market
3. Select advisory and consultancy services for investors and investment banks
4. Examine the Stock Risk & Derivative Security Market

Course Content:

Unit I-Introduction to Financial Economics **7 Hours**

Role of financial intermediation; financial markets; money vs. capital markets; primary vs. secondary markets; instruments in the money market

Unit II- Financial Regulations **6 Hours**

Money market regulations and credit policy of RBI; capital market regulations of SEBI; legal norms in security trading.Financial sector reforms:Concept of capital account convertibility; lessons from other countries

Unit III- Equity Market & Stock Evaluation **7 Hours**

Private vs. Public placement- IPO and Book building process; stock quotations? stock indexes; stock market performance. Stock evaluation methods; fundamental vs. technical analysis; Efficient Market Hypothesis; Capital Asset Pricing Model; factors affecting stock prices.

Unit IV- Stock Risk & Derivative Security Market **6 Hours**

Measures of risk; Beta of the stock; Risk and return framework and investment decisions; methods of determining maximum expected loss. Financial future market; valuation of financial futures; option market; speculation with option market; hedging; arbitrage.

References:

- M Y Khan, *The Indian Financial System*, Tata-McGraw-Hill, 2011.
- Boddie, K.M., and Ryan,*Investments*, McGraw-Hill, 2003.
- Copeland,T.E. and J.F.Weston,*Financial Theory and Corporate Policy*, Addison Wesley, 1988.
- Hull,J.M, *Futures, Options and other Derivatives*, Prentice Hall, 2003.
- Ross.S.A., Randolph W Westerfield, Bradford D Jordan, and Gordon S Roberts, *Fundamentals of Corporate Finance*, McGraw-Hill, 2005.
- Robert C Radcliffe, *Investment Concepts, Analysis and Strategies*.Paerson, 1997.
- Machiraju H R, *Indian Financial System*, Vikas Publishing House, 2019.
- L.M. Bhole, *Financial Institutions and Markets*, McGraw Hill Education, 2009.
- Donald E Fisher, Roland J Jordan, *Security Analysis and Portfolio management*, Eastern Economy Edition, 1995.

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21ABS622	Economics – VIII (B) (Managerial Economics)	SC	1	1	0	2	3

Course Description:
The course aims at Defining Managerial Economics, Economics and Managerial Decision Making, The Economics of a Business, Important Economic Terms and Concepts, The Firm and its Goal, Profit Maximizing Vs Wealth Maximizing, Five Fundamental Questions in Economics, Discounting Principle, Opportunity Cost Principle, Economy and Economic System, National Income, Inflation, Monetary and Fiscal Policy.

Pre-requisites: Acute knowledge of fundamental concepts of economics

Pedagogy: Direct method, inquiry based and collaborative method

Course Objectives:
1. To explain basic concepts Nature and Scope of Managerial Economics
2. To outline the Demand, Cost and Profit Analysis
3. To demonstrate the Organizational Design, Principal-Agent Analysis & Incentive Design
4. To elaborate the Pricing Policies and Practices

Course Outcomes:
After the completion of the course, the students will be able to
1. Examine the internal and external decisions to be made by managers
2. Analyze the demand and supply conditions and assess the position of a company
3. Design competition strategies, including costing, pricing, product differentiation, and market environment according to the natures of products and the structures of the markets.
4. Analyze real-world business problems with a systematic theoretical framework.

Course Content:

Unit I: Nature and Scope of Managerial Economics 7 Hours
Nature and Scope of Managerial Economics; Basic Economic Tools in Managerial Economics: Opportunity Cost Principle, Incremental Principle, Principle of Time Perspective, Discounting Principle and Equi-marginal Principle.

Unit II: Demand, Cost and Profit Analysis 6 Hours
Demand Analysis: Demand Estimation for major consumer durables,non- durable products; Demand forecastingtechniques; CostEstimation, Cost-Volume-Profit Analysis (Break-Even Analysis) : What is C-V-P Analysis? Objectives of C-V-P Analysis, Assumptions of C-V-P Analysis Determination of Break-even point, Profit-Volume Graph, Profit-Volume Ratio, Margin of Safety, Uses and Applications of Break-Even Analysis, Limitations of C-V-P Analysis.

Unit III- Organizational Design, Principal-Agent Analysis & Incentive Design 7 Hours
The Nature of the Firm, the Breadth of the Firm, Assigning Decision-Making Responsibilities, Monitoring & Rewarding performance, Separation of Ownership & Control in the Modern Corporation.

Unit IV- Pricing Policies and Practices **6 Hours**

Factors Governing Prices, Objectives of Pricing Policy, Price Leadership, Full – Cost Pricing, Mark-up Pricing, Limit Pricing, Marginal Cost Pricing or Variable Cost Pricing, Rate of Return Pricing, Going-Rate Pricing, Peak- Load Pricing, Cyclical Pricing, Pricing over the life-cycle of a product (a) Skimming Price (b) Penetration Price (c) Pricing in Maturity; Product-line pricing, Price Discounts and Differentials, Price Forecasting

References:

- Debroy,Bibek.*Managerial Economics*,AllIndiaManagementAssociation& Global BusinessPress, 2020.
- James A. Brickley, Clifford W. Smith, Jr., and Jerold L. Zimmereman - Managerial *Economics & Organizational Architecture*, Tata McGrawHill, 1997.
- Colley, J, Doyle, J, Logan, G &Stettinius, *What Is Corporate Governance*, McGraw Hill, NewYork, 2004.
- Monks, Robert A G &Minow, *Nell - Corporate Governance*,Blackwell, 2011.
- Bhattacharya, Harasankar and Sarkhel, Jaydeb. *Managerial Economics*, Book Syndicate Pvt Ltd,Kolkata, 2002.
- Varshney,R.L and Maheshwari, K.L. *Managerial Economics* , Sultan Chand, NewDelhi, 2001.
- Keat, Paul G and Young, Philip K.Y. *Managerial Economics*,Pearson Education, NewDelhi, 2007.
- Mehta, P.L. *Managerial Economics*, Sultan Chand, NewDelhi. 2012.
- William F. Samuelson and Stephen G. Marks. *Managerial Economics*.Wiley StudentEdition, 1998.
- Thomas Clarke. *International Corporate Governance* Routledge,2007.

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21ABS631	**Journalism -VIII (A) (Political Communication)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course examines the triangle that exists between politics, the media and the public. Political communication examines the relationships that exist between these three actors that are central to contemporary democracies: to communicate with the public, political elites need to pass through the media gates, as most people get their political information through the media.

Prerequisites: Interest and exposure towards various political communication content.

Pedagogy: Direct method, inquiry based and collaborative method

Course Objectives:

1. To provide a detailed understanding and critical interrogation on areas of political communication and its applicability and relevance in a democratic set-up
2. To explore the changing face of politics and the growing significance of mediated communication in campaigns and election processes
3. To explore the significance of journalism in creating awareness of political issues of the day
4. To familiarize with the concept of political public relations

Course Outcomes:

After the successful completion of the course, the students will be able to-

1. Interpret the central theoretical issues in political communication and be able to apply them to Indian settings
2. Analyze in some detail specific political communications issue
3. Critically evaluate and adopt the present media practices in political writing
4. Apply the concepts of PR for political communication

Course Content:

Unit I-Political communication **7 hours**

Definition-scope and nature Politics, democracy and media; the theory of liberal democracy-constitutionality participation-rational choice-public opinion and public sphere; the role of media in democracy; Political journalism in India: status and dynamics

Unit II- Political Parties in India **6 hours**

Congress- BJP-CPI-CPI(M)-the emergence of regional political parties-Akali Dal- Shiv Sena-DMK-AIDMK-Telugu Desam-Samajvadi party-BSP; Elections in India-setting up elections commission in India-conduct of elections- model code of conduct- voter education-use of technology- media and elections

Unit III- Political Messages **7 hours**

Political advertising; political campaigns-news coverage of political campaigns- their impact; Agenda-setting-gate-keeping and the media-the spiral silence

Unit IV- The Art of Political Public Relations **6 hours**

Spin-doctoring; Selling politicians and creating celebrity status; Selling policies and beliefs; Film stars and political images

References:

- Brian McNair. *Introduction to political communication* (fifth edition).London: Routledge.2012.
- Eric Louw. *Media and Political Process*, New Delhi: Sage. 2010.
- Peter Gonsalves. *Clothing for Liberation*, New Delhi: Sage. 2010.
- John Corner. (eds). *Media and Restyling of Politics*, New Delhi: Sage, 2003.
- Arvind Rajgopal. (ed). *Indian Public Sphere: Readings in Media History*, New Delhi: Oxford University Press. 2009.
- Peter DeSouzaand E Sridharan. *India"s political parties*. New Delhi: Sage, 2012.
- S P Qurashi.*An undocumented wonder ; the making of Great Indian election*; New Delhi:Rupa, 2014.

- Arvind Rajgopal. *Politics After Television*. New Delhi: Oxford University Press.2005.

Course Code	Course Title	CourseType	L	T	P	C	Hrs./Wk.
B21ABS632	**Journalism - VIII (B) (Business Journalism)**	**SC**	**1**	**1**	**0**	**2**	**3**

Course Description:
This course will focus on the mechanics of how to identify and pursue business topics in journalism. The course would help students to develop the necessary skills to research on these topics and write while maintaining an appropriate business writing style.

Prerequisites: Primary exposure to the business related writings and programmes.

Pedagogy: Direct method, inquiry based and collaborative method

Course Objectives:

1. To orient the students on basic economic concepts and how to report business and economic issues
2. To train the students in the craft of writing a credible and relevant business and/or economic stories
3. To enable the students to produce succinct news stories in a variety of areas from company performance and activity, to economics, the stock market and currencies to personal finance
4. To make the students familiarize with the various issues in Business Journalism

Course Outcomes:
On successful completion of this course, the student should be able to:

1. Judge the work in a variety of newsrooms and adequately cover business news stories
2. Evaluate the basic areas in business journalism and how to write about them with intelligence and understanding
3. Explain key financial terms
4. Construct write-ups on wider economic issues, government budgets, industrial relations, how firms communicate

Course Content:

Unit I- Milestone of Indian Economy **7 hours**
Green revolution - white revolution - blue revolution - population policy - bank nationalization - information technology, bio-technology and telecommunication policies - new economic policy (NEP) – LPG–liberalization – privatization – globalization – FDI-commercial banks – non-banking financial institutions.

Unit II- Business Reporting & Editing **6 hours**
Definition and scope, principles of business reporting, qualifications of a business reporter, sources of business reporting; Types of business reporting- Financial reporting, Budget reporting, market

reporting, Chamber of commerce, CSR and business, Reserve Bank of India and basics of monetary policy – introduction to stock markets – regulatory mechanism

Unit III- Business Journalism in India **7 hours**

Economic Times, Business Line, Financial Express, Business pages and supplements of major Newspapers, leading business magazines – Business India, Business World, Business Today, Outlook Business Magazine; Business Reporting on TV Channels

Unit IV- Issues in Business Journalism **6 hours**

Tools of business communication, Video and web conferencing, Social networking sites, house journals, trade Journals, annual reports; Ethics in Business Journalism; New trends in business journalism; Consumer relations and media

References:

- E.C. Thomas. Economic and Business Journalism. New Delhi: Sterling Publishers, 1998.
- Asha, K. Business Communication, PHI Learning Private Limited, New Delhi, 2009.
- R C Bhatia. Business Communication, Ane Books Pvt Ltd, New Delhi, 2008.
- Chris Roush. *Profits and Losses - Business Journalism and its role in Soceity*, Marion Street Press, Portland, 2006.
- Peter Kjar& Tore Slaatta. Mediating Business - The Expansion of Business Journalism, Copenhagen Business School Press, Denmark. 2007.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS633	**Journalism Practical – VIII (A) (Political Communication)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Producing PSAs on Voting awareness
- Political Reporting
- Critical study of government policies
- Comparitive study of the manifestos of political parties

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21ABS634	**Journalism Practical – VIII (B) (Business Journalism)**	**SC**	**0**	**0**	**2**	**2**	**4**

Practical Components:

- Writing reports on Share Markets and Budget
- Finance
- TV Anchoring and business reporting
- Organizing video and web conference on business issues
- Bring out a two page business journal

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B21AH0601	Soft Skills Training - II	MC	0	0	2	2	4

Course Description:
Soft skills incorporate a wide variety of personality traits, communication and people skills, social attitudes and emotional intelligence. These qualities also known as core skills are increasingly important for success in the workplace – and not just for those in leadership positions. The Course is offered in two parts – Soft skills Training – I and Soft Skills Training–II. Soft Skills Training – I is offered in the fifth semester and Soft Skills Training – II in the sixth semester. While the two components are to take as a whole, for sheer logistic reasons, the course is spread over two semesters.

Pre-requisites: Students must possess a flair for reading and basic writing skills.

Pedagogy: ICT/Blended learning/Direct method/Collaborative/Flipped Classroom

Course Objectives:

- To understand and aware about importance, role and contents of soft skills through instructions, knowledge acquisition, demonstration and practice to improve his writing and documentation skills.
- To develop student‟s overall personality.
- To construct professionals with idealistic, practical and moral values.
- To access communication and problem-solving skills.

Course Outcomes:

On completion of the course, learner will be able to–

• Improved communication, interaction and presentation of ideas.
• Right attitudinal and behavioral change.
• Developed right-attitudinal and behavioral change.

UNIT-I Leadership skills **7 Hours**

a) Leadership: Leaders‟ role, responsibilities and skill required - Understanding good Leadership behaviors, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules.

b) Leaders: skills, roles, and responsibilities. Vision, Empowering and delegation, motivating others, organizational skills, team building, Organizing and conducting meetings, Coaching, Mentoring and counselling

UNIT-II Time Management and Problem-Solving skills 6 Hours

a) Managing Time, Managing Stress, Meditation. Improving personal memory, Study skills that include Rapid Reading.

b) Problem solving skills: Communicate, Brain storming, Learn from mistakes, identify various Solution, Evaluate alternatives, and Take actions

UNIT –III SWOC Analysis 7 Hours

a) SWOC analysis, Method of Execution

b) Meaning & benefits of SWOC analysis on strength, weaknesses, opportunities & challenges.

c) Personal success factors, Handling failure, Depression, and Habit, prioritization, Emotional Intelligence (EI) and Emotional, Quotients (EQ).

UNIT-IV Etiquettes 6 Hours

a) Manners during professional meetings, over lunch/dinner, basics of the table mannerism.

b) Telephonic etiquettes; tone and pitch, of the voice, voice mail

c) Importance of multi-tasking, and concerns related to multi-tasking, prioritize the work.

References:

- Mohan Krishna, Meera Banerji. *Developing Communication Skill*, - MacMillan India Ltd.2002.
- Ghosh B N. Managing *Soft Skills for Personality Development*, Mc Graw Hill 1998.
- Whitbeck Caroline. *Ethics in Engineering Practice and Research:* Cambridge University press1996.
- Dutt Kiranmai. *A Course In Communication Skills*, Cambridge University press 2002.
- Sweeney Simon. *English for Business Communication*, Cambridge University Press 2006.
- Sounderaj Francis .*Basics Of Communication In English*, MacMillan India Ltd.1999.
- Goodale Malcolm. *Professional Presentations*, Cambridge University Press, 2003.
- Das. *An Introduction to Professional English And Soft Skills*, Cambridge University Press 2002.

CAREER DEVELOPMENT AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Journalism, Political Science & Economics is not only knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Applied sciences also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. Special training is also arranged for those interested in entrepreneurial venture. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOU‟s with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students‟ exchange programs for higher learning and for conducting certification programs.

Registrar
REVA University
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