REVA UNIVERSITY

Bengaluru, India

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

B. TECH IN ELECTRICAL AND ELECTRONICS ENGINEERING

2019-23

Rukmini Educational Charitable Trust

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech (Electrical and Electronics Engineering) Program

HANDBOOK

2019-23

Rukmini Knowledge Park,
Kattigenahalli, Yelahanka, Bangalore - 560 064
Phone No: +91-080-66226622, Fax: 080-28478539

Registrar
REVA University
Bengaluru - 560 064

Rukmini Educational
Charitable Trust

www.reva.edu.in

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. S. Y. Kulkarni
Vice-Chancellor, REVA University

MESSAGE FROM THE DIRECTOR

The B.Tech in Electrical Engineering is designed keeping in view the current situation and possible future developments, both at national and global levels. This course is designed to give greater emphasis on core Electrical Engineering. There are ample number of courses providing knowledge in specialized areas of power system, electrical machines, control system, power electronics etc. facilitating students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts.

Electrical engineering is one of the earliest to start among the core subjects. The structure of the course has undergone a face-lift with the introduction of subjects from computer science and electronics engineering streams. Thus students in Electrical engineering have the flexibility to broaden their horizons in electronics or software related industries apart from the core related fields. For example, signal processing and communication theory related to mobile technology needs signal processing, robotics require control theory as well as programming skills and integrated circuits need VLSI techniques. Thus the electrical engineering stream is designed to provide you with several options to choose from for your later years. Electrical Engineering use mathematics, electronics, computing techniques and physics to solve real world problems. The Indian government plans to add another 100 GW of generation capacity during 2012-2017 and to pump 1.4 trillion to build national power transmission grid which will enhance inter-regional transmission capacity to 32 GW by 2013. Hence power sector offers lots of job opportunities for well qualified graduates.

The program is thus designed to expose students to various subjects having applications in power sectors, and IT and electronics related industries through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. 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 and sustainability. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

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 and sustainability.

If you are interested in any one of the following, then EEE is the option you should consider.

- Power sector- to design robust power system, to implement measures to keep the system secure, to maintain quality of power, to mitigate harmonics, to damp oscillations, to design protective measures using relays and circuit breaker etc
- Renewable energy sources- to harness power from renewable sources using power electronics devices, to study integration of these sources with the grid.
- Transport- electric vehicles, vehicle to grid power transactions
- High –Voltage engineering – study of breakdown mechanisms of insulators, search for new types of insulators, development of high voltage testing equipment.
- Power Electronics- design of compact and highly efficient power supplies, battery energy storage system, ultra-capacitor applications, aerospace power requirements, UPS, applications in power system using FACTS devices, interconnection of two regions via HVDC link.
- Computer – Developing algorithms to solve complex functions, developing simulation tools to simulate the entire system, applications to SMART grid.

The benefits of choosing Electrical and Electronics Engineering are:

- Flexibility to choose various fields upon graduation.
- Opportunity to work on live problems.
- Opportunity to work on environmental related technologies.
- Opportunity for programmers to develop software for electrical related projects.

I am sure the students choosing B Tech in Electrical and Electronics Engineering in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Dr. Rajashekar P. Mandi,
Director
School of Electrical and Electronics Engineering

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 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 27th 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 24 Post Graduate Degree programs, 21 Degree and PG Degree programs in various branches of studies and has 14000+ students studying in various branches of knowledge at graduate and post graduate level and 410 Scholars pursuing research leading to PhD in 21 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 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, 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 recognised 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 facilitate 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 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 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 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.

ABOUT SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

The School of Electrical Engineering is supported by well qualified and dedicated faculty members. The school of Electrical and Electronics Engineering under REVA University is established in the year 2014 with an aim of developing human resources in the area of Electrical and Electronics Engineering. The School of EEE offers under graduate (UG) course in 'Electrical and Electronics Engineering' and post graduate (PG) course in 'Advanced Power Electronics' along with Doctoral program in various research areas of Electrical Engineering. It has experienced and qualified faculty in various areas such as Power systems, Power Electronics, VLSI, Signal processing, Embedded systems, Industrial drives, Energy systems and Control systems. The School is well equipped with laboratories catering to the development of experiments and projects in the aforementioned areas. The School has state of art computing facilities and latest softwares. Along with technical skills the School conducts various extracurricular and co-curricular activities to develop overall personality of the students.

The faculties have number of publications in reputed national and international journals/conferences. The school is also involved in funded research projects. The other important features of the school are individual counseling of students for academic performance, additional coaching classes for important subjects for all the semesters, soft skill development classes, scientific and student centered teaching-learning process.

Student's welfare is given utmost priority here at School of Electrical Engineering. Advanced learning methods are adopted to make learning truly interactive. More focus is on discussion and practical applications rather than rote learning. Notes/handouts are given and critical thinking questions are asked to test understanding. Experienced, well qualified and friendly faculties always strive hard to provide best of education to students.

This is reflected in various core subjects offered within the program

Vision

"The School of Electrical and Electronics engineering aspires to develop excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards"

Mission

"To mould students to become skilled, ethical and responsible engineers for the betterment of society."

Academic Objectives

- To encourage faculty to acquire skills to implement novel teaching methods that emphasize critical thinking, self learning, group discussions and self appraisal
- To encourage students to take part in paper presentation contests and other co-curricular activities to enhance their skills.
- To provide opportunities for students to carry out mini projects to strengthen their fundamentals.
- To setup high quality research lab in the School.
- To establish industry-university alliance to set up research lab.
- To carry out applied research work and to attract consultancy works.
- To initiate students exchange program with overseas universities.
- To initiate summer industrial training program for students.

ADVISORY BOARD

Sl. No.	Name of Members
1	Dr Adrian Inoinovici, Fellow IEEE, Director, Power Electronics and Green Energy Centre, Sun-Yat-Sen University, China. adrian@hit.ac.il
2	Dr Danny Sutanto, Professor of Power Engineering, School of Electrical, Computer and Telecommunications Engineering, University of Wollongong, Australia. soetanto@uow.edu.au
3	Dr K.W. Eric Cheng, Professor, Director of Power Electronics research Centre, The Hong Kong Polytechnic University, Hong Kong. eeecheng@polyu.edu.hk
4	Mr Amit Kumar Singh, Research Scholar NUS, Singapore, Ex-Scientist B, DRDO. amit.rishu@gmail.com
5	Dr. Z. H. Sholapurwala Managing Director Zeonics Systech Defence & Aerospace Engineers Pvt. Ltd. zeonicssystech@india.com
6	K N Singh Manager-Marketing - Special Applications EFD Induction Private Limited Mob: +91 98456 05871 skn@efdgroup.net

B Tech (Electrical and Electronics Engineering) Program

Programme Overview

Electrical Engineering is a discipline of engineering that utilizes natural resources for generation, transmission and utilization of electric power. In addition, electrical engineering deals with design, analysis, prototyping, manufacturing, and maintenance of electrical generators, electric motors, transformers, transmission and distribution equipment, wiring and lighting and electrical appliances. In the recent past, the use of electronics for control of electrical systems is gaining importance and the discipline is known as Electrical and Electronic Engineering instead of pure Electrical Engineering. It is one of the oldest and broadest engineering disciplines. The present day electrical engineers focus on use of renewable sources like solar photovoltaic, wind and other non-renewable energy sources for power generation.

Electricity became a subject of scientific interest in the late 17th century. Probably the greatest discovery with respect to power engineering came from Michael Faraday who in 1831 discovered that a change in magnetic flux induces an electromotive force in a loop of wire—a principle known as electromagnetic induction that helps explain how generators and transformers work. In 1881, using two waterwheels electricity was produced in the world's first power station at Godalming in England. Thomas Edison produced continuous power using steam power in 1882. At present, electric power is being produced using Thermal, Hydro, Solar, Wind and many other non-renewable and renewable energy sources and at present world's installed capacity of electric power is 16000 GW.

India has one National Grid with an installed capacity of 344.00 GW as on 31 May 2018 out of which 69.02 GW is from renewable energy sources. India's being very active in renewable energy sector would like to achieve an installed total capacity of 175 GW by 31 March 2022, and the central Govt. has set up US$350 million fund to finance the solar projects.

Overall employment of electrical and electronics engineers is projected to grow 7 percent over the next ten years, about as fast as the average for all occupations. At present, the world power sector is facing global warming crisis due to large scale emission of carbon dioxide from thermal power plants. The future is about production of electrical power that is free from production of carbon dioxide, a greenhouse gas responsible for global warming. Thus there is a demand for electrical and electronic engineers who could play key roles in new developments with solar arrays, semiconductors, and wind power technologies. The need to upgrade the nation's power grids will also create demand for electrical engineering services.

The School of Electrical and Electronics Engineering at REVA UNIVERSITY offers B. Tech., Electrical and Electronics –an undergraduate programme to create motivated, innovative, creative and thinking graduates to fill the roles of Electrical Engineers who can conceptualize, design, analyse, develop and produce Electrical Power Systems to meet the modern-day requirements.

The B. Tech., in Electrical and Electronics Engineering curriculum developed by the faculty at the **School of Electrical and Electronics 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 power and energy sector makes this programme unique.

Programme Educational Objectives (PEOs)

The programme helps to develop critical, analytical, innovative, creative and problem-solving abilities amongst its graduates. The programme makes the graduates employable as electrical and electronic engineers in power and energy, manufacturing and service sectors. With further education and earning of higher-level degrees help the graduates to pursue a career in academics or scientific organisations as researchers.

The Programme Educational Objectives are to prepare the students to:

1. be Electrical and Electronic Engineers to work in Power and Energy, Manufacturing, and Services sectors
2. act as administrators in public, private and government organisations with further training and education
3. pursue for higher degrees to work in colleges, universities as professors or as scientists in research establishments or business administrators
4. be conversant with environmental, legal, cultural, social, ethical, public safety issues
5. work as a member of a team as well as lead a team
6. communicate effectively across team members and work under constraints
7. set his/her own enterprise with further training
8. adopt lifelong learning philosophy for continuous improvement

Programme Outcomes (POs)

After undergoing this programme, a student will be able to:

1. explain the principles involved in working and designing of modern electrical systems
2. design new ways to use electrical power to develop or improve products
3. perform detailed calculations to develop manufacturing, construction, and installation standards and specifications
4. choose appropriate materials, processes and direct the manufacture, installation, and testing of electrical equipment to ensure that products meet specifications and codes

5. investigate complaints from customers or the public, evaluate problems, and recommend solutions
6. work with project managers on production efforts to ensure that projects are completed satisfactorily, on time, and within budget
7. use modern tools and techniques for design and development of electrical and electronic systems
8. conform to cultural, environmental, sustainability and ethical issues
9. communicate across teams verbally, visually and by writing
10. choose appropriate online programmes for further learning, participate in seminars and conferences

Program Specific outcome

1. Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronics circuits, control systems, electrical machines, power system, renewable energy system and electric vehicle.
2. Apply the appropriate, state of the art techniques and modern engineering hardware and software tools in electrical and electronics engineering to engage in life-long learning andto successfully adapt in multi-disciplinary environments.
3. Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively.

REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Engineering Graduate Degree Programs, 2020

(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 the **"REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Engineering Graduate Degree Programs, 2020".**

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

2. The Programs:

The following programs and all Engineering Graduate Degree programs to be instituted and introduced in REVA University in coming years shall follow these regulations.

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. Definitions:

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

(i) L= Lecture (ii) T= Tutorial (iii) 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 that equip students to acquire the much required skill component.

4. Courses of study and Credits

4.1. The study of various subjects in B Tech degree program are grouped under various courses. Each of these course carries credits which are based on the number of hours of teaching and learning.

4.1.1. In terms of credits, every **one hour session of L amounts to 1 credit per Semester.**
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** over a period of one Semester of 16 weeks for teaching-learning process.

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

4.1.3. A course shall have either or all the four components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

4.1.4. ***The concerned BoS will assign Credit Pattern for every course based on the requirement. However, generally, courses can be assigned with 1-4 Credits depending on the size of the course.***

4.1.5. Different C**ourses of Study** are labeled and defined as follows:

a. Core Course:

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz – (i) Foundation Course, (ii) Hard Core Course, and (iii) Soft Core Course.

b. Foundation Course (FC):

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

c. Hard Core Course (HC):

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.

d. Soft Core Course (SC):

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.

e. Open Elective Course:

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 O**pen Elective Course.**

f. Project Work / Dissertation:

Project work / Dissertation denoted as "D" is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Minor project normally will be assigned with 4-6 credits and a major project/dissertation will be assigned with 8-16 credits. **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.**

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	Passed 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry Biotechnology / Biology / 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 students, 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.
4	B Sc (Honors) in Computer Science (with specialization in Cloud and Big Data)	4 Years (8Semesters)	Pass in PUC /10+2 examination with Physics, Mathematics as compulsory subject along with at least one of the Chemistry,/ Bio-Technology / 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. Scheme, Duration and Medium of Instructions:

6.1. B Tech degree program is of 8 semesters - 4 years duration. 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.

6.2. The medium of instruction shall be English.

7. Credits and Credit Distribution

7.1. A candidate has to earn 192 credits for successful completion of B Tech degree with the distribution of credits for different courses as given in **Table-1** below:

	Credits

Course Type	For B Tech Degree (8 Semesters)
Foundation Core Course	A minimum of 08
Hard Core Course	A minimum of 136, but not exceeding 156
Soft Core Course	A minimum of 24 but not exceeding 44
Open Elective	A minimum of 04
Total	**192**

7.2. 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
1	English for Technical Communication	4
2	Environmental Studies	2
3	Indian Constitution and Professional Ethics	2

7.3. A candidate can enrol for a maximum of 32 credits and a minimum of 20 credits per Semester. However he / she may not successfully earn a maximum of 32 credits per semester. This maximum of 32 credits does not include the credits of courses carried forward by a candidate.

7.4. 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 192 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.

8. Assessment

b) Each course is assessed for a total weight of 100%. Out of the total 100% weight; 50% weight is for Continuous Internal Assessment (CIA or IA) and the remaining 50% for the Semester End Examination (SEE). This applicable for theory, laboratory, workshop, studio and any such courses

c) Out of 50% weight earmarked for Internal Assessment (IA)- 10% is for Quizzes, 15% for test-1, 15% for test-2 and 10% for Assignments and this is applicable for theory based courses

d) The quizzes, tests and assignments are conducted as per the semester academic calendar provided by the University

The details as given in the table

Component	Description	Conduction	Weight Percentage
C1	Quizzess	At the end of each class	10
C2	Test-1: IA1	6th week from the starting date of semester	15
	Test-2: IA2	12th week from the starting date of semester	15
C3	1 Assignment	7th week	05
	2 Assignment	13 th week	05
C4	SEE including practical	between 17th Week-20th Week	50
Results to be Announced			By the end of 21st Week

Note: IA or CIA includes C1,C2, C3

Each test must be conducted for a duration of 60 minutes, setting the test question paper for a maximum of 30 marks. The final examination must be conducted for a duration of 3 hours and the question paper must be set for a maximum of 100 marks.

e) Students are required to complete courses like communication skills, technical English, Professional ethics and Indian Constitution, Environmental Sciences, technical skills, placement related courses, Open electives and any such value addition or specialized courses through online platforms like SWAYAM/NPTEL/Any other reputed online education aggregator. Students are required to choose the courses on the advice of their course coordinator/Director and required to submit the course completion certificate along with percentage of marks/grade scored in the assessment conducted by the online education aggregator. If the online education aggregator has issued a certificate along with the grade or marks scored to students, such courses will be considered for SGPA calculations, in case the aggregator has issued only a certificate and not marks scored, then such courses will be graded through an examination by concerned School, in case, if grading is not possible, students will be given a pass grade and award the credit and the credits will not be considered for SGPA calculations. The Online/MOOCs courses will not have continuous internal assessment component

f) Such of those students who would like to discontinue with the open elective course that they have already registered for earning required credits can do so, however, they need to complete the required credits by choosing an alternative open elective course.

9. Setting question paper and evaluation of answer scripts.

i. ***For SEE, three sets of question papers shall be set for each theory course out of which two sets will be by the internal examiners and one set will be by an external examiner. In subsequent years by carrying forward the unused question papers, an overall three sets of question papers should be managed and depending on the consumption of question ppaers either internal or external examiner be called for setting the question paper to maintain an overall tally of 3 papers with the conditioned mentioned earlier. The internal examiner who sets the question paper should have been course tutor***

ii. ***The Chairman of BoE shall get the question papers set by internal and external examiners.***

iii. ***The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation. It is the responsibility of the BoE to see that all questions contained in the question paper are within the prescribed syllabus of the concerned course.***

iv. ***There shall be single valuation for all theory papers by internal examiners. However, there shall be moderation by the external examiner who has the subject background. In case no external examiner with subject background is available, a senior faculty member within the discipline shall be appointed as moderator.***

v. ***The SEE examination for Practical work / Field work / Project work/Internship will be conducted jointly by internal and external examiners as detailed below: However, the BoE on its discretion can also permit two internal examiners.***

vi. ***If a course is fully of (L=0):T:(P=0) type or a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.***

[

10. Evaluation of Practical's and Minor Project / Major Project / Dissertation

10.3.1. A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

10.3.2. In case a course is fully of P type (L=0:T=0:P=4), the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a) ***Continuous Internal assessment (CIA) = 50 marks***
b) ***Semester end practical examination (SEE) = 50 marks***

The 25 marks for continuous assessment shall further be allocated as under (IA or CIA):

i	*Conduction of regular practical throughout the semester*	*20 marks*
ii	*Maintenance of lab records*	*10 marks*
iii	*Laboratory test and viva*	*20 marks*
	Total	*50 marks*

The 50 marks meant for Semester End Examination, shall be allocated as under:

i	*Conduction 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*

10.3.3. The SEE for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

10.3.4. In case a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.

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

10.4. 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:

1	*First project presentation describing the problem definition*	*Should be done a semester before the project semester*	*Weightage: 0%*

2	***Project Progress presentation-1***	***7th week from the start date of project semester***	***Weightage: 25%***
3	***Project progress presentation-2***	***14th Week from the start date of project semester***	***Weightage -25%***
4	***Final project Viva and Project Report Submission***	***17th -20th Week of project Semester***	***Weightage: 30% for Project Report Weightage : 20% for Final Viva Voce***

11. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1,C2 and C3 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of 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 taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

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

- The Registrar (Evaluation) - 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.

12. Eligibility to Appear for Semester End Examination

12.1. 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 course(s), as provided in the succeeding sections, shall be eligible to appear for SEE examination.

12.2. Requirements to Pass a Course

Students are required to score a total minimum of 40% (Continuous Internal assessment and SEE) in each course offered by the University/ Department for a pass (other than online courses) with a minimum of 13 (25% of 50) marks in final examination

12.3. Requirements to Pass the Semester

To pass the semester, a candidate has to secure minimum of 40% marks in each subject / course of the study prescribed in that semester.

13. Provision to Carry Forward the Failed Subjects / Courses:

13.1. The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of immediate succeeding year of study. And he / she shall appear for C4 examination of failed courses of previous semesters concurrently with odd semester end examinations (C4) and / or even semester end examinations (C4) of current year of study. However, he / she shall have to clear all courses of both odd and even semesters of preceding year to register for next succeeding semester.

Examples:-

b. 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 C4 examination of 1 failed Course of First Semester concurrently with Third Semester C4 examination. Likewise, he / she is eligible to appear for C4 examination of 3 failed Courses of Second Semester concurrently with Fourth Semester C4 examination. However, he / she has to clear all the failed Courses of First and Second Semesters before seeking admission to Fifth Semester.

c. Student "B" has failed in 2 Courses in Third 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 C4 examination of 2 failed Courses of Third Semester concurrently with Fifth Semester C4 examination. Likewise he / she is eligible to appear for C4 examination of 2 failed Courses of Fourth Semester concurrently with Sixth Semester C4 examination. However, he / she is not eligible to seek admission to Seventh Semester unless he / she passes in all the failed courses of Third and Fourth Semesters.

d. Student "C" has failed in 4 Courses in Fifth Semester but has cleared all the courses in Sixth Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "C" is eligible to seek admission for Seventh Semester and appear for C4 examination of 4 failed Courses of Fifth Semester concurrently with Seventh Semester C4 examination. However, he / she has to pass all the failed courses of Fifth Semester along with Seventh and Eighth Semesters courses to earn B Tech Degree.

e. Student "D" passed in 1to 4 semesters, but failed in 3 courses of 5th Semester and in 1 course of 6th Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "D" is also eligible to seek admission for 7th Semester and appear for C4 examination of 3 failed courses of 5th Semester concurrently with 7th Semester C4 examination and one failed course of 6th Semester concurrently with 8th Semester C4 examination. However, he / she has to pass all the 3 failed courses of Fifth Semester and 1 course Sixth Semester along with Seventh and Eighth

Semester courses to earn B Tech Degree.

13.1. Re-Registration and Re-Admission:

a) 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 end semester examination (C4) and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b) 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.

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 (C4) examination and such student shall seek re-admission as provided in 7.8.4.

14.4. Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C4, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C4 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

15. Absence during Mid Semester Examination:

In case a student has been absent from a mid semester (C1,C2 and C3) examination 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 Head of the School, for make-up examination. The Head 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 test for such candidate(s) well in advance before the C4 examination of that respective semester. Under no circumstances C1,C2& C3 test shall be held after C4 examination.

16. Grade Card and Grade Point

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

16.2. **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 Registrar (Evaluation).

16.3. **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
91-100	10	v*10	O
81-90	9	v*9	A+
71- 80	8	v*8	A
61-70	7	v*7	B+
55-60	6	v*6	B
50- 54	5.5	v*5.5	C
40-49	5	v*5	P
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail

Here, P is the percentage of marks (P=[C1+C2+C3+C4] 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.

16.3.1. 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 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	4	A+	9	4X9=36
Course 2	4	A	8	4X8=32
Course 3	3	B+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	P	5	3X5=15

Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			188

Thus, **SGPA = 188 ÷ 24 = 7.83**

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	P	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**

16.4. Cumulative Grade Point Average (CGPA):

16.4.1. Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (192) 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.

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

Illustration:
CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	6.83	24 x 6.83 = 163.92
2	24	7.29	24 x 7.29 = 174.96
3	24	8.11	24 x 8.11 = 192.64
4	26	7.40	26 x 7.40 = 192.4
5	26	8.29	26 x 8.29 = 215.54
6	24	8.58	24 x 8.58 = 205.92
7	24	9.12	24 x 9.12 = 218.88
8	24	9.25	24 x 9.25 =222
Cumulative	196		1588.26

Thus, **CGPA** = $\frac{24x6.83+24x7.29+24x8.11+26x7.40+26x8.29+24x8.58+24x9.12+24x9.25}{196}$ = 8.10

16.4.2. *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 8.10 x 10=81.0

16.5. 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	P	Pass	Satisfactory

.

Overall percentage=10*CGPA

17. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script 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 Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for C3 component.

b. The answer scripts 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.

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

B. Tech (Electrical and Electronics Engineering) Program

Scheme of Instructions

I Semester Physics Cycle

SL	Course Code	Title of the Course	HC/SC/OE	Credit Pattern & Credit Value				CH	Teaching School/Dept.
				L	T	P	C		
1	B19EE1010	Engineering Mathematics – I	HC	4	0	0	4	4	Mathematics
2	B19EE1020	Engineering Physics	HC	2	1	0	3	4	Physics
3	B19EE1030	Engineering Mechanics	HC	2	1	0	3	4	Civil
4	B19EE1040	Elements of Mechanical Engineering	HC	2	1	0	3	4	Mechanical
5	B19EE1050	Basic Electrical & Electronics Engineering	HC	2	1	0	3	4	EEE/ECE
6	B19EE1060	Indian Constitution and Professional Ethics	FC	2	0	0	2	2	Law
7	B19EE1070	Technical English I	FC	0	0	2	2	4	A & H
8	B19EE1080	Physics Lab	HC	0	0	2	2	2	Physics
9	B19EE1090	Basic Electrical Engineering lab	HC	0	0	2	2	2	EEE
TOTAL CREDITS				**14**	**4**	**6**	**24**	**30**	

II Semester Chemistry Cycle

SL	Course Code	Title of the Course	HC/ SC/ OE	Credit Pattern & Credit Value				CH	Teaching School/Dept.
				L	T	P	C		
1	B19EE2010	Engineering Mathematics – II	HC	4	0	0	**4**	4	Mathematics
2	B19EE2020	Engineering Chemistry	HC	2	1	0	**3**	4	Chemistry
3	B19EE2030	Electrical Power Generation & Transmission	HC	2	1	0	**3**	4	EEE
4	B19EE2040	Computer Concepts & C++ Programming	HC	2	1	0	**3**	4	CSE
5	B19EE2050	Electrical &Electronic Instrumentation and Measurements	HC	2	1	0	**3**	4	EEE
6	B19EE2060	Environmental Sciences	FC	2	0	0	**2**	2	Chemistry
7	B19EE2070	Technical English II	FC	0	0	2	**2**	4	A & H
8	B19EE2080	Chemistry Laboratory	HC	0	0	2	**2**	2	EEE
9	B19EE2090	Computer programming (C++) Lab	HC	0	0	2	**2**	2	CSE
FINAL CREDITS				**14**	**4**	**6**	**24**	**30**	

III Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	L	T	P	C	CH	Teaching School/Dept.
1	B19EE3010	Engineering Mathematics–III	HC	4	0	0	**4**	4	Mathematics
2	B19EE3020	Electrical Circuit Theory	HC	3	1	0	**4**	5	EEE
3	B19EE3030	Electrical Machines I	HC	4	0	0	**4**	4	EEE
4	B19EE3040	Analog Electronic & Digital Electronic Circuit Design	HC	2	1	0	**3**	4	EEE
5	B19EE3050	Theory and Applications of Linear Integrated Circuits	HC	2	0	1	**3**	4	EEE
6	B19EE3060	Microcontrollers and Applications	HC	2	1	0	**3**	4	EEE
7	B19EE3070	Analog Electronic & Digital Circuit Design Laboratory	HC	0	0	2	**2**	3	EEE
8	B19EE3080	Electrical and Electronics Measurements Lab.	HC	0	0	2	**2**	3	EEE
9	B19EE3090	Soft Skill	RULO	1	0	1	**2**	2	T & P / EEE
		Mandatory total Credits		**18**	**3**	**6**	**27**	**33**	
10	B19EE3X10	Skill Development	RULO	0	0	2	**2**	2	EEE / Industry
		FINAL CREDITS		**18**	**3**	**8**	**29**	**35**	

IV Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B19EE4010	Engineering Mathematics–IV	HC	4	0	0	**4**	4	Mathematics
2	B19EE4020	Electromagnetic Theory	HC	4	0	0	**4**	4	EEE
3	B19EE4030	Electrical Machines II	HC	4	0	0	**4**	4	EEE
4	B19EE4040	Power Electronics	HC	4	0	0	**4**	4	EEE
5	B19EE4051	Electrical Power Utilization	SC	4	0	0	**4**	4	EEE
	B19EE4052	Electric drives							EEE
	B19EE4053	Digital system design using VHDL							ECE/EEE
	B19EE4054	Data Base Management System							C&IT
6	B19EE4061	Management & Entrepreneurship	SC	4	0	0	**4**	4	EEE
	B19EE4062	Electricity Act							EEE
	B19EE4063	Programmable Logic Circuits							ECE/EEE
	B19EE4064	Data Structures using C++							C&IT
7	B19EE4070	Electrical Machines-I Laboratory	HC	0	0	2	**2**	2	EEE
8	B19EE4080	Microcontroller Laboratory	HC	0	0	2	**2**	2	EEE
9	B19EE4090	Soft Skill	SS	0	0	2	**2**	2	T & P / EEE
		Mandatory total Credits		**24**	**0**	**6**	**30**	**32**	
10	B19EE4X20	Yoga/Sports/Performing Arts/Meditation	SC	0	0	2	2	4	EEE
		TOTAL CREDITS		**24**	**0**	**8**	**32**	**34**	

V Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B19EE5010	Power System Analysis	HC	3	0	0	**3**	4	EEE
2	B19EE5020	Switch Gear & Protection	HC	3	0	0	**3**	4	EEE
3	B19EE5030	High Voltage Engineering	HC	3	0	0	**3**	4	EEE
4	B19EE5041	Design of Electrical Machines	SC	3	0	0	**3**	4	EEE
	B19EE5042	Advanced Power Electronics							EEE
	B19EE5043	VLSI Circuits and Design							ECE/EEE
	B19EE5044	Python Programming							C&IT
5	B19EE5051	Operation & Research	SC	3	0	0	**3**	4	EEE
	B19EE5052	Electric & Hybrid Vehicles							EEE
	B19EE5053	Digital Image Processing							ECE/EEE
	B19EE5054	Web Programming							C&IT
6	B19EE5061	Electrical Power Quality	SC	3	0	0	**3**	4	EEE
	B19EE5062	Electrical Regulations & Safety							EEE
	B19EE5063	Embedded Systems & IOT							ECE/EEE
	B19EE5064	Artificial Intelligence							C&IT
7	B19EE5070	Power Electronics Laboratory	HC	0	0	2	**2**	3	EEE
8	B19EE5080	Electrical Machines Laboratory II	HC	0	0	2	**2**	3	EEE
9	B19EE5090	Soft Skill	RULO	0	0	2	**2**	2	T & P / EEE
		Mandatory total Credits		**18**	**0**	**6**	**24**	**32**	
10	B19EE5X10	Skill Development	RULO	1	0	1	**2**	2	EEE / Industry
		TOTAL CREDITS		**19**	**0**	**7**	**26**	**34**	

VI Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B19EE6010	Computer Aided Power System Analysis and Stability	HC	3	0	0	3	4	EEE
2	B19EE6020	Computer Aided Electrical Drawing	HC	3	0	1	4	5	EEE
3	B19EE6030	Control Engineering	HC	3	0	0	3	4	EEE
4	B19EE6041	Testing and Commissioning of Electrical Equipment	SC	3	0	0	3	4	EEE
	B19EE6042	Energy storage systems							EEE
	B19EE6043	Electrical Engineering Materials							EEE
	B19EE6044	MEMS Technology							ECE/EEE
	B19EE6045	Big Data Analytics & Cloud Computing							C&IT
5	B19EE6051	Power System Planning and Reliability	SC	3	0	0	3	4	EEE
	B19EE6052	Modeling and Simulation of Electrical Machines							EEE
	B19EE6053	Industrial Instrumentation and Automation							ECE
	B19EE6054	Fundamentals of Robotics							ECE/EEE
	B19EE6055	JAVA Programming							C&IT
6	B19EE6061	Smart grid	SC	3	0	0	3	4	EEE
	B19EE6062	Reactive power management							EEE
	B19EE6063	Advanced Electrical Machines							EEE

	B19EE6064	Analog & Digital Communication Systems							EEE
	B19EE6065	Cryptography & Network Security							C&IT
7	B19EE6070	Power System Simulation Laboratory	HC	0	0	2	2	3	EEE
8	B19EE6080	Control System Laboratory	HC	0	0	2	2	3	EEE
9	B19EE6090	Soft Skill	SS	2	0	0	2	2	T & P / EEE
10	B19EE6X10	SWYAM/MOOC Course	RULO	2	0	0	2	2	EEE
11	B19EE6X20	Skill Development	RULO	1	0	1	2	2	EEE / Industry
		FINAL CREDITS		**23**	**0**	**5**	**28**	**34**	

VII Semester

SL No.	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B19EE7010	Project Phase -1	HC	0	1	1	2	2	EEE
2	B19EE7020	Signal Processing	HC	2	1	0	3	4	EEE
	B19EE7031	Advanced Control Engineering							EEE
	B19EE7032	Electrical Energy Conservation							EEE
3	B19EE7033	Computer Control of Electric drives	SC	2	1	0	3	3	EEE
	B19EE7034	Advanced microcontrollers							ECE
	B19EE7035	Software Testing							C&IT
	B19EE7041	HVDC							EEE
	B19EE7042	Operation and Control of Power Systems							EEE
4	B19EE7043	Non Conventional Energy Sources	SC	2	1	0	3	3	EEE
	B19EE7044	Optic Fiber Communications							ECE/EEE
	B19EE7045	Computer Networks Concepts and Protocols							C&IT
5	B19EE7050	Open Elective subject offered by other school	OE	3	0	0	3	3	OTHER SCHOOLS
6	B19EE7060	Signal Processing Laboratory	HC	0	0	2	2	3	EEE
7	B19EE7070	High Voltage Engineering Lab	HC	0	0	2	2	3	EEE
		TOTAL CREDITS		**13**	**0**	**5**	**18**	**22**	

VIII Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B19EE8010	Project work	HC	0	1	7	8	16	EEE/Industry
2	B19EE8021	Trouble Shooting of Common Electrical Equipments							EEE
	B19EE8022	Introduction to Flexible AC transmission system	SC	2	1	0	3	4	EEE
	B19EE8023	Wireless Communication							ECE/EEE
	B19EE8024	Machine Learning Techniques							C&IT
TOTAL CREDITS				**3**	**1**	**7**	**11**	**20**	

Credit Distribution

SL. No	Semester	Mandatory Credits								Additional credits				Grand Total
		FC	HC	SC	OE	SS	Project	Internship	Total	Yoga/Sports / Performing Arts/Meditation	Swayam / Mooc	Skill	Total	
1	I	4	19	-	-	-	-	-	23	-	-	-	0	23
2	II	4	19	-	-	-	-	-	23	-	-	-	0	24
3	III	-	23	-	-	2	-	-	25	-	-	2	2	27
4	IV	-	16	6	-	2	-	-	24	2	3	-	5	29
5	V	-	13	9	-	2	-	-	24	-	-	2	2	26
6	VI	-	13	9	-	2	-	-	24	-	3	2	5	29
7	VII	-	8	6	3	-	2	-	19	-	-	2	2	21
8	VIII	-	-	3	-	-	8	3	14	-	-	-	-	14
Total		**8**	**111**	**33**	**3**	**8**	**10**	**3**	**176**	**2**	**6**	**8**	**16**	**192**

B. Tech (Electrical and Electronics Engineering) Program

Detailed Syllabus

I Semester Physics Cycle

Sub Code: B19EE1010	Engineering Mathematics – I	L	T	P	C	CH
Duration : 14 Wks		4	0	0	4	4
Prerequisites:	Knowledge of basics limits, continuity, differentiation, integration, matrices, determinants, and geometry.					
Course Objectives	1. To understand the concepts of differential calculus and its applications. 2. To familiarize with partial differentiation and its applications in various fields. 3. To familiarize with linear algebraic applications and different reduction techniques. 4. To familiarize with concept of vector calculus and its applications.					
Course Outcomes	After the completion of the course the student will be able to: 1. Apply the knowledge of differential calculus in the field of wave theory and communication systems. 2. Apply the knowledge of Differential Equations in the field of Engineering. 3. Analyze and implement the concepts of Divergence and curl of vectors which play significant roles in finding the Area and volume of the closed surfaces. 4. Apply the knowledge of convergence of the series, which help in forming JPEG image compression. 5. To determine whether a sequence or a series is convergent or divergent and evaluate the limit of a convergent sequence or the sum of a convergent series.					

Course Contents

UNIT-I Differential Calculus-I **[12 Hrs]**

Successive differentiation-nth derivatives (proof and problems), Leibnitz Theorem (without proof) and problems, Taylor's series and Maclaurins series expansion for one variable (only problems), Polar curves- Angle between the radius vector and tangent, angle between two curves, Pedal equation for polar curves.

UNIT-II Differential Calculus-II **[12 Hrs]**

Derivative of arc length – concept and formulae without proof, Radius of curvature-Cartesian, parametric, polar and pedal forms (without proof) problems.
Indeterminate forms and solution using L'Hospital's rule.

Partial Differentiation: Partial derivatives-Euler's theorem-problems, Total derivative and chain rule,

UNIT-III Differential Calculus-III and Differential equations [12 Hrs]

Jacobians-definition and problems (only find *J*and*reference- one example on $JJ^{/}$=1). Taylor's Expansion of function of two variables (only problems- up to 2nd order).Maxima and Minima for a function of two variables (simple problems).Differential equations: Exact equation and reducible to exact form (1. Close to expression M or N and find IF, 2. y f(x) dx+x g(y) dy)

UNIT-IV Integral Calculus [12 Hrs]

Reduction formulae for the integrals of $\sin^n x$,$\cos^n x$,$\sin^m x\cos^n x$ and evaluation of these integrals with standard limits(direct result) - Problems. Multiple Integrals – Double integrals, change of order of integration (simple problems), and triple integrals. Beta and Gamma functions (definition),(properties and duplication formula -without proof), Relation between beta and gamma function and simple problems.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Edition, 2013.
2. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

Sub Code: B19EE1020	**Engineering Physics**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	3	4
Prerequisites:	Basic knowledge of physics of pre-university					
Course Objectives	1. Learn fundamentals of Physics and make their basic foundation in engineering education very strong. 2. Expose the students of different branches of engineering with a theoretical and practical knowledge of Engineering Physics 3. To prepare students and make them ready to take up higher semester core engineering subjects by giving them strong physics background. 4. Gain knowledge of different physical systems, basic quantum mechanics and materials science etc.					

Course Outcomes	On completion of this course the student will be able to: 1. Describe wave mechanics and apply knowledge to solve quantum mechanics problems. (Knowledge and Application) 2. Explain CO_2 and semiconductor laser and holography. (Knowledge) 3. Classify optical fibers and derive expression for NA, number of Modes and attenuation. (Analysis) 4. Derive expression for conductivity in metals, and to solve numerical related to electricity in metals. (Application) 5. Summarize superconductivity with applications. (Comprehension) 6. Explain ultrasonic and Non-destructive testing. (Comprehension) 7. Derive expression for internal field in one- dimensional solid dielectrics. (Application) 8. Distinguish synthesis of nanomaterials. (Analysis)

Course Contents

Unit I **[12 hrs]**

Wave mechanics: Introduction to Wave mechanics, Wave particle dualism. De-Broglie hypothesis, Matter waves and their characteristic properties. 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. Relation between group velocity and particle velocity Expression for de-Broglie wavelength using the concept of group velocity. Heisenberg's uncertainty principle, its significance and its applications (non existence of electron inside the nucleus).

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.

Unit II **[12 hrs]**

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 (CO2) laser, semiconductor laser, Holography, Applications of holography.

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

Unit III **[12 hrs]**

Electrical properties of conductors: Drude-Lorentz classical free electron theory and definitions, Expression for electrical conductivity in metals, Effect of impurity and temperature on electrical resistivity in metals, Failures of classical free electron theory; Quantum free electron theory, Fermi-Dirac statistics, Fermi level, Fermi energy and Fermi factor, Density of states, effective mass, Merits of Quantum free electron theory.

Superconductors : Temperature dependence of resistivity in superconductors, variation of critical field with temperature Properties of superconductors, Types of superconductors, BCS theory, Applications of super conductors, Maglev vehicle and superconducting magnet.

Unit IV **[12 hrs]**

Ultrasonic: Production of ultrasonic by piezoelectric method; Measurement of velocity of ultrasonic in solid and liquid, Non-destructive testing of materials using ultrasonic.

Dielectric materials: Electric dipole and dipole moment, electric polarization (P), dielectric susceptibility (χ,), dielectric constant, relation between χ and P, Electrical polarization mechanisms, Expression for internal field in one- dimensional solid dielectrics, Ferro, Piezo and Pyro electric materials – their properties and applications,

Nanomaterials: Introduction to nanoscience, nanomaterials and their applications, Synthesis of nano materials using bottom-up method, top-down methods, Carbon Nanotubes: properties and applications.

Text books:

1. Engineering Physics, R.K Gaur and S.L. Gupta, Dhanpat Rai Publications(P) Ltd, New Delhi.
2. A text book of Engineering Physics, M.N. Avadhanulu and P.G. Kshirsagar, S. Chand and Company, New Delhi.
3. Solid State Physics, S.O. Pillai, New Age International publishers, New Delhi.

Reference Books:

1. Laser Fundamentals, William T. Silfvast, 2nd Edition, Cambridge University press, New York (2004).
2. Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, New York (2001).
3. Introduction to Solid State Physics,7th Edition Charls Kittel, Wiley, Delhi (2007).
4. Arthur Beiser, Concepts of modern Physics, Tata McGraw Hill publications, New Delhi.

Sub Code: B19EE1030	**Engineering Mechanics**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	3	4
Course Objectives	1. To enable students to establish a broad concept of engineering mechanics. 2. To enable students to understand the basics of composition of coplanar forces. 3. To enable students to understand the concept of equilibrium of coplanar forces. 4. To provide an overview of centroid of plane area & Moment of Inertia of plane area.					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the moment of force and couples and equivalent force-couple system. 2. Solve numerical problems on composition of coplanar concurrent and non-concurrent force system. 3. Solve numerical problems on equilibrium of coplanar force system. 4. Locate the centroid and moment of inertia of different geometry.					

Course Contents

UNIT-I: Engineering mechanics **[12Hrs]**

Introduction to basic civil engineering – Scope of civil engineering, role of civil engineer, branches of civil engineering (brief discussion 2 to 3 hours only)

Engineering mechanics

Basic idealizations - Particle, Continuum and Rigid body; Force and its characteristics, types of forces, Classification of force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of forces; Newton's laws of motion, Introduction to SI units, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system, Resolution of forces, composition of forces; Numerical problems on moment of forces and couples and equivalent force - couple system.

UNIT-II Analysis of Force Systems [12Hrs]

Composition of forces - Definition of Resultant, Composition of coplanar -concurrent force system, Parallelogram Law of forces, Principle of resolved parts, Numerical problems on composition of coplanar concurrent force systems, Composition of coplanar - non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar concurrent force systems.

UNIT-III Equilibrium of coplanar forces [12 Hrs]

Definition of static equilibrium and Equilibrant, Conditions of static equilibrium for different coplanar force systems, Lami's theorem, Concept of Free Body Diagram, Numerical problems on equilibrium of coplanar – concurrent and non concurrent force systems.

UNIT-IV Centroid and Moment of Inertia [12 Hrs]

Centroid: Introduction to the concept, Centroid of plane figures, Locating the centroid of triangle, semicircle, quadrant of a circle and sector of a circle using method of integration, Centroid of composite sections; Numerical problems.

Moment of Inertia: Introduction to the concept, Rectangular and polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem, Moment of Inertia of rectangle, circle, semi-circle, quarter circle and triangle from method of integration, Moment of inertia of composite areas, Numerical problems.

Text Books:

1. M. N. Shesha Prakash and Ganesh B. Mogaveer, **"Elements of Civil Engineering and Engineering Mechanics"**, PHI Learning, 3rd Revised edition
2. A. Nelson, **"Engineering Mechanics-Statics and Dynamics"**, Tata McGraw Hill Education Private Ltd, New Delhi, 2009
3. S. S. Bhavikatti, **"Elements of Civil Engineering"**, New Age International Publisher, New Delhi, 3rd edition 2009.

Reference Books:

1. S. Timoshenko, D.H. Young and J.V. Rao, **"Engineering Mechanics"**, TATA McGraw-Hill Book Company, New Delhi
2. Beer FP and Johnston ER, **"Mechanics for Engineers- Dynamics and Statics"**, 3rd SI Metric edition, Tata McGraw Hill. - 2008
3. Shames IH, **"Engineering Mechanics–Statics & Dynamics"**, PHI–2009.

<table>
<tr><td>Sub Code: B19EE1040</td><td rowspan="2">Elements of Mechanical Engineering</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>2</td><td>1</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To develop the basic knowledge of working of various turbines and IC engines
2. To incorporate the concepts of metal joining process, their applications and power transmission modes like belt drives, gears and gear trains
3. To understand various machines and its operations in Mechanical Engineering.
4. To give exposure to basic power transmission elements.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">The student will be able to
1. Apply the concepts of working principle of turbines in the power plants and also of the IC engines in the basic design of the vehicles
2. Have a basic knowledge of metal joining and power transmission and apply them in some basic requirements
3. Gain the knowledge about machine tools, cutting operations; belt and gear drive power transmission.
.</td></tr>
</table>

Course Contents

UNIT - 1 **[10 Hrs]**

Properties of steam: Introduction**,** Steam formation, Types of steam. Steam properties, Specific Volume, Enthalpy and Internal energy, Steam table and simple numerical problems

Turbines- Introduction to turbines & prime movers, Classification of turbines, Working principle and applications of impulse and reaction steam turbines, gas turbines (open and closed cycle type) and pelton turbine.

UNIT - 2 **[10 Hrs]**

Internal Combustion Engines : Introduction, Classification of IC engines, parts of IC engine, Working principle of four stroke (petrol and diesel), differences between petrol & diesel engines,

Refrigeration and Air conditioning- Introduction, Principle of refrigeration, parts of refrigerator, Principle and working of vapor compression refrigeration and vapor absorption refrigeration. Refrigerants, Properties of refrigerants, Refrigerating effect, Ton of Refrigeration, COP, Relative COP, UNIT - of Refrigeration, Principle and applications of Room air conditioners.

UNIT - 3 **[10Hrs]**

Machine Tools: Introduction, working principle and classification of lathe, drilling and milling machines, major parts of a lathe and their functions, lathe operations on lathe - Specifications of lathe, parts of radial drilling machines, drilling operations, parts of horizontal milling machines, milling operations.

Metal joining processes- Introduction, classification of metal joining processes, method of welding (Electric Arc welding), soldering and brazing and their differences.

UNIT - 4: **[10 Hrs]**

Power Transmission- Introduction to transmission systems and its classification, types of Belt Drives**,** Definitions of Velocity ratio, angle of contact Creep and slip, Idler pulley, stepped pulley, fast & loose pulley..

Gears - Definitions, Spur gear terminology, Types and applications of Gears.

Gear Trains – Simple and compound gear trains, Simple problems on gear trains

Text Books:

1. A Text Book of Elements of Mechanical Engineering – K.R. Gopalkrishna, Subhash Publishers, Bangalore.
2. Elements of Mechanical Engineering – Kestoor Praveen and M.R. Ramesh 2nd Edition 2011, Suggi Publications

Reference Books:

1. The Elements of Workshop Technology - Vol I & II, SKH Chowdhary, AKH Chowdhary, Nirjhar Roy, 11th edition 2001, Media Promotors and Publishers, Mumbai.

Sub Code: B19EE1050	**Basic Electrical & Electronics Engineering**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 WEEKS		2	1	0	3	4
Course Objectives	1. To make students understand the basics of representation of electrical quantities and relationship among them 2. To make the students understand single phase and three phase AC circuits 3. To make students understand the semiconductors and working of diodes 4. To make students understand the transistor and its operating principle					
Course Outcomes	On completion of this course the student will be able to: 1. Apply fundamental laws to electrical circuits for analysis 2. Differentiate between single and three phase systems 3. Use diodes for various signal processing operations 4. Understand the principle of operation of a transistor					

Course Contents

UNIT-I: **[10Hrs]**

Introduction to D.C. Circuits: Ohm's Law and Kirchhoff's Laws, analysis of series, parallel and series- parallel circuits excited by independent voltage sources. Power and Energy. Illustrative Examples.

A.C. Fundamentals: Generation of sinusoidal voltage, frequency of generated voltage, definition and numerical values of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities.

UNIT-II: **[10 Hrs]**

A.C.Circuits: Analysis with phasor diagram, of circuits with R,L, C, R-L, RC, R-L-C for series and parallel configurations. Real power, reactive power, apparent power and power factor. Illustrative Examples. Three-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of three phase power using two wattmeter method. Illustrative Examples.

UNIT-III: [10Hrs]

Semiconductor Diodes: P-N junction diode, V-I characteristics, Diode parameters, Concept of load line, Temperature effects and Small signal equivalent circuit. Numerical examples. Operation and V-I Characteristic of Zener diode. Voltage Regulator using a Zener diode. Numerical Examples.

Diode Applications: Half wave rectifier, Full wave rectifier and Bridge rectifier: analysis with and without Capacitor Filter. Numerical examples. Wave shaping circuits: Clipper and Clamper circuits, Numerical examples.

UNIT-IV: [10Hrs]

Bipolar Junction Transistor: Introduction, BJT operation, BJT voltages and currents, input and output characteristics, DC load line and Operating Point. Introduction to BJT biasing, Introduction to BJT Configuration: Common Base, Common Emitter and Common Collector Characteristics, Numerical examples, Introduction to BJT applications as amplifiers & oscillators

Text Books:

1. Kulshreshtha C, "Basic Electrical Engineering" Tata McGraw Hill, 2nd Edition, 2011
2. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 8TH Edition, 2008.
3. Kothari D.P., L.J. Nagrath "Basic Electrical Engineering", Tata McGraw Hill, 2009
4. D.P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill Education (India) Private Limited, 2014.

Reference Books

1. Robert L. Boylestad and Louis Nashelsky, "Introduction to Electricity, Electronics and Electromagnetics" Prentice Hall, 5th edition, 2001

Hughes, "Electrical Technology", International Students 9th Edition, Pearson, 2005

<table>
<tr><td>Sub Code: B19EE1060</td><td rowspan="2">Indian Constitution and Professional Ethics</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>2</td><td>0</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Prerequisites</td><td colspan="6">Pre-university level Constitution of India and Professional Ethics</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To provide and gain knowledge on Constitution of India.
2. To know and understand about the Fundamental Rights, Duties and other Rights which is been given by our law.
2. To prepare students in the practicality of Constitution perspective and make them face the world as a bonafide citizen.
3. To attain knowledge about ethics and also know about professional ethics.
4. Explore ethical standards followed by different companies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the student will be able to:</td></tr>
</table>

	1. Strengthen the knowledge on Indian constitutional law and make the practical implementation of it. 2. Understand the fundamental rights and human rights. 3. Get the knowledge to explain the duties and more importantly practise it in a right way. 4. Adopt the habit of raising their voice against a non constitutionality of any laws and upon any legal discrimination as we have session of debates on Constitutional validity. 5. Get exposed about professional ethics and know about etiquettes about it. 6. Know about ethical standards of different companies which will increase their professional ability.

Course Contents

UNIT-I Constitution of India **[8 Hrs]**
Definition, Making 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 Union and State: **[8 Hrs]**
Organs of the Government; Legislature, Executive and Judiciary. Union and State Executives: President, Vice President, Prime Minister, Supreme Court, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission. Right to Information (RTI), Consumer and Consumer Protection.

UNIT III Ethics: **[8 Hrs]**
Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

UNIT IV Engineering Ethics: **[8 Hrs]**
Definition Scope and needs, Ethics in Consumer Protection, 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.

Reference books:

1. M V Pylee, An introduction to Constitution of India.
2. M Govindarajan, S Natarajan, V S Senthil Kumar, Engineering.

Sub Code: B19EE1070	**Technical English I**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		0	0	2	2	4
Course Objectives	1. To develop basic communication skills in English in the learners. 2. To prioritize listening and reading skills among learners. 3. To simplify writing skills needed for academic as well as workplace context.					

	4. To examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom.
Course Outcomes	On completion of the course, learners will be able to: 1. Interpret audio files and comprehend different spoken discourses/ excerpts in different accents (Listening Skills). 2. Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies (Speaking Skills). 3. Make use of reading different genres of texts adopting various reading strategies (Reading Skills). 4. Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic (Writing Skills)..

Course Outline:
This is a 2 credit course for first semester consisting of 4 hours of teaching learning per week, inclusive of direct classroom teaching and practice in language lab.

COURSE CONTENT/ SYLLABUS

Unit	Description	Evaluation Pattern	Topics	Teaching Hours
I	**Functional English**	**25 Marks** Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Grammar:** Prepositions; Modal Auxiliaries **Listening:** Listening to audio (verbal & sounds) **Speaking:** Debating Skills **Reading:** Skimming a reading passage; Scanning for specific information **Writing:** Email communication	**12 Hours**
II	**Interpersonal Skills**	**25 Marks** Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Grammar:** Tenses; Wh-questions **Listening& Speaking:** Listening and responding to video lectures / talks **Reading:** Reading Comprehension; Critical Reading; Finding key information in a given text **Writing:** Process descriptions (general/specific); Recommendations	**12 Hours**
III	**Multitasking Skills**	**25 Marks** Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Grammar:** Conditional Sentences **Listening & Speaking:** Listening to specific task; focused audio tracks and responding **Reading:** Reading and interpreting visual material **Writing:** Channel conversion (flowchart into process); Types of paragraph (cause and effect / compare and contrast / narrative / analytical); Note Taking/ Note Making	**12 Hours**
IV	**Communication Skills**	**25 Marks** Fill in the blanks/	**Grammar:** Direct and indirect speech **Listening & Speaking:** Watching videos	**12 Hours**

		MCQs/ Comprehension Tasks/ Descriptive Questions	/ documentaries and responding to questions based on them; Role plays **Reading:** Making inference from the reading passage; predicting the content of a reading passage **Writing:** Interpreting visual materials (line graphs, pie charts etc.); Different types of Essay Writing	

References:

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.

Sub Code: B19EE1080	**Physics Lab**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		**0**	**0**	**2**	**2**	**2**
Course Objectives	1. This course is to make the students to gain practical knowledge to co-relate with the theoretical studies. 2. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipment. 3. Design of circuits using new technology and latest components and to develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.					
Course Outcomes	At the end of the course a students are able to 1. Develop skills to apply practical knowledge of Physics in real time solution. 2. To understand and verify different laws of Physics using some simple experiments. 3. To design simple electrical circuits and analyze obtained result. 4. Ability to apply knowledge of basic electronics in making simple circuits using diodes and transistors and analyze the responses. 5. Ability to use the knowledge acquired for different applications and projects.					

Course Contents

List of Experiments

1. To find the velocity of ultrasonic waves in non-conducting medium by piezo-electric method.
2. To find the band gap of intrinsic semi-conductor using four probe method.

3. To find the value of Planck's constant by using Light emitting diode.
4. To study the V-I characteristics of a zener diode.
5. To find the laser parameters–wavelength and divergence of laser light by Diffraction method.
6. To study the photo diode characteristics and hence to verify the inverse square law.
7. To determine capacitance and dielectric constant of a capacitor by charging and discharging a capacitor.
8. Study of attenuation and propagation characteristics of optical fibre cable.
9. Determination of Particle size using laser.
10. Determination of electrical resistivity of Germanium crystal and study the variation of resistivity with temperature by four probe method
11. To Study the characteristics of a given npn transistor and to determine current gain and amplification factor in CE mode.
12. To determine the resonance frequency and bandwidth of a given LCR circuit (Series and Parallel).

Recommended Learning Resources (Text books):

1. Thiruvadigal, J. D., Ponnusamy, S. Sudha.D. and Krishnamohan M., “Physics for Technologists”, Vibrant Publication, Chennai, 2013
2. R.K. Shukla and Anchal Srivastava, “Practical Physics”, 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Recommended Learning Resources (Reference books):

1. G.L. Souires, “Practical Physics:”, 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, “An Advanced Course in Practical Physics”, 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
4. Practical Physics – S.L. Gupta & V. Kumar (Pragati Prakashan).
5. Advanced Practical Physics Vol. I & II – Chauhan & Singh (Pragati Prakashan).

<table>
<tr><td>Sub Code: B19EE1090</td><td rowspan="2">Basic Electrical Engineering Lab</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>0</td><td>0</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To establish a broad concept of various types of electrical apparatus, tools and instrumentation.
2. To provide hands on experience with electrical apparatus and electrical safety norms.
3. To train students to read and understand schematics so as to make electrical connection for different appliances.
4. To train students in collecting and interpreting experimental data.
5. To enhance written skills of students.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Use appropriate electrical tools for electrical connections and repair of electrical equipments.
2. Recognize various symbols in a schematic and make connection as per the schematic
3. Systematically follow various safety procedures.
4. Make use of various measuring instruments to collect experimental data
5. Relate experimental results with theoretical analysis.</td></tr>
</table>

	6. Demonstrate the ability to critically evaluate the performance of electrical appliances.

List of experiments

1. Electrical tool introduction
    (i) Electrical Tools
    (ii)Measuring Instruments like Ammeter, Voltmeter, Multimeter, Clamp on meter, Energy meter, Watt meter (UPF & LPF)
2. Home electrical wiring demonstration:
    (i) Tube light wiring
    (ii) Fan wiring
    (iii) Two way control
    (iv) Socket to switch connection.
    (v) Electrical wiring materials & accessories
3. Study of mutual induction effect.
4. Electrical safety training:
    (i) Electrical activities to avoid shocks and importance of earthing
    (ii) Working of MCB, ELCB
    (iii) Role of fuse.
5. Home electrical wiring demonstration: short circuit, series and parallel operation of load.
6. Single phase transformer: polarity tests.
7. Diode rectifier applications: Half wave and Full wave rectifier, ripple factor calculations.
8. Sensor experiments: Pressure sensor, light sensor and temperature sensor.
9. DC Machine demonstration.

II Semester Chemistry Cycle

<table>
<tr><td>Sub Code: B19EE2010</td><td rowspan="2">Engineering Mathematics – II</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>4</td><td>0</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Prerequisites</td><td colspan="6">Knowledge of basics of derivatives, vectors, complex numbers</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand the concepts of Linear algebra and its applications in various fields of engineering and Technology.
2. To understand the concepts of Integral calculus and its applications.
3. To familiarize with partial differential equations, and its applications to standard problems like Heat, Wave and Laplace.
4. To impart the Knowledge of Laplace transforms and its applications in the field of engineering.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After the completion of the course the student will be able to:
1. Apply the knowledge of Linear Algebra in Image processing and digital signal processing.
2. Apply the knowledge of Integral calculus to perform integration and other operations for certain types of functions and carry out the computation fluently.
3. Apply the knowledge of partial differential equations in the field of signals and systems, control systems, magnetic wave theory.
4. Apply the knowledge of Laplace transformation from the time domain to the frequency domain, which transforms differential equations into algebraic equations and convolution into multiplication.</td></tr>
</table>

Course Contents

UNIT-I Linear Algebra **[12 hr]**

Rank of matrix, Echelon form, (*reference-Normal form: one example), Solution of a system of linear equations by Gauss elimination (*reference-Gauss –Jordan methods: one example), Gauss seidel iterative method, Rayleigh Power method to find the largest eigen value and corresponding eigen vector.LU decomposition, Linear and Inverse transformation.
Diagosnalisation of a matrix, Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT-II Differential Equations: **[12 hr]**

Linear Differential Equations: Definitions, Complete solution, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral.
Method of variation of parameters (simple problems), Cauchy's and Legendre's linear differential equations.
Partial differential equation: Formation of Partial differential equations, Solution of Lagranges linear PDE.

UNIT-III Vector Calculus **[12 hr]**

Curves in space, tangents and normal, Velocity and acceleration related problems, scalar and vector point functions-Gradient, Divergence and curl, directional derivatives. Solenoidal and irrotational vector fields. Vector identities-div($\emptyset A$), curl($\emptyset A$), curl(grad$\emptyset$), div(curl A).
Line integral-Circulation-work, Surface integral: Green's Theorem, Stokes Theorem.
Volume integral: Divergence theorem. (All theorems without proof, no verification, only evaluation).

UNIT-IV Laplace Transforms: **[12 hr]**

Definition, Transforms of elementary functions, properties of Laplace Transforms (without proof) problems. Transforms of periodic functions (only statement and problems), Unit step functions and unit impulse functions.

Inverse Laplace transforms- Problems, convolution theorem (without proof) - verification and problems, solution of linear differential equation using Laplace transforms.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Edition, 2013.
2. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

Sub Code: B19EE2020	**Engineering Chemistry**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	**3**	4
Course Objectives	1. To understand basic principles of Cell and Batteries, types of electrodes and their importance in some applications 2. To study and understand the materials required for designing and proper functioning of batteries. 3. To understand the Corrosion and metal finishing that explains why and how materials corrode and their prevention. 4. To understand the properties of various polymeric materials and their commercial significance.					
Course Outcomes	After the completion of the course the student will be able to: 1. Know the importance of electrodes and materials in designing a battery 2. Apply the knowledge of Corrosion phenomenon and precautions to be taken in the selection of materials in controlling corrosion 3. Fabricate of PCB which is an important component for electronic industries 4. Apply the knowledge of Properties of polymers and their applications in various field, also that of composite materials in sports, aviation etc.,					

Course Contents

UNIT – I **[10 Hrs]**

ATOMIC, MOLECULAR STRUCTURE AND PERIODIC PROPERTIES

Atomic, molecular structure: Classical to quantum mechanical transition, Origin of quantum mechanics, dual nature of light and matter, concept of quantization – Max Planck, Einstein, de Broglie, Schrödinger wave equation, particle in a box (1D)-Energy solutions, quantum states of electron, wave functions in bonding in molecules (H_2).

Periodic properties: Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro negativity.

Self Study: Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. polarizability, oxidation states, coordination numbers and geometries.

UNIT – II **[11 Hrs]**

ENERGY STORAGE AND CONVERSION DEVICES: Battery: Introduction to electrochemistry, Basic concepts of Cells and Battery, Battery characteristics –primary (Leclanche Cell), secondary (Lead-Acid), Lithium batteries, Advantage of use of Li as electrode material (Lithium & Lithium ion), super capacitors.

Fuel cells-Difference between battery and fuel cell, types of fuel cells- construction working, applications, advantages & limitations of Solid oxide fuel cells and phosphoric acid fuel cell.

Photovoltaic cell- Introduction to Electromagnetic spectrum and light-mater interaction, Production of Si from chemical method, Single crystal Si semiconductor by Crystal pulling technique (Czocharlski method),and zone refining.

Band structure of solids and the role of doping on band structures. Properties of Silicon, advantages, P-N Junction diode, antireflective coatings. Construction, working of photovoltaic cells, applications, advantages and disadvantages.

Self-study – Reserve battery, Alkaline Fuel Cell, Design of solar cells-Modules, Panels and arrays.

Unit-III

SCIENCE OF CORROSION AND ITS CONTROL: **[10 Hrs]**

Corrosion: Electrochemical theory of corrosion, galvanic series, types of Corrosion-differential metal corrosion, differential aeration corrosion (Pitting & water line), boiler corrosion, and grain boundary corrosion, 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 on the nature of electrodeposit- electroplating process, Electroplating of gold. Electro less plating of copper and nickel, PCB manufacture by Electro less plating of copper.

Self Study: Energy concept (Pourbiax) under different pH conditions. Corrosion Studies on Al, Fe with pourbiax diagram. Inorganic Coatings-Anodizing & Phospating, and Corrosion Inhibitors

UNIT IV: CHEMISTRY OF ENGINEERING MATERIALS **[11 Hrs]**

Semiconducting and Super Conducting materials-Principle and some example.

Magnetic materials – Principle and types of magnetic materials-applications of magnetic materials in storage devices.

Polymers-Introduction, Glass transition temperature (t_g) - definition, significance. Structure-Property relationship – tensile strength, plastic, deformation, chemical resistivity, crystallinity and elasticity.

Adhesives: properties, synthesis and applications of epoxy resin.

Polymer composites: (carbon fiber and Kevlar, synthesis, advantages, applications).

Conducting polymers: Mechanism, synthesis and applications of polyacetyline, synthesis of polyaniline and its applications. Liquid Crystals: Introduction, classification and applications.

Nanomaterials-Introduction – Definition, classification based on dimensionality (0D, 1D and 2D), quantum confinement (electron confinement). Size dependent properties- surface area, magnetic properties (GMR phenomenon), thermal properties (melting point), optical properties and electrical properties. Properties and applications of Carbon Nanomaterials (Fullerenes, Carbon nanotubes, Graphenes).

Self Study: Types of polymerization - Addition and Condensation (two example; Polyester and Teflon), Biocompatible materials, Nano electronics, nano medicines and energy conversion devices, Applications of nano materials- in hyperthermia (magnetic property), in corrosion control (Nano-coatings).

Recommended Learning Resources (Text books):

1. A Text book of Engineering Chemistry by SS Dhara, S. Chand Publications, New Delhi.
2. Text Book of Engineering Chemistry, Shashichawla, Dhanapathirai Publications.
3. P.W. Atkins, Physical Chemistry, Oxford university press.
4. Engineering Chemistry: Fundamentals and Applications -Shikha Agarwal-Cambridge University Press.

Recommended Learning Resources (Reference books):

1. Polymer chemistry by V.R. Gowrikar, N.N. Vishwanathan and J. Sreedhar by Wiley eastern ltd.
2. Corrosion engineering by Mars G. Fontana, Tata McGraw-Hill Publishing Pvt. Ltd, Third edition.
3. Introduction to Nanotechnology by Charles P. Poole Jr., Frank J. Owens Wiley India Publishers.
4. Composite materials – Science and Engineering by Krishan K Chawla, Springer International edition, Second edition.

<table>
<tr><td>Sub Code: B19EE2030</td><td rowspan="2">Electrical Power Generation & Transmission</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration :14 Wks</td><td>2</td><td>1</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To provide an awareness of various conventional and non-conventional energy resources and also of principle of their conversion process into electrical energy.
2. To provide fundamental concepts about Power plant structure, operation and control.
3. To equip the students with basic concepts of Substations, Grounding systems and economic aspects.
4. To provide basis for further study of both conventional and Non-Conventional Energy resources</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Compare the relative merits and limitations of available Energy Sources.
2. Interpret the values of various factors influencing the economic aspects of a power system
3. Recognize the role of Substation and the fundamentals of Grounding systems.
4. Estimate the energy cost from the given tariff.</td></tr>
</table>

COURSE CONTENTS

UNIT- I

Sources of Electrical power and Power Generation-1 **[12hrs]**

Introduction: Fuel cell, tidal, geo-thermal, bio-generation, Concept of co-generation (waste heat recovery), Concept of distributed generation.(only block diagram approach)

Hydro Power Generation: Classification of hydro-electric plants, Mini-generation, micro-generation. General arrangement and operation. Selection of site, hydroelectric plant power station structure, control and Layout. Merits and demerits.

Wind Power Station: General arrangement and operation. Selection of site. Power station structure, control and Layout. Merits and demerits

UNIT- II

Power Generation-2 **[12hrs]**

Solar Power Generation: General arrangement and operation. Selection of site. Power station structure, control and Layout, solar photovoltaic-grid integration. Merits and demerits

Nuclear Power Station: Pros and cons of nuclear power generation. Selection of site, cost, components of reactors, Types of reactors, Description of fuel sources. Safety of nuclear power reactor. Merits and demerits

Thermal Power Generation: General arrangement and operation, coal, gas and diesel, Selection of site. Power station structure, control and Layout. Merits and demerits, Concepts of Solar-thermal power generation.

UNIT- III **[12hrs]**

Typical Transmission & Distribution System: Introduction, general layout of power system scheme, Standard voltages for transmission, advantages of high voltage transmission, Transmission line efficiency & line drop, Feeders, Distributors & Service mains.

Overhead Transmission Lines:

Types of supporting structures & line conductors used**,** Sag calculation- Supports at same level, Supports at different levels, Effect of wind & ice on sag calculation, Stringing chart, Sag template & Vibrators, Problems on sag calculation.

UNIT- IV **[9hrs]**

Insulators: Introduction, Materials used, Types**,** Potential Distribution over suspension insulators, String efficiency, Methods to improve string efficiency, Grading rings, Arching horns, Testing of Insulators, Problems.

Corona: Introduction, Phenomenon of corona, Disruptive & Critical voltages, Power loss due corona, Advantages & Disadvantages of corona, Numerical.

Text Books Power Generation and Transmission:

1. A. Chakrabarti, M. L. Soni, and P.V. Gupta**,"Power System Engineering",** Dhanpat Rai and Co., New Delhi.
2. S. N. Singh, PHI, **"Electric Power Generation, Transmission and Distribution",** 2nd Edition, 2009.
3. M. V. Deshpande**, "Elements of Electrical Power System Design"**, PHI, 2010
4. E.L-Wakil, "Power Plant Technology", International Edition 1984, McGraw Hill book company, Singapore.
5. G.D. Rai, "**Non-Conventional Energy Sources"**, Published in 2011 by Khanna Publishers. Soni Gupta & Bhatanagar, "A Course of Electrical Power", Dhanpat Rai & Sons (New Delhi)
6. C. L. Wadhwa "Electrical Power Systems", Wiley Eastern.

Reference Books:

1. Ajith Krishnan R, Jinshah B S, “**Magneto hydrodynamic Power Generation”** International Journal of Scientific and Research Publications, Volume 3, Issue 6, June 2013
2. Allen J wood & Wollenberg, “**Power generation, operation and control**”, John Wiley and Sons, 2nd Edition.
3. W D Stevenson, ‘**Elements of Power System Analysis**’, TMH, 4th edition
4. S M Singh, ‘**Electric Power Generation Transmission & Distribution**, PHI, 2nd Edition, 2009
5. Dr S L Uppal, ‘**Electrical Power’**, Khanna Publications

Sub Code: B19EE2040	**Computer Concepts and C++ Programming**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	**3**	4
Course Objectives	The objective of this course is to: 1. Introduce the fundamentals of computer System. 2. Provide an understanding of problem solving with computers. 3. Introduce C programming language. 4. Provide a familiarization with the UNIX programming environment. 5. Provide problem solving skills through executing C programs.					
Course Outcomes	1. A student who successfully completes the course will have the ability to: Explain the different UNIX commands, their usage and their syntax and fundamentals of computer. 2. Apply the C programming concepts like operators, data types, functions, arrays, strings and pointers to solve the given problem Apply the C language knowledge to solve variety of problems.					

Course Contents

Unit-I: **[12Hrs]**

Introduction to Computer System: Definition of Computer, Structure of a computer, Basics of computer hardware and computer software, Types and Functions of operating system. Algorithms and Flow charts.

Getting started with UNIX: Introduction to Unix Operating System, Introduction to Basic Command Format, Using the VI text editor, Basic UNIX commands, Types of computer networks.

Unit-II: **[12Hrs]**

Fundamentals of Problem Solving and Introduction to C Language: Introduction to C Language –Structure of a C Program, Data type, Variables, Constants, Input / Output, Tips and common programming errors.

Operators: Types of Operators, Expressions and Statements.

Branching constructs: Conditional Branching- if, if-else, else-if ladder, nested if, switch. Unconditional- goto, break, continue, and return.

Unit-III: **[12Hr]**

Looping constructs: for, while, do- while, nested-for, Advantages of Looping.

Arrays: One Dimensional and Two Dimensional Arrays; Searching Techniques, Sorting-bubble sort;

Unit-IV: **[12Hrs]**

Functions: Inbuilt and User defined Functions, Parameter Passing mechanisms, Call by value and Call by address;

Strings: String Operations with and without using inbuilt String Functions;

Pointers: Introduction to Pointers.

Recommended Learning Resources:

1. Herbert Schildt, C: The Complete Reference, 4th Edition, Tata McGraw Hill
2. Kernighan, Dennis Ritchie, The C Programming Language, 2nd edition, Englewood Cliffs, NJ: Prentice Hall, 1988
3. Sumitabha Das, UNIX Concepts and Applications, 4th Edition; Tata McGraw Hill
4. B.S. Anami, S.A. Angadi and S. S. Manvi, Computer Concepts and C Programming: A Holistic Approach, PHI, Second Edition, 2008.
5. E. Balaguruswamy, Programming in ANSI C, 4th Edition, Tata McGraw Hill, 2008.

Sub Code: B19EE2050	Electrical & Electronic Instrumentation and Measurements	L	T	P	C	CH
Duration :14 Wks		2	1	0	3	4
Course Objectives	1. To provide basic knowledge about measuring units of physical parameters. 2. To describe the principles of various measuring instruments 3. To equip students with basic concepts of different Electrical transducers used in process control. 4. To enable students with necessary mathematical skills for instruments' measurement range					
Course Outcomes	On completion of this course the students will be able to: 1. Adopt various measurement units associated with physical parameters 2. Select different instruments for measuring different electrical parameters in industries 3. Describe the operation of measuring instruments 4. Identify and use different type of transducers for various applications in industries.					

Course Content

Unit 1: Measurement of Resistance, Inductance and Capacitance **[11 hrs]**

Wheat stone's bridge, sensitivity, limitations. Kelvin's double bridge. Earth resistance, measurement by fall of potential method and by using Insulation tester (Megger).Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance &capacitance bridge, Schering bridge. Problems

Unit 2: Transducers &Display Devices, Signal Generators **[10 hrs]**

Classification and selection of transducers. Strain gauges. Problems. LVDT, Measurement of temperature and pressure. Photo-conductive and photo-voltaic cells. , X-Y recorders. LCD and LED technology. Signal generators and function generators.

Unit 3: Electronic Instruments **[11 hrs]**

Introduction. True RMS voltmeter. Electronic millimeters. Digital voltmeters. Q meter. Problems. Dual trace oscilloscope — front panel details of a typical dual trace oscilloscope. Method of measuring voltage, phase, frequency and period. Use of Lissajous patterns. Working of a digital storage oscilloscope. Brief note on current probes, clamp on meters/ tong testers

Unit 4: Measurement of Power and Energy **[10 hrs]**
Dynamometer wattmeter. UPF and LPF wattmeters, Measurement of real and reactive power in three-phase circuits. Problems. Construction and operation of electro-dynamometer single-phase power factor meter. Weston frequency meter and phase sequence indicator. Smart metering system – AMR, e.g.: prepaid meter, ToD meter etc.

Text Books :

1. A. K. Sawhney, Dhanpatrai and Sons, "Electrical and Electronic Measurements and Instrumentation", New Delhi.
2. Cooper D. and A.D. Heifrick, "Modern Electronic Instrumentation and Measuring Techniques", PHI, 2009 Edition.

Reference Books:

1. David A. Bell , "Electronic Instrumentation and Measurement", oxford Publication ,2nd Edition, 2009.
2. Golding and Widdies, Pitman ,"Electrical Measurements and Measuring Instruments".

<table>
<tr><td>Sub Code: B19EE2060</td><td rowspan="2">Environmental Sciences</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Course Objectives</td><td colspan="6">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. Acquiring knowledge about environmental pollution-sources, effects and control measures of environmental pollution, degradation and waste management.
6. Explore the ways for protecting the environment.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Analyze the environmental conditions and protect it.
2. Will observe the role of individual, government and NGO in environmental protection.
3. Get motivate to find new renewable energy resources with high efficiency through active research.
4. Analyze the ecological imbalances and protect it.
5. List the causes of environmental pollution & find ways to overcome them.</td></tr>
</table>

Course Contents

UNIT-1 **[6Hrs]**

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, Initiative and Role of Non-government organizations in India and world

Self study: Need for public awareness on the environment, Gaia Hypothesis

UNIT-2 **[7 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 natural disasters.

UNIT-3 **[7Hrs]**

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, Deforestation-Causes, effects and controlling measures)

Self study: Hydrology & modern methods adopted for mining activities.

UNIT-4 **[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 and nitrogen 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.MS Reddy & Chandrashekar, REVA University.
2. "Environmental Studies", by R.J. Ranjit Daniels and Jagadish Krishnaswamy, (2009), Wiley India Private Ltd., New Delhi.
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. Rajagopalan R. 2005, "Environmental Studies – from Crisis to cure", Oxford University Press
6. Environmental Science by Arvind walia, Kalyani Publications, 2009.
7. Environmental Studies by Anilkumar Dey and Arnab Kumar Dey.

Sub Code: B19EE2070	**Technical English II**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		**0**	**0**	**2**	**2**	**4**
Course Objectives	1. To utilize the ability of using language skills effectively in real-life scenarios. 2. To develop the learners' competence in employability skills. 3. To improve the habit of writing, leading to effective and efficient communication. 4. To prioritize specially on the development of technical reading and speaking skills among the learners.					
Course Outcomes	On completion of the course, learners will be able to: 1. Organize their opinions clearly and meaningfully. 2. Demonstrate the ability to speak appropriately in social and professional contexts. 3. Build inferences from the text. 4. Take part in interviews confidently. 5. Develop accurate writing skills using different components of academic writing.					

Course Contents

Course Outline:

This is a 2 credit course for second semester consisting of 4 hours of teaching learning per week, inclusive of direct classroom teaching and practice in language lab.

Unit	**Description**	**Evaluation Pattern**	**Topics**	**Teaching Hours**
I	**Language**	**25 Marks**	**Grammar:** Active and passive voice	**12 Hours**

	Acquisition	Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Listening & Speaking:** Listening to informal conversations and interacting **Reading:** Developing analytical skills; Deductive and inductive reasoning **Writing:** Giving Instructions; Dialogue Writing	
II	**Persuasive Skills**	**25 Marks** Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Grammar:** Compound words; Phrasal verbs **Listening:** Listening to situation based dialogues **Speaking:** Group Discussions **Reading:** Reading a short story or an article from newspaper; Critical reading **Writing:** Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives)	**12 Hours**
III	**Cognitive Skills**	**25 Marks** Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Grammar:** Homonyms; homophones **Listening:** Listening to conversations; Understanding the structure of conversations **Speaking:** Presentation Skills **Reading**: Extensive reading **Writing:** Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions - interpretation of data using charts, PPT); Precis Writing	**12 Hours**
IV	**Employability Skills**	**25 Marks** Fill in the blanks/ MCQs/ Comprehension Tasks/ Descriptive Questions	**Grammar:** Idioms; Single Word Substitutes **Listening:** Listening to a telephone conversation; Viewing model interviews (face-to-face, telephonic and video conferencing) **Speaking:** Interview Skills, Mock Interviews **Reading:** Reading job advertisements and the profile of the company concerned **Writing:** Applying for a job; Writing a cover letter with résumé / CV	**12 Hours**

References:

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.

Sub Code: B19EE2080	Chemistry Laboratory	L	T	P	C	CH
Duration : 14 Wks		0	0	2	2	2
Course Objectives	To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence					
Course Outcomes	1. On completion of lab course students will have the knowledge in; 2. Handling different types of instruments for analysis of materials for better accuracy and precision 3. Carrying out different types of titrations for quantitative estimations of materials.					

Course contents

LAB EXERCISES

1. Potentiometric estimation of FAS using standard K2Cr2O7.
2. Conductometric estimation of an acid mixture using standard NaOH solution.
3. Determination of pKa of a weak acid using pH meter.
4. Determination of molecular weight of given polymer sample using ostmail's Viscometer.
5. Colorimetric estimation of copper.
6. Determination of COD of the given industrial waste water sample.
7. Determination of total and temporary hardness of water using disodium salt of EDTA.
8. Estimation of alkalinity of given water sample using standard HCl solution.
9. Determination of Iron in the given haematite ore solution using potassium dichromate.
10. Determination of calcium oxide in the given sample of cement by rapid EDTA method
11. Flame photometric estimation of sodium in the given sample of water.
12. Electroplating of copper and nickel.

Sub Code: B19EE2090	Computer programming (C++) Lab	L	T	P	C	CH
Duration : 14 Wks		0	0	2	**2**	2
Course Objectives	1. Introduce the Basic Principles of Problem Solving using a Computer; 2. Present and Provide the Programming Constructs of 'C' Programming Language; 3. Provide the skills required to Design, Demonstrate and Implement Computable Problems / Mini-projects / Projects using 'C' Programming Language. 4. Provide the Arena for Development of Analytical, Reasoning and Programming Skills; 5. Set the Strong Foundation for Software Development in the field of Programming and hence to Create high quality 'C' Professionals.					
Course Outcomes	After completion of this course, the students would be able to: 1. Understand the Basic Principles of Problem Solving 2. Study, understand and identify the Representation of Numbers, Alphabets and other Characters in the memory of Computer System 3. Understand Analyze, Integrate, Apply and Demonstrate Software Development Tools; like Algorithms, Pseudo Codes and Programming Structures.					

	4. Study, Understand, Analyze and Categorize the logical structure of a Computer Program, and hence to Apply different programming constructs to develop a Computer Program using ‘C’ Programming Language. 5. Offer Engineering Solutions to simple (moderate) mathematical and logical problems using ‘C’ Programming Language. 6. Study, Understand, Analyze, Integrate, Classify, Compare and Apply simple Data Structures, Pointers, Memory Allocation and Data Handling through files using ‘C’ Programming Language. 7. Understand and identify the working of different Operating Systems; like Windows and Linux. 8. Enhance their Analytical, Reasoning and Programming Skills.

Course contents

1. Unix Commands – execution and learn extra options than what is taught in theory
2. How to edit, compile and execute a C program on UNIX using editors like G-edit, K-write, writing a shell program.
3. Programs on data types, operators, expressions
4. Conditional statements – simple if statement, if-else statement, nested if-else, else-if ladder, switch statement
5. Looping statements – for, while and do-while statements
6. Arrays – 1-D and 2-D arrays
7. Programs on Sorting and searching
8. User defined Functions – pass by value, pass by reference, passing arrays to functions
9. Strings – finding length, string concatenation, string compare, substring search, palindromes etc
10. Programs on pointers.

Recommended Learning Resources:

1. Herbert Schildt, C: The Complete Reference, 4th Edition, Tata McGraw Hill
2. Sumitabha Das, UNIX Concepts and Applications, 4th Edition; Tata McGraw Hill
3. Reema Thareja, Computer fundamentals and programming in C.
4. Kernighan, Dennis Ritchie, The C Programming Language ,2nd edition, Englewood Cliffs, NJ: Prentice Hall, 1988
5. http://c-faq.com/index.html
6. Paul Deitel, C How to Program, 7th Edition, Deitel How to Series.

III Semester

Sub Code: B19EE3010	Engineering Mathematics – III	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	4	4
Course Objectives	To study and understand the application approach of the concepts of Numerical methods, Probability, random variables and Sampling distributions in various fields of engineering.					
Course Outcomes	After the completion of the course the student will be able 1. To understand the basics of numerical methods and their applications. 2. To solve the problems of Probability and statistics in various engineering fields. 3. To apply the numerical methods and Sampling Theory concepts to solve various engineering problems					

COURSE CONTENTS

UNIT-I **[12 hrs]**

Numerical Method – I

Numerical Solution of algebraic and transcendental equations: Regula-falsi method, Newton - Raphson method. Iterative methods of solution of a system of equations: 2 Gauss-seidel and Relaxation methods.

Finite differences and Interpolation :-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 and Problems.

UNIT –II **[12 hrs]**

Numerical Method – II

Numerical Differentiation and Integration:- Derivatives using Newton's forward and backward difference formula. Trapezoidal Rule, Simpson's $1/3^{rd}$, $3/8^{th}$ Rule, Weddle's formula and Problems.

Linear Programming: Mathematical Formulation of Linear Programming Problem(LPP), Simplex Method, BigM method.

UNIT-III **[12 hrs]**

Probability Theory – I

Introduction of Probability, Probability associated with set theory, addition law, conditional Probability, multiplication law, Baye's Theorem.

Random variables (discrete and continuous), Probability density function, probability distribution – binomial and Poisson's distributions; exponential and normal distributions.

UNIT-IV **[12 hrs]**

Probability Theory – II

Sampling theory:-Sampling, Sampling distributions, standard error, test of hypothesis for means and confidence limits for means and distributions and Chi-square distributions.

Joint Probability distribution and Markov's chains:-Concept of joint probability, joint distributions –discrete random variables, independent random variables, problems on expectation and variance.

Markov's chains-Introduction, probability vectors, stochastic matrices, fixed points and regular stochastic matrices, Markov's chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd edition, 2013.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2012.
3. K S Trivedi "Probability and Random processing".

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1st edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition, 2002.

Sub Code: B19EE3020	**Electrical Circuit Theory**	**L**	**T**	**P**	**C**	**CH**
Duration:14Weeks		3	1	0	**4**	5
Course objectives	1. To enable students to apply network theorems for solving network problems 2. To describe the constituents of two port network 3. To discuss the concept of resonance and the associated terminologies for different configurations of the tank circuit 4. To enable the students evaluate the transient response of RLC networks 5. To enable the students to realize a network through different forms 6. To design attenuator networks 7. To solve a given network problem through state variable analysis					
Course Outcomes	After the completion of the course the student will be able to 1. Solve network problems using KCL, KVL, loop and mesh analysis 2. Represent the given network in terms of two-port network 3. Apply the concept of resonance in the design of filter and also to understand the principle behind ZVS and ZCS in a power electronic circuit 4. Calculate the initial and transient conditions in power electronic circuits 5. Develop network of immittance functions 6. Calculate parameters an attenuator for the given specifications and also to analyze attenuation of a probe 7. Develop to solve network problems using state variable concept and also to relate the concept with the state estimation technique in power system					

COURSE CONTENTS

UNIT- I **[12Hrs]**

Basic Concepts: Use of KCL, KVL, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh, Problems

Two Port Network Parameters: Definition of z, y, h and transmission parameters, modeling with these parameters and Problems

UNIT- II **[12Hrs]**

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem and Maximum Power transfer theorem (Only the case when source and load impedances complex, load resistance and inductive reactance varying) Problems

Resonance: Series and parallel resonance, frequency-response of series and parallel circuits, Q factor, Bandwidth.

UNIT- III **[12Hrs]**

Initial Conditions and Transient conditions: Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions in RL,RC and RLC circuits for AC and DC excitations. Solution of transient network problems by the use of LT

UNIT-IV **[12Hrs]**

Network Synthesis: Passive network synthesis: Realizing a reactance network-Foster and Cauer forms

Attenuators: Introduction, Nepers, Decibels, T-type attenuator, π-type attenuator, insertion loss.

State Variable Analysis: Introduction, state variable approach, state space representation, transfer function, linear transformation, diagonalization, state transition matrix, solution to non homogeneous state equations, minimal set of state variable formulation.

Text Books:

1. Engineering Circuit Analysis, Hayt, Kemmerly and Durbin, TMH, 7th Edition, 2010
2. Networks and systems, Roy Choudhury, New Age International Publications.,2nd Edition, 2006 re-print
3. Roy Choudhury, "Networks and systems", New Age International Publications., 2nd Edition, 2006 re-print.
4. Charles K. Alexander and Matthew N. O. Sadiku, "Fundamentals of Electric Circuits"
5. David K. Cheng," Analysis of Linear Systems", Narosa Publishing House, 11th reprint, 2002.

Reference Books:

1. Electric Circuits, Schaum's Outlines, M Nahvi & J A Edminister, TMH, 5th Edition, 2009.
2. Network Analysis, M. E. Van Valkenburg, PHI, 3rd edition, reprint 2009.
3. Analysis of Linear Systems, David K. Cheng, Narosa Publishing House, 11th reprint, 2002
4. Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N. O. Sadiku
5. Schaum's Outlines, M Nahvi & J A Edminister, "Electric Circuits", TMH, 5th Edition, 2009

<table>
<tr><td>Sub Code: B19EE3030</td><td rowspan="2">Electrical Machines - I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration :16 weeks</td><td>4</td><td>0</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable the students to familiarize with the theory, construction, classifications and working principle of transformers and Induction motors
2. To enable the students to learn the necessity of different tests conducted and the parallel operation on single phase transformers
3. To enable to study the Classification and different connections of three phase Transformers
4. To enable to draw equivalent circuit & circle diagram for the performance Analysis of three phase induction motor.
5. To enable to understand the necessity of starters & speed control for 3 phase IM</td></tr>
<tr><td>Course outcomes</td><td colspan="6">On the successful completion of this course, the student is expected to be able to:
1. Reveal their knowledge and understanding of electromechanical energy conversion in Transformers and Induction machines.
2. Analyze the concepts of fundamental torque equation and rotating fields
3. Analyze the fundamental characteristics of Transformers and Induction machines.
4. Interpret experimental results and correlate them with theoretical predictions.</td></tr>
</table>

COURSE CONTENTS

UNIT – I **[11 hr]**

Transformers-I

Single Phase Transformers: Introduction, Construction and Principle of transformer, operation of ideal, practical transformer at no load and on load, phasor diagram, voltage current and power relations. Exact and approximate equivalent circuits. Transformer losses, efficiency and Voltage regulation

UNIT – II **[10 hr]**

Transformers-2

Single Phase Transformers: OC & SC test on transformer, Sumpner's test. Parallel operation of transformers(Theoretical Approach)

3-Phase transformers: Introduction ,three phase transformer connections. Open Delta Connection, Scott Connection.

UNIT – III **[10 hr]**

Induction machines

Introduction to three phase induction motor, constructional details, three phase rotating magnetic field. Exact and approximate per phase equivalent circuit; Phasor diagram. Power flow diagram in a three phase induction machine, Torque-slip characteristics. Starting torque, breakdown slip and breakdown torque. Introduction to Induction Generators.

UNIT – IV **[11 hr]**

Testing of three phase induction machines

No load and blocked rotor tests for determining equivalent circuit parameters; losses and efficiency. Induction machine performance computation from circle diagram. Cogging torque and crawling; Double cage rotors- construction and working.

Direct on line starting, rotor resistance based starting. Star/delta and auto transformer based starting. Speed control of induction motors by stator voltage variation and pole changing techniques. V/f control method, slip power control method.

Text books:

1. Electric Machines, I.J. Nagarath and D. P. Kothari, T.M.H 4th Edition,2010
2. Electric Machines, Mulukuntla S Sarma, Mukesh K. Pathak, Cengage Learning, First edition, 2009.

References

1. Performance and Design of A C Machines, M G Say, C S B Publishers, 3rdEdition, 2002
2. Theory of Alternating current Machines, Alexander Langsdorf, T M H 2nd edition, 2001
3. Electrical Machines and Transformers, Kosow, Pearson, 2nd edition, 2007

Sub Code: B19EE3040	**Analog Electronic and Digital Electronic Circuit Design**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		2	1	0	**3**	4
Course Objectives:	1. To provide an insight into the modeling of bipolar junction transistors, biasing techniques. 2. To illustrate the application and its design of BJTs as amplifiers and oscillators. 3. Illustrate Boolean laws and minimization techniques for simplification of expressions like minterm, maxterm using K-Map and QMT 4. Introduce various application oriented circuits which can be implemented in real world examples for making the learners attuned to Logic concepts. 5. Introduce and differentiate between the Combinational and Sequential Circuits.					
Course outcomes	At the end of this course, student will be able to: 1. Describe the operation, applications and characteristics of devices BJT. 2. Analyze and design circuits such as amplifiers and oscillators using BJT. 3. Define a Boolean term, expression, SOP, POS, and construct the K-map/QMT Table for real time application implementation 4. Design arithmetic and combinational logic circuits using gates, encoders, decoders, multiplexers and de-multiplexers. 5. Design specified synchronous or asynchronous sequential logic circuits using appropriate flip flops.					

COURSE CONTENTS

Unit 1: Transistors **[11 Hrs]**

DC load line, Q point effect on signal swing, biasing techniques, discussion on bias stability, BJT transistor modeling (re and h models) for various CE configurations (fixed bias, voltage divider bias and emitter bias), Small signal BJT amplifiers: analysis of CE configuration using re-model, h- parameter model; emitter follower.

Unit 2: Amplifiers and Oscillators **[11 Hrs]**

Darlington connections, Feedback Amplifiers: Characteristics of feedback, feedback topologies, Power amplifiers: classification and application, series fed class A amplifier, Transformer coupled Class A amplifiers, Class B Push-Pull amplifiers, Complementary Push-Pull and Transformer–coupled load Push-Pull, Amplifier distortions.

Oscillators: Principle of operation (Barkhausen's Criteria, positive feedback concept), Introduction to Audio frequency Oscillators, Radio frequency Oscillators, Crystal Oscillators. (BJT Version Only)

Unit 3: Minimization Techniques Analysis and Design of combinational Circuits **[10 Hrs]**

Introduction to combinational logic circuits, generation of switching equation from truth table. Minimization Techniques: Boolean algebra expression minimization. Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS), Karnaugh map (3, 4, 5 Variable) and Quine - McCluskey method of minimization Design procedure of Half adder, Full Adder, Half subtractor, Full subtractor, Carry Look Ahead adder, BCD adder, Comparator – 1bit and 2 bit , Principle of Encoder and Decoder with cascading of decoders. Principle of Multiplexers and Demultiplexer with cascading of Mux and Boolean function implementation using Mux and decoders.

Unit 4: Sequential circuits Design and Logic Families **[10 Hrs]**

Basic bistable element, S R Latch , application of SR latch as a switch debouncer, Edge triggering – Level Triggering, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation. Registers, Shift Register, Universal shift register, Counters: Binary Ripple Up/Down Counter, Design of synchronous Mod- n counter using flip-flop. Logic families: Diode-Transistor Logic, Transistor-Transistor Logic, Emitter-Coupled Logic, NMOS and PMOS Logic, CMOS Logic.

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education. 9th Edition.
2. John M Yarbrough, "**Digital Logic Applications and Design**", *Thomson Learning, 1st Edition, 2001*.
3. Donald D Givone, "**Digital Principles and Design**", *Tata McGraw-Hill 1st Edition, 2002*.

Reference Books:

1. Jacob Millman & Christos C. Halkias , "**Integrated Electronics",** Tata - McGraw Hill, 2nd Edition, 2010.
2. David A. Bell , **"Electronic Devices and Circuits"** , PHI, 5th Edition, 2009.
3. Muhammad H. Rashid, **"Electronic Circuits and Applications",** Cengage learning, 1st Edition
4. Muhammad H. Rashid, "Electronic Devices and Circuits", Cengage Learning, 1st Edition.

5. D P Leach, A P Malvino, & Goutham Saha, " **Digital Principles and applications**", Tata McGraw-Hill, 7th Edition, 2010.
6. Moshe Morris Mano, "**Digital Design**" Prentice Hall, 3rd Edition, 2008.

<table>
<tr><td>Sub Code: B19EE3050</td><td rowspan="2">Theory and Applications of Linear Integrated Circuits</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration:</td><td>2</td><td>0</td><td>1</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce the basic building blocks of linear integrated circuits.
2. To outline the design procedure of applications using operational amplifiers, analog multipliers and PLL.
3. To study the operation of ADC and DAC
4. To introduce the concepts of waveform generation and introduce some special function ICs</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After completion of the course, the student can able to:
1. Describe the fabrication methods and characteristics of op-amp and Timer ICs
2. Design different applications using general purpose op- amp and application specific ICs.
3. Design multipliers and PLL, and design of applications using Timer IC</td></tr>
</table>

COURSE CONTENTS

Unit 1: Basics of Op-amps **[12hrs]**

op-amp structure, IC-741 structure and its characteristics, features of Op-amp, Design of Non inverting and Inverting Amplifiers, differential amplifiers, Capacitor coupled voltage follower, capacitor coupled non-inverting amplifier capacitor coupled inverting amplifier, setting upper cut off frequency, capacitor coupled difference amplifier, and use of single polarity supply.

Unit 2: **[12hrs]**

A. Signal processing circuits: Precision half wave &full wave rectifiers, limiting circuits, clamping circuits, peak detectors, Sample & Hold Circuit, A-D and D-A converters.

B. Nonlinear circuits: Op-amps in switching circuits, crossing detectors, inverting Schmitt trigger circuits, non-inverting Schmitt circuits, Astable Multivibrator, and Monostable Multivibrator.

Unit 3: **[14hrs]**

A. Signal generator: Triangular/Rectangular wave generator, waveform generator design, Phase Shift Oscillator, Wein Bridge Oscillator, amplitude stabilization, signal generators output controllers.

B.OP-AMP Applications: Voltage sources, current sources and current sinks, Current amplifiers, instrumentation Amplifier, PLL-operating principles, Phase detector / comparator. Architecture of 555 timer. Design Astable and Monostable multivibrator using 555 timer

Unit 4: **[14hrs]**

A. Active filters: First and Second Order High Pass And Low Pass Filters, Band Pass Filter, Band Stop Filter.
B. Specialized IC's: Universal Active Filter, Switched Capacitor Filter, Basics of Voltage Regulators, 723 voltage regulator.

Text Books:
1. Ramakanth A Gayakwad, 'Operational amplifiers and linear IC's', Pearson, 4^{th} edition, 2007.
2. David A Bell, 'Operational amplifiers and linear IC's', PHI

Reference Books:
1. Roy & Choudary, 'Operational amplifiers and linear IC's', New age International.
2. Stanley William D, 'Operational amplifiers and linear IC's', 4^{th} edition, Pearson Education

Sub Code: B19EE3060	Microcontrollers and Applications	L	T	P	C	CH
Duration: 14 Weeks		2	1	0	3	4
Course Objectives	1. To describe the architecture of microcontroller and various features associated with different models of the microcontrollers. 2. To discuss various computations and accessing methods associated with the microcontrollers. 3. To develop the skill of programming microcontrollers in controlling different applications in real time. 4. To demonstrate the interfacing of various devices to the microcontroller.					
Course Outcomes	After the completion of the course the student will be able to: 1. To recognize the architecture of the 8051 and MSP430 microcontrollers. 2. To be adept at using various inbuilt features and external peripherals based on the requirement. 3. To program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled using the microcontroller. 4. To develop the ability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller.					

COURSE CONTENTS

UNIT-I: Fundamentals of 8051 **[11hrs]**
Fundamentals of 8051
Fundamentals of Microprocessor, Comparison of Microprocessor and Microcontroller, Harvard and Von Neumann architecture, RISC and CISC, block diagram of Microcontroller 8051 and functions of each block**,** pin details of 8051, I/O ports functions, Internal Memory organization, External memory (ROM & RAM) interfacing, stack and stack operation.

UNIT-II: Features of 8051 **[11hrs]**
Instruction set of 8051 along with simple programs, Addressing modes, programming in C:

Data types and Time delay, I/O programming, Logical operations and Data conversion programs in 8051 C, Timers/Counters and programming, Interrupts and programming.

UNIT III: Communication and Interfacing [11hrs]
I/O port programming, serial communication.
Interfacing: ADC and DAC, LCD, DC motor, stepper motor, sensors (e.g.: temperature, pressure). Case studies/application notes.

UNIT-IV: MSP 430 Microcontroller [11 hrs]
MSP430 RISC CPU architecture, instruction set, addressing modes, on-chip peripherals of MSP430, Programming in ALP/C, case studies/application notes.

Text books:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay ,"The 8051 Microcontroller and Embedded Systems – using assembly and C ", PHI, 2006 / Pearson, 2006
2. John Davies , "MSP430 Microcontroller Basics", Elsevier, 2010 (Indian edition available)

Reference Books:

1. Ajit pal, "Microcontrollers, Principles and Applications", PHI Ltd., - 2011.
2. Design reference notes and data sheets of MSP430 (TI)

Sub Code:B19EE3070	**Analog Electronics & Digital Circuit Design Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		0	0	2	**2**	3
Course Objectives	1. To enable students to identify the various electronic components 2. To enable students to verify theoretical analysis with experimental results. 3. To enable students to conduct experiments, collect results, interpret results and analyze any discrepancies 4. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits. 5. To enable students to verify theoretical analysis with experimental results. 6. To To prepare students to perform the analysis and design of various digital electronic circuits.					
Course Outcomes	Students will be able to 1. Rig circuit as per the circuit and conduct experiments. 2. Demonstrate the ability to design circuits for a given specification and to choose appropriate instruments for measurements. 3. Analyze and design simple electronic circuits such as rectifiers, clippers, clampers, amplifiers and oscillators. 4. Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis. 5. Have a thorough understanding of the fundamental concepts					

	and techniques used in digital electronics. 6. Define a Boolean term expression, SOP, POS, Minterm etc. and contrast and differentiate combinational and sequential circuits. Express real world reasoning problems in terms of logic expressions. 7. Assemble basic elements like gates to design basic memory elements called flip flops, registers and counters

COURSE CONTENTS

List of analog electronics experiments:

1. Design and Testing of Diode Clipping (Single and Double ended) circuits.
2. Design and Testing of Clamper Circuits (Positive and Negative Clamping).
3. Design of RC coupled Single stage BJT amplifier and determination of the gain-frequency response, input and output impedances.
4. Design of BJT Darlington Emitter Amplifier and determination of the gain frequency response and input /output impedance.
5. Design and testing of BJT R-C Phase shift Oscillator.
6. Design and testing of BJT Hartley and Colpitt's Oscillators.
7. Design of Rectifier Circuits with and without capacitor filter. Determination of ripple factor, regulation and efficiency.
8. Design of Class-B Push-Pull Amplifier and determination of its conversion efficiency.
9. Study of Crystal Oscillator.
10. Study of Voltage series feedback amplifier and determination of the gain, Input and output Impedance.

List of digital electronics experiments:

1. Simplification, realization of Boolean expressions using logic gates/universal gates.
2. Realization of Half/Full adder and Half/Full Subtractors using logic gates and realization of parallel adder/Subtractors using7483 chip
3. Realization of One/Two bit comparator and study of 7485 magnitude comparator.Realize a) Decoder chip to drive LED display.
4. Truth table verification of Flip-Flops: (i) JK Master Slave (ii) T-Type and (iii) D Type and realization of 3 bit counters as a sequential circuit and MOD – N counter design (7476, 7490, 74192, 74193).
5. Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using 74S95. Implementation of Sequence generator.

Sub Code: B19EE3080	Electrical & Electronics Measurement Lab	L	T	P	C	CH
Duration :14 Wks		0	0	2	**2**	3
Course Objectives	1. To understand the working of various electrical bridge 2. To understand the energy meter 3. To know the working of Op-amps					
Course Outcomes	On completion of this course the students will be able to: 1. Measure various parameters of given bridge 2. To apply the Op-amps in various signal processing circuits					

COURSE CONTENTS

List of lab experiments:

1. Measurements of low resistance using Kelvin's Double Bridge.
2. Measurements of inductance using Maxwell inductance Capacitance bridge &
3. Determination of Q factor.
4. Measurements of capacitance using De-sauty's bridge & determination of dissipation factor.
5. Measurement of active and reactive power in balanced 3 phase circuit using two wattmeter method.
6. Adjustment & Calibration of single phase energy meter.
7. Inverting, non-inverting & scale charging of signals using Op amps (using simulation Packages)
8. RC phase shifting oscillator using op amps(using simulation Packages)
9. Rectifier circuits – Bridge rectifier, clipping & clamping circuits(using op-amps).simulation package.
10. Schmitt – Trigger inverting and non-inverting

Course Code	Soft Skill	Course Type	L	T	P	C	Hrs./Wk.
B19EE3090		RULO	1	0	1	**2**	2

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.

B19EE3X10	SKILL DEVELOPMENT	RULO	0	0	2	**2**	2

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

IV Semester

Sub Code: B19EE4010	**Engineering Mathematics –IV**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	To study and understand the application approach of the concepts of Numerical methods, Fourier transforms, Z-transforms and Complex variables.					
Course Outcomes	After the completion of the course the student will be able 1. To understand the basics of numerical methods and their applications. 2. To solve the problems of Probability and statistics in various engineering fields. 3. To apply the numerical methods and Sampling Theory concepts to solve various engineering problems.					

COURSE CONTENTS

Unit –I **[12 Hrs]**

Numerical Methods –III: (i) Numerical solution of simultaneous first order ODE: Picard's and Runge-Kutta method of fourth order.
(ii) Numerical solution of second order ordinary differential equations, Picards method, Runge-Kutta method and Milne's method
(iii) Numerical solutions of PDE: Finite difference approximations to derivatives, Numerical solution of two –dimensional Laplace equation, one-dimensional Heat and Wave Equations.

Unit –II **[12 Hrs]**

Fourier series and Transforms :Convergence and divergence of infinite series of positive terms , definition and illustrative examples, periodic functions, Dirichlet's conditions and Fourier series of period functions of period 2π and arbitrary period, half range Fourier series, Complex form of Fourier series and Practical Harmonic analysis.
Infinite Fourier Transform, Fourier sine and cosine transforms, properties, inverse transforms.

Unit-III **[12 Hrs]**

Z-transforms and special functions: Z-Transforms- Definition, standard Z-transforms , damping rule, shifting rule , initial value and final value theorems , inverse Z-transform , application of Z-transform to solve difference equations.
Solution of Laplace equation in cylindrical and spherical systems leading Bessel's and Legendre's differential equations, Series solution of Bessel's differential equation leading to Bessel function of first kind, Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula.

Unit-IV **[12 Hrs]**

Complex variables –I & II

Function of a complex variable, Analytic functions-Cauchy-Riemann equations in cartesian and polar forms. Properties of analytic functions.

Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.

Conformal Transformations: Bilinear Transformations. Discussion of Transformations: $w = z^2$, $w = e^z$, $w = z + (a^2 / z)$,Complex line integrals-Cauchy's theorem and Cauchy's integral formula

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th edition, 2013.
2. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

Sub Code: B19EE4020	**Electromagnetic theory**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To study the basic concepts of vector calculus and co-ordinate system. 2. To discuss the concept of potential and energy density in the case of static and time varying fields. 3. To discuss the concepts of Coulomb's law and Gauss law and their applications. 4. To study the concept of the steady magnetic field, magnetic materials and inductance calculation. 5. To provide the knowledge of time varying field and Maxwell's equations.					
Course Outcomes	After the completion of the course the student will be able to: 1. Able to understand the concepts of vector calculus and co-ordinate system. 2. Able to understand the concept of potential and energy density in the case of static and time varying fields. . Able Coulomb's law and Gauss law and their applications in real world applications. 3. Able to understand the steady magnetic field, magnetic materials and inductance calculation 4. Investigate the electromagnetic phenomenon in a time varying electric and magnetic fields.					

COURSE CONTENTS

UNIT-I **[12 Hrs]**

Coulomb's Law and electric field intensity: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge.

Electric flux density, Gauss' law and divergence: Electric flux density, Gauss' law, Divergence, Maxwell's First equation (Electrostatics), vector operator ∇ and divergence theorem.

UNIT-II **[12 Hrs]**

Energy and potential : Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge and system of charges, Potential gradient , Energy density in an electrostatic field.

Conductors, dielectrics and capacitance: Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics, capacitance and examples.

Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solutions of Laplace's and Poisson's equations

UNIT-III **[12 Hrs]**

The steady magnetic field: Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials.

Magnetic forces: Force on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit.

UNIT-IV **[12 Hrs]**

Magnetic materials and inductance: Magnetization and permeability, Magnetic boundary conditions, Magnetic circuit, Potential energy and forces on magnetic materials, Inductance and Mutual Inductance.

Time varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equation in point and Integral form, retarded potentials.

Text books:

1. William H Hayt Jr. and John A Buck, "Engineering Electromagnetics", Tata McGraw-Hill, 7th edition, 2006

Reference Books:

1. John Krauss and Daniel A Fleisch, "Electromagnetics with Applications"**,** McGraw-Hill, 5th edition, 1999
2. Edward C. Jordan and Keith G Balmain, "Electromagnetic Waves And Radiating Systems," Prentice – Hall of India / Pearson Education, 2nd edition, 1968.Reprint 2002
3. David K Cheng, "Field and Wave Electromagnetics", Pearson Education Asia, 2nd edition, - 1989, Indian Reprint – 2001

Sub Code: B19EE4030	Electrical Machines –II	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	4	4
Course Objectives	1. To equip the students with the knowledge electromechanical energy conversion. 2. To equip the students with physical concepts and operational features of DC and synchronous machines. 3. To equip the students with basic experimental skills 4. To provide basis for further study of Electrical Machines					
Course Outcomes	On completion of this course the students will be able to: 1. Understand the concept of electromechanical energy conversion in DC and synchronous machines 2. Analyze the concepts of fundamental torque equation and rotating fields 3. Analyze the fundamental characteristics of DC and synchronous machines 4. Interpret experimental results and correlate them with theoretical predictions 5. Describe the parallel operation of alternators.					

COURSE CONTENTS

Unit 1: DC Generators **[10Hrs]**

Principle and Construction of DC generators, Armature winding, EMF equation, Armature Reaction, Commutation, Inter poles and Compensating Windings, Performance Characteristics of D.C. generators.

Unit 2: D.C. Motors **[11Hrs]**

Principle and Construction, Significance of back EMF and torque equation, Performance Characteristics of D.C. motors; Starting of DC Motor: 3-point and 4-point starter; Speed control of D.C. motors: Field Control, armature control and Ward Leonard method; Efficiency and Testing of D.C. machines (Swinburne’s Test, Hopkinson’s and Field Test).

Unit-3: Synchronous Machine I **[11 Hrs]**

Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier’s Triangle Method, Parallel Operation of synchronous generators.

Unit 4: Synchronous Machine II **[10Hrs]**

Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics Synchronous Motor, V- Curves, Hunting & damping, synchronous condenser.

Text Books:

1. I.J. Nagrath & D.P. Kothari, ‘Electrical Machines’, Tata McGraw Hill
2. A.E. Fitggerald, C. Kingsley Jr and Umans, ‘Electric Machinery’ 6th Edition McGraw Hill, International Student Edition.
3. P.S. Bimbhra, ‘Electrical Machinery’, Khanna Publisher

Reference Books:

1. M.G. Say, 'Alternating Current Machines', Pitman & Sons
2. B.R. Gupta & Vandana Singhal, 'Fundamentals of Electrical Machines', New Age International.
3. Irving L. Kosow, 'Electric Machine and Transformers', Prentice Hall of India

<table>
<tr><td>Sub Code: B19EE4040</td><td rowspan="2">Power Electronics</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>0</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To provide basic knowledge of power semiconductor devices.
2. To illustrate the students about concepts of Gate driver circuits, and need of isolation and protection circuits of various power semiconductor devices.
3. To enumerate operation of Phase controlled Rectifiers for various loads.
4. To inculcate the skills of analyzing the basic topologies of DC-DC converters, Inverters and AC voltage regulators for various loads.
5. To discuss the different modulation techniques for output voltage control of Inverters.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After the completion of the course student will be able to:
1. Acquire a basic knowledge of solid state electronics devices including power diodes, power BJT, power MOSFETs, SCR, IGBT etc.
2. Analyze power electronic circuits such as control rectifiers, inverters, choppers & AC voltage regulators.
3. Describe the role of Power Electronics as an enabling technology in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc.
4. Apply engineering tools (MATLAB, PSIM) to solve electrical & electronics circuits.</td></tr>
</table>

COURSE CONTENTS

Unit 1: Power Transistors **[11Hrs]**

Introduction to Power Electronics, Power semi-conductor devices and Static Characteristics, Types of power electronic converters, Power Transistors: Power BJT's – switching Characteristics, Switching limits – SOA, Base drive control, Power MOSFETs & IGBT's Internal structure –characteristics, gate driver circuits, Isolation of gate and base drives.

Unit 2: Silicon Controlled Rectifiers/Thyristors **[10Hrs]**

Introduction, Two Transistor Model, Characteristics- static & dynamic, di/dt, dv/dt protection, Series & Parallel operations of thyristors, Thyristors firing circuits: Design using UJT, R, RC circuits, Commutation Techniques: Definitions and conditions for commutation, Classification

Unit 3: **[11Hrs]**

AC Voltage Controller: Principle of ON-OFF Control and Phase control, Single Phase bi-directional controllers with R & RL Loads.

Phase Controlled Converters: Principle of phase controlled converter operation, Single phase half, semi & full converters with R and RL load. Three phase half wave and full converter with R load (Quantitative Analysis only)

Unit :4 **[10Hrs]**

DC to DC Converters: Introduction, Principle of step down and step up chopper with R and R-L load, Chopper Classification, Performance Parameters.

Inverters: Introduction, Single phase bridge inverters R & RL load, Three phase inverters (both 120^0 mode and 180^0 mode) PWM Techniques to control voltage of single phase inverters -- Single PWM, Multiple PWM & Sinusoidal PWM.

Text Books:

1. M.H. Rashid, "Power Electronics: Circuits, Devices, and Applications", Prentice-Hall International third edition 2006.
2. M D Singh and Khanchandani K B , "Power Electronics", TMH second edition 2001
3. Mohan / Undeland / Robbins , "Power Electronics: Converters, Applications, and Design", Wiley third edition 2008

References:

1. Daniel. W. Hart, " Power Electronics", TMH edition 2011
2. John G. Kassakian, Addison Wesley, "Principles of Power electronics".

Sub Code: B19EE4051	Electrical Power Utilization	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To enable students to understand the advantages of utilization of electricity. 2. To give an insight into various industrial applications of electricity. 3. To illustrate electric traction and the speed time curves associated with it. 4. To compare the characteristics of various types of motors suitable for electric traction. 5. To introduce the basic knowledge of electric and hybrid vehicles.					
Course Outcomes	On completion of this course the students will be able to: 1. Identify the motors suitable for electric traction for various applications. 2. Analyze various electrolytic processes for different applications. 3. Interpret the type of illumination required for a given application. 4. Illustrate various industrial heating and welding techniques.					

COURSE CONTENTS

Unit 1: Electric Traction **[12Hrs]**

Introduction, requirements of an ideal traction, systems of traction, speed time curve, tractive effort, co-efficient of adhesion, selection of traction motors, method of speed control, energy saving by series parallel control, ac traction equipment. AC series motor, characteristics, regenerative braking, linear induction motor and their use. AC traction, specific energy, factors affecting specific energy consumption.

Unit 2: **[12Hrs]**
Introduction to Electric and Hybrid Vehicles: Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.
Electrolytic Process: Fundamental principles, extraction, refining of metals and electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

Unit 3: Illumination **[12Hrs]**
Illumination: Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps-incandescent, fluorescent, vapor, CFL and LED lamps and their working, comparison, Glare and its remedy.

Unit 4: Heating and Welding **[12Hrs]**
Advantages and methods of electric of heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building. Electric welding, resistance and arc welding, control devices and welding equipment.

Text Books:

1. E Openshaw Taylor, 'Utilization Of Electric Energy', 12th Impression, 2009, Universities Press.
2. Mehrdad, Ehsani, Yimin Gao, Sabastien. E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles', CRC Press.

Reference Books:

1. Soni Gupta and Bhatnager, 'A Course in Electrical Power', Dhanapat Rai & Sons.
2. Dr. S.L. Uppal, 'Electrical Power', Khanna Publications

<table>
<tr><td>Sub Code: B19EE4052</td><td rowspan="2">Electrical Drives</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>0</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand the basics of electrical drive system
2. To Describe the various braking methods of DC and Induction Motor Drives
3. To understand the control aspects of electrical drives using power electronics converters</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Describe the structure of a drive system and their role in any application.
2. Analyze the given specifications and suggest a suitable motor for a particular application
3. Select a power electronic converter and decide its operational parameters for DC & AC motor drive system</td></tr>
</table>

COURSE CONTENTS

Unit 1: Basic Elements of Electrical Drives **[10Hrs]**
Components of electrical Drives – electric machines, power converter, controllers - dynamics of electric drive - torque equation - components of load torques - four quadrant operation of a motor — steady state stability – classes of motor duty- Selection of motor rating.

Unit 2: DC and AC Motor Drives **[11Hrs]**
DC Drives: Braking- Regenerative, Dynamic, Plugging, related Problems.
AC Drives: Induction motor Drive- Speed-Torque characteristics for braking- regenerative, dynamic, plugging.

Unit 3: Speed Control of DC Drives **[10Hrs]**
Controlled rectifier fed dc drives, 1-ph fully controlled rectifier control of dc separately excited motor, 3-ph fully controlled rectifier control of dc separately excited motor, chopper control of separately excited motor, supply harmonics, power factor, and ripple in motor current,

Unit 4: Speed control of Induction Motor Drives **[11Hrs]**
Stator voltage control, performance of induction motor under unbalanced supply and single phasing, variable frequency control, slip speed control. Induction motor slip power recovery drives, Static Kramer drive

Text Books:

1. G.K. Dubey, 'Power semiconductor controlled drives', Prentice Hall, 1989
2. P.C. Sen, 'Principles of Electric Machines and Power Electronics', John Wiley & Sons, 2nd Edition, 1996.

References:

1. P.C. Sen, 'Principles of Electric Machines and Power Electronics', John Wiley & Sons, 2nd Edition, 1996.
2. Vedam Subrahmaniam, 'Electric Drives', TMH, 1994
3. R. Krishnan, 'Electrical Motor Drives', PHI, 2003
4. Bimal. K. Bose, 'Modern Power Electronics and AC Drives', Pearson Education
5. Introduction to Electrical Drives: http://textofvideo.nptel.iitm.ac.in/video.php?courseId=108108077

Sub Code: B19EE4053	**Digital System Design Using VHDL**	**L**	**T**	**P**	**C**	**CH**
Duration: weeks		4	0	0	**4**	4
Course Objectives	1. To demonstrate an understanding of the fundamentals for an HDL. 2. To demonstrate an understanding of data flow descriptions. 3. To implement combinational and sequential circuits using VHDL. 4. To implement various digital circuits using Programmable Logic Devices. 5. Implement various logical circuits using CMOS circuits					

Course Outcomes	On completion of this course the students will be able to: 1. Compare Verilog HDL and VHDL. 2. Design simple logic circuits using data flow, structural and behavioral modeling concepts. 3. Implement combinational and sequential circuits. 4. Design of logic circuits using CMOS circuits.

COURSE CONTENTS

Unit 1: **[10Hrs]**
Introduction: A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Comparison of VHDL and Verilog.
Data –Flow Descriptions: Data-Flow Description, Structure of Data-Flow Description, Data Type – Vectors.

Unit 2: **[10Hrs]**
Behavioral Modelling: Behavioral Description, structure of HDL behavioral Description, the VHDL variable –Assignment Statement, sequential statements.
Structural Modelling: Structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements.

Unit 3: **[10Hrs]**
Combinational and Sequential Circuit Design: VHDL Models and Simulation of combinational circuits-Multiplexers, Demultiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions. VHDL Models and Simulation of Sequential Circuits Shift Registers, Counters.

Unit 4: **[12Hrs]**
Mixed –Type Descriptions:
Why Mixed-Type Description? VHDL User-Defined Types, VHDL Packages, Mixed-Type Description examples.
Digital CMOS circuits overview: Overview, Design and performance analysis of CMOS inverter, Logic gate circuits, Pass transistor logic, Dynamic logic circuits.

Text Books:
1. Charles H. Roth. Jr, ‘Digital Systems Design Using VHDL’, Cengage, 2010.
2. A Pedroni, Volnet, ‘Digital Electronics and Design With VHDL’, Elsevier, 1st edition, 2008
3. Brown and Vranesic, ‘Fundamentals of Digital Logic with VHDL Design’, McGraw Hill, 3rd Edition 2008.

Reference Books:
1. Stephen Brwon & Zvonko Vranesic, ‘Fundamentals of Digital Logic with VHDL Design’, TMH, 2nd Edition 2006
2. Floyd, ‘Digital Fundamentals using VHDL’, Pearson Education, 2003
3. Wakerly J. F., ‘Digital Design – Principles and Practices’, 4th Edition, Pearson Education,2008.
4. Navabi, ‘VHDL Modular Design’, McGraw Hill, 2008.

<table>
<tr><td>Sub Code: B19EE4054</td><td rowspan="2">Database Management Systems</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>0</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Understand the role of a database management system in an organization.
2. Understand basic database concepts, including the structure and operation of the relational data model.
3. Construct simple and moderately advanced database queries using Structured Query Language (SQL).
4. Understand and successfully apply logical database design
5. Principles, including E-R diagrams and database normalization.
6. Design and implement a small database project using Microsoft Access.
7. Understand the concept of a database transaction and related database facilities, including concurrency control.
8. Understand the role of the database administrator.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Master the basic concepts and appreciate the applications of database systems.
2. Master the basics of SQL and construct queries using SQL.
3. Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.
4. Be familiar with the relational database theory, and be able to write relational algebra expressions for queries
5. Be familiar with the basic issues of transaction processing and concurrency control.</td></tr>
</table>

Course Contents

Unit-1

INTRODUCTION TO DATA BASE SYSTEMS **[04 Hrs]**

Managing data, a historical perspective, File systems versus DBMS, Advantages of DBMS, Describing and Storing Data in DBMS, Queries in DBMS, Transaction management, Structure of DBMS, People who work with databases.

ENITTY – RELATIONSHIP MODEL **[06 Hrs]**

Using high- Level Conceptual Data Models for Database Design, An example of Database Application, Entity types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY database, ER Diagrams, Naming Conventions and Design Issues.

Unit-2

RELATIONAL MODEL AND RELATIONAL ALGEBRA **[06 Hrs]**

Relational model concepts, relational model constraints and relational database schemes, update operations and 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, relational database design using ER-to-Relational mapping.

DATABASE SECURITY **[04 Hrs]**

Introduction, Access control, Discretionary Access, Mandatory Access Control

Unit-3

SQL –THE RELATIONAL DATABASE STANDARD [14 Hrs]

SQL Data definition and data types, specifying basic constraints in SQL, Schemes, Change statements in SQL, basic Queries in SQL, more complex SQL queries, Insert, Delete and update statements in SQL, additional features SQL, specifying general constraints as assertion, views (virtual tables) in SQL, database Programming, issues and Techniques, Embedded SQL, Dynamic SQL, more examples; PL/SQL.

NOTE: Lab sessions to be conducted for unit 3.

Unit-4

TRANSACTION MANAGEMENT [06 Hrs]

The ACID properties, transactions and schedules, concurrent execution of transactions, lock based concurrency control, performance of locking, transaction support in SQL. Introduction to lock management.

TEXT BOOKS

1. Database management systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 3rd edition, 2003
2. Fundamentals of database systems, Elmasri and Navathe, Pearson Education,5th edition
3. Database system concepts, Silberschatz kortts Sudharshan, McGraw Hill, 5th edition, 2006
4. Database system concepts, Peter Rob, Carlos Coronel, Cengage Learning, First edition, 2008

Sub Code: B19EE4061	**Management and Entrepreneurship**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To explain the basic concepts, principles, and processes of management. 2. To use the elements of effective decision making–research, assessment and consequence. 3. To develop the abilities to plan for effective communication – learn how to reflect, present and evaluate communication. 4. To Analyse organizational practices that facilitate creativity and innovation 5. To Integrate functional areas into strategic business problems from a general management perspective 6. To develop an ability to work with moral and ethical dilemmas and make decisions using critical thinking					
Course Outcomes	On completion of this course the students will be able to: 1. Integrate management concepts in a technical and innovative setting as required by today's dynamic business environment 2. Possess relevant skills preparing students for entry into management careers in business, government, public, or social service organizations 3. Analyse a business case, propose a creditable solution to a					

	business problem and support your decision with strong arguments. 4. Propose his/her own business ideas and present it to a relevant audience. 5. Apply elements of effective decision making to areas that are central to career development – self assessment, market conditions and planning.

COURSE CONTENTS

Unit 1: Introduction to management principles **[10hrs]**
Development of Management Thought-Early Management Approaches-Modern Management Approaches, Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of Management - Management as a Science, Art or Profession, Management & Administration, Levels of Management, Roles of Manager. Communication-meaning and importance-Forms and types of communication

Unit 2: Management Process **[12hrs]**
PLANNING-Nature, importance and purpose of planning process - Objectives - Types of plans (Meaning only), Importance of planning - steps in planning & planning premises - Hierarchy of plans. Decision Making, Organisation- Nature and purpose of organization - Principles of organization -Types of organization, Staffing-Nature and importance of Staffing -Process of Selection & Recruitment (in brief). Meaning and nature of directing - Leadership styles, Coordination- meaning and importance and Techniques of Co – ordination.

Unit 3: Project Preparation **[10hrs]**
The Management for Engineers-Personal Management-Personal Management-Objective setting-Self Appraisal Preparation Of Project-Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Errors of Project Report; Project Appraisal.

Unit 4: Entrepreneurship **[12hrs]**
Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur. Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.
Small Scale Industry- Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start an SSI - Government policy towards SSI; Different Policies of S.S.I.; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I., Effect of WTO/GATT Supporting Agencies of Government for S.S.I. Meaning

Text books:

1. P. C. Tripathi, P. N. Reddy ‘Principles of Management’, Tata McGraw Hill, 4th Edition, 2010.
2. Vasant Desai, ’Dynamics of Entrepreneurial Development & Management’, Himalaya Publishing House.
3. Poornima M Charantimath, ‘Entrepreneurship Development - Small Business Enterprises’, Pearson Education, 2006.

Reference Books:

1. Robert Lusier, 'Management Fundamentals - Concepts, Application, Skill Development' Thomson.
2. S S Khanka - S Chand & Co, 'Entrepreneurship Development'.
3. Stephen Robbins, 'Management', Pearson Education /PHI -17th Edition, 2003

Sub Code: B19EE4062 Duration: weeks	Electricity Act	L	T	P	C	CH
		4	0	0	4	4
Course Objectives	1. To provide Power factor scenario before Enactment of Electricity act 2003 2. To provide information about regulatory commission and Power trading 3. To understand the necessity of Consumer protection act, Factories Act and workmen compensation act etc., 4. To make understand need for the formation of BEE					
Course Outcomes	On completion of this course the students will be able to: 1. To understand the different Electricity act, enactment of electricity act, power trading. 2. To understand the importance and necessity of reducing transmission and distribution loss. 3. To understand relevant acts and rules					

COURSE CONTENTS

Unit 1. **[10Hrs]**

Power sector scenario before Enactment of Electricity act 2003.Enactment of Electricity act 2003, power trading, open access, Regulatory commission, appellate tribunals, liberating generation plants, from permits (except hydro).

Unit 2. **[12Hrs]**

Electricity reforms envisaged in the country, necessity of forming electricity regulatory commission at the centre and states, enactment of regulatory commission act 1998, Karnataka electricity reforms act 1998, necessity of reducing T&D loss, formulation of uniform structure of tariff, de-linking of generation, transmission and distribution activities.

Unit 3. **[14Hrs]**

Relevant acts, rules, related, important clauses and subjects there on, - in respect of Consumer Protection Act, Factories Act, Workmen Compensation Act, Indian Telegraphic Act Pertaining to Power sector, Companies act, Boiler Safety Act, Right to Information Act and KTPP Act.

Unit 4. **[14Hrs]**

Energy Conservation Act 2001. Necessity and formation of BEE, Green power/green building concepts, carbon trading and formation of international bodies for protection of environment, CDM technologies. Introduction of friendly measures to encourage independent power producers.

Reference

1. Anita Abraham, “Electricity Rules Cited – Electricity Law Manual”.
2. Various acts and rules as cited.
3. KERC ES&D Code.
4. Condition of Supply of Electricity of Distribution Licenses in various states.

Sub Code: B19EE4063	**Programmable Logic Controllers**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To provide knowledge levels of PLC programming 2. To train the students for creating ladder logic for PLC processes programming. 3. To apply the knowledge of Timers and Counters for Industrial applications					
Course Outcomes	On completion of this course the students will be able to: 1. Ability to gain knowledge on Programmable Logic Controllers. 2. To provide the knowledge about various types of registers in PLC. 3. Able to create the ladder diagrams from process and control descriptions					

COURSE CONTENTS

Unit 1: [10Hrs]

PLC Basics: PLC system, Internal architecture I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules. **(Self-study: Applications of Sensors)**

Unit 2: [10Hrs]

PLC Programming: Input Devices: Mechanical switches, Proximity switches, Photoelectric sensors and switches; Temperature sensors, position / Displacement sensors; Strain gauge sensors; Pressure sensors; Liquid level detectors; Fluid flow measurement ; Smart sensors; Outputs Devices : Relay; Directional control valves; Motors ; Stepper motors; Operational procedures, programming examples and PLC applications. **(Self-study: Motors, Sensors)**

Unit 3: [10hrs]

Digital logic gates, programming in the Boolean algebra system, conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system. **(Self-study: Number system and conversations)**

Unit 4: [10hrs]

PLC Registers: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

PLC Functions: Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions

Text Books:

1. John W. Webb & Ronald A. Reiss, ‘Programmable Logic Controllers- Principles and Applications’, Fifth Edition, PHI

2. J R. Hackworth &F.D Hackworth Jr., 'Pogrammable Logic Controllers- Programming Method and Applications', Pearson, 2004
3. William Bolton, 'Programmable Logic Controllers', fifth Edition.

Sub Code: B19EE4064	Data Structures Using C++	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. Introduce the basic concepts for defining classes with data and member functions. 2. Explain the knowledge of structure, operations and applications of various data structures like arrays, structures, unions, lists, stacks, queues, trees, graphs, hash tables and heaps. 3. Provide the students with solid foundations in the basic concepts of programming: data structures and algorithms. 4. Familiarize the concept of Abstract Data Types (ADT) and Implement ADT in several programming languages					
Course Outcomes	On completion of this course the students will be able to: 1. Implement classes and objects for a given problem. 2. Demonstrate the ability of accessing members in the written programs. 3. Impart the effectiveness of data structures and algorithms for solving a given problem. 4. Package a set of data structures and algorithms as an abstract data type.					

COURSE CONTENTS

Unit 1: [**10hrs**]

Introduction: Overview of C++, 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, The scope resolution operator, Static Class members.

Introduction to Objects, Array of Objects, Dynamic Objects, Pointers to objects, Friend Function

Unit 2: [**11hrs**]

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 3: Data Structure-I [**11hrs**]

Pointers: Introduction, Recursion, Stacks, Queues: Simple, circular and priority Queues, Linked Lists: Singly and Doubly Linked List.

Unit 4: Data Structure-II **[10hrs]**

Trees: Terminologies and types, Binary Trees, Binary Search Trees, Tournament Trees, Heaps, Hash Tables, Graphs and Algorithms: Basic Terminologies and BFS DFS Algorithm

Text Books:

1. Herbert Schildt, 'The Complete Reference C++', 4th Edition, Tata McGraw Hill, 2003.
2. Sanley B. Lippmann, Josee Lajore, 'C++ Primer', 4th Edition, Pearson Education, 2005.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 'Introduction to Algorithms', IT Press, 2002
4. Horowitz, Sahni, Anderson-Freed, 'Fundamentals of Data Structures in C', 2nd Edition, Universities Press, 2007

Reference Books:

1. Paul J Deitel, Harvey M Deitel, 'C++ for Programmers', Pearson Education, 2009.
2. K R Venugopal, Rajkumar Buyya, T Ravi Shankar, 'Mastering C++', Tata McGraw Hill, 1999.
3. ACM, ACM Transactions on Programming Languages and Systems (TOPLAS)
4. Joshi, 'Data Structures and Algorithms in C', Tata McGraw-Hill Education, 2010
5. Richard Gilberg, Behrouz Forouzan, Data Structures, 'A Pseudo code Approach with C', Cengage Learning, 2004

Sub Code: B19EE4070	**Electrical Machines-I Lab**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		0	0	2	**2**	2
Course Objectives	1. To Evaluate the performance of a given machine through testing. 2. To control the speed of Induction Motor 3. Evaluate the various characteristics of Induction motor and transformer for industrial applications. 4. To demonstrate the conversion of 3-phase system to 2-phase system					
Course outcomes	At the end of this course, Student will be able to 1. Apply the three phase transformer in the industrial needs like electrical drives and agricultural pumps etc. 2. Understand parallel operation of transformer, three phase transformer, auto transformer and their practical applications. 3. Analyze equivalent circuits of single phase transformers. 4. Understand the different testing methods for evaluating the various losses of the transformers and Induction motors					

List of Experiments:

1. (a) Predetermination of efficiency and regulation by Open Circuit and Short circuit tests on single - phase transformer.
   (b) Calculation of parameters of equivalent circuit from the readings of the tests and determination of efficiency and regulation from the equivalent circuit to correlate results obtained earlier.
2. Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.
3. Parallel operation of two dissimilar (different kVA) single-phase transformers and determination of load sharing and analytical verification given the Open Circuit and Short circuit tests details.
4. Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.
5. Scott connection with balanced and unbalanced resistive loads.
6. Load test on 3-phase induction motor- and plot of Torque versus speed, output hp versus efficiency, power factor and slip.

7. Predetermination of performance of 3-phase induction Motor from the Circle diagram.
8. (a) Determination of parameters of the equivalent circuit of a 3-phase Induction Motor by conducting NO load and Blocked rotor tests.
   (b) Determination of performance quantities of the induction motor from the equivalent circuit to correlate the results obtained from the load test or circle diagram.
9. Speed control of 3-phase induction motor by varying rotor resistance.
10. Load test on single- phase induction motor.

Sub Code: B19EE4080	**Microcontroller Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		0	0	2	**2**	2
Course Objectives	1. Understand the architecture of microcontroller and various features associated with the different models of the microcontrollers. 2. Understanding of various computations and accessing methods associated with the microcontrollers. 3. Gain the knowledge of programming. 4. Develop the ability to program the microcontroller in controlling the different applications in real time. 5. Develop the capability to program and interface various devices to the microcontroller.					
Course Outcomes	After the completion of the course the student will be able to: 1. Understand the architecture of the 8051 and features 2. Make use of various inbuilt features and external peripherals based on the requirement. 3. Design simple electronic circuits which could be controlled using the microcontroller. 4. Develop the capability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller.					

List of Experiments:

I. PROGRAMMING

1. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.
2. Arithmetic operations – addition ,subtraction, multiplication ,division, square, Cube.
3. Boolean & Logical Instructions (Bit & Byte manipulations).
4. Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX .
5. Serial port Programming
6. On-Chip timer / counter Programming.

II. INTERFACING:

7. Stepper & DC motor interfacing with 8051
8. Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface to 8051; change the frequency and amplitude.
9. Hex Keyboard and LCD interfacing with 8051
10. Seven segment display and Hex Keyboard interface to 8051

Course Code	Soft Skill	Course Type	L	T	P	C	Hrs./Wk.
B19EE4090		RULO	0	0	2	**2**	2

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

Sub Code: **B19EEX10**	MOOC / SWAYAM	L	T	P	C	CH
		0	0	2	2	4

Note: Students shall choose to take up any online course of four credits as guided by the school or shall have to undergo internship of four weeks duration, the details of which are provided here under.

MOOC/ SWAYAM:

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.

A student shall register and successfully complete any of the courses available on SWAYAM.

Student shall inform the MOOC/SWAYAM coordinator of the school about the course to which he/she has enrolled. The minimum duration of the course shall be not less than 40 hours and of 4 credits. The student should submit the certificate issued by the SWAYAM to the MOOC/SWAYAM coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University.

Internship: Minimum of four weeks duration internship should be carried out by the student either in industry or in an R&D organization, including educational institutes with excellent research culture. In case, if a student is unable to secure internship either in industry or in an R&D organization, a project may be carried out within the university. The student is expected to submit a formal report at the end of the internship programme. The student shall be awarded the marks for internship based on the (a) presentation and (b) comprehensive viva by the panel of examiners constituted by the school

<table>
<tr><td>Sub Code:
B19EE4X20</td><td rowspan="2">YOGA / SPORTS / MUSIC / DANCE/ THEATRE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td></td><td>0</td><td>0</td><td>2</td><td>2</td><td>4</td></tr>
</table>

Note: Music, Dance, and Theater courses are offered by the School of Performing Arts, whereas the Sports and Yoga courses are offered by the Department of Physical Education. The students have to choose any **ONE** of these courses.

A. YOGA FOR HEALTH

Course Objectives:

Following are the Course Objectives.

- To prepare the students for the integration of their physical, mental and spiritual faculties;
- To enable the students to maintain good health;
- To practice mental hygiene and to attain higher level of consciousness;
- To possess emotional stability, self control and concentration; and
- To inculcate among students self discipline, moral and ethical values.

Course Outcomes:

On completion of the course learners will be able to:

- Practice yoga for strength, flexibility, and relaxation.
- Learn techniques for increasing concentration and decreasing anxiety
- Become self disciplined and self-controlled
- Improve physical fitness and perform better in studies
- Gain self confidence to face the challenges in the society with commitment to serve the society

Course Contents

Unit-I:

Yoga: Introduction, Tips from Sage Patanjali’s Yoga Sutras

Surya Namaskara:- 10 counts,12 counts,16 counts

Unit-II:

Asanas: Sitting- Vajrasana, Dandasana, Padmasana, Matsyasana, Ardha Matsyendrasana, Suptavajrasana, Paschimottasana, Bakasana, Simhasana, Shirasasana.

Asanas: Standing- Tadasana, Trikonasana, Parshwa konasana, Veerabadrasana, Parivrutta trikonasana.

Unit-III:

Asanas: Prone Position- Bhujangasana, Dhanurasana, Shalabhasana.

Asanas: Supine Position- Sarvangasana, Sethubandha sarvangasana, Halasana, Karnapeedasana.

Mudras- Dhyana mudra, Chinmaya mudra, Namaste mudra, Nasika mudra

Unit-IV:

Pranayams:- Ujjayi, Nadi Shodhana, Anuloma – Viloma, Basthrika, Bhramari, Sheethali

Dhyana & its types

Competition format, Rules and their interpretations

B. SPORTS (VOLLEYBALL)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of volleyball.
2. To develop skills in passing, setting, serving, spiking, and blocking.
3. To learn basic offensive and defensive patterns of play.
4. To develop a positive attitude towards volleyball as a lifetime sport and to improve physical fitness through participation in volleyball.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with volleyball.
2. Apply these skills while playing volleyball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Contents:

Unit-I

- **Introduction about Volleyball**
- Players Stance, Receiving and passing
- The Volley (Overhead pass), The Dig (Underhand pass), Service Reception

Unit-II

- Service- Under Arm Service, Tennis Service, Side Arm Spin Service, Round Arm Service, High spin service, Asian serve / American serve (floating)
- Setting the ball- Set for attack, Back set, Jump set

Unit-III

- Smash/Spike- Straight smash, Body turn smash, Wrist outward smash, Wrist inward smash
- Block- Single block, Double block, Three-man block
- Rolls- Overhead pass & back rolling, One hand underhand pass with side rolling, Forward dive

Unit-IV

- Attack Combination, Defense Systems, Libero play
- Court marking, Rules and their interpretations and Duties of officials

C. SPORTS (BASKETBALL)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of Basketball
2. To develop technical skills in passing, in ball handling, individual offense, individual defense, rebounding, screen, team offense, team defense and fast break.
3. To learn basic offensive and defensive strategies of play.
4. To develop a positive attitude towards Basketball as a lifetime sport and to improve physical fitness through participation in Basketball.
5. To develop positive understanding and appreciation of the basketball game.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with basketball.
2. Apply these skills while playing basketball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Contents:

Unit-I

- Basketball: Introduction
- Grip; Player stance- Triple threat stance and Ball handling exercises
- Passing (Two hand/one hand)- Chest pass, Bounce Pass, Over head pass, Underhand pass, Hook Pass, Behind the back pass, Baseball pass, Side arm pass and passing in running.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

Unit-II

- Dribbling- How to start dribble, How to stop dribble, High / Low dribble with variations

- Shooting- Layup shot and its variations, One hand set shot, One hand jump shot, Free throw, Hook shot, Tip-in shot.
- Stopping- Stride/Scoot, Pivoting and Faking /Feinting footwork.

Unit-III

- Rebounding- Defensive rebound, Offensive rebound, Box out, Rebound Organization.
- Individual Defensive- Guarding the man with the ball and without the ball.
- Offensive drills, Fast break drills, Team Defense/Offense, Team Tactics

Unit-IV

- Court marking, Rules and their interpretations

D. SPORTS (FOOTBALL)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of football.
2. To develop skills in passing, receiving, controlling the ball, dribbling, shielding, shooting, tackling, beating a defender and heading in football.
3. To learn basic offensive and defensive patterns of play
4. To use different parts of the body in utilizing the above skills while playing football
5. To develop a positive attitude towards football as a lifetime sport and to improve physical fitness through participation in football.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with football.
2. Apply these skills while playing football and exhibit improved performance
3. Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.
4. Improve physical fitness and practice positive personal and lifestyle.
5. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

Unit-I

Football: Introduction

Kicks- Inside kick, Instep kick, Outer instep kick, Lofted kick, Chipping, Volley, Half Volley

Trapping- Trapping rolling the ball, Trapping bouncing ball with sole

Unit-II

- Dribbling- With instep and outer instep of the foot.
- Heading- From standing, running and jumping.
- Feinting- With the lower limb and upper part of the body.

Unit-III

- Tackling- Simple tackling, Slide tackling.
- Throw-in- Standing and Sliding
- Goal Keeping- Collection of balls, Ball clearance, throwing and deflecting.

Unit-IV

- Ground marking, Rules and their interpretations

E. SPORTS (TRACK AND FIELD)

Course Objectives:

1. To teach students the skilled techniques in sprints, relay running, hurdles, long jump, high jump, and shot put and practice them.
2. To develop competence among students in demonstrating all the techniques covered in the course.
3. To make students understand some of the scientific and empirical principles and their rationale underlying the development of skilled performance.
4. To inculcate among students the habit of team work and cooperative learning and develop competence in detecting / correcting technique errors.
5. To develop a positive attitude towards sports in general and athletics in particular and to improve physical fitness through participation in various athletic games / sports activities.

Course Outcomes:

On completion of the course learners will be able to:

1. Display competencies in executing basic techniques and skills associated with select track and field events.
2. Develop basic skills and techniques to improve one's running posture and take-off position for different jumps.
3. Learn regular practice of select track and field events and improve physical fitness
4. Appreciate track and field events by applying sports science knowledge to explain the execution of the events.

Course Content:

Unit-I

Athletics: Introduction
Track Events - Steeple Chase, Race Walking, Middle and Long distance races

Race walking - Technique, Faults and Officiating.

Middle and Long distance races – Technique and Training

Unit-II

Jumping Events - High Jump and Triple Jump: Basic Skills and techniques

High Jump - Straddle Roll & Flop Technique, Approach, Take-off, Technique in the air, Clearance over the bar & Landing

Triple Jump – Hop, Step and Jump Technique, Approach, Take-off & Landing

Unit-III

Throwing Events - Discus Throw and Hammer Throw: Basic Skills and techniques

Discus Throw - Standing and Rotatory techniques, Grip, Stance, Rotation Technique, Power stance, Release and Reverse (Follow through)

Hammer Throw - Grip, Swings, Rotation foot work, Release and Follow through

Unit-IV

Rules, Officiating and Marking - Ground / Sector Marking, Interpretation of Rules.

Reference Books

(Athletics Part-I and Athletics Part-II)

1. Arthur E. Ellison (ed) (1994). Athletic Training and Sports Medicine.
2. Ballisteros, J.M. (1998). Hurdles Basic Coaching Manual, IAAF.
3. Bosen K.O. (1993). Teaching Athletics Skills and Technique.
4. Bosen K.O. (1990). Study Material on Hurdles for the Regular Course Students.
5. Doherty K. (1995). Track and Field Omni book.
6. Martin, David E. Peter N. Coe (1991). Training Distance Runner.
7. Howard S. (1981). Science of Track and Field Athletics.
8. Briggs Graeme (1987). "Track and field coaching Manual", Australian Track and Field Coaches Association. Rothmans Foundation National Sports Division.
9. Carr, Gerry (1999). "Fundamentals of Track and Field. Track Athletics 1 Title G.V. 1060 5.e. 368.
10. I.A.A.F. Level-II (2001). Text Book on Jumping Event.
11. Jarver, Jesse (1987). "The Jumps", Track and Field Coaching Manual Australia.

F. DRAMATICS

Pre-requisites: Students with background in Theatre Arts/ Keen interest in Dramatics.

Course Objectives:

•To imbibe the acting skills.

•To understand the broader applications of theatre studies in allied arts forms.

•To be able to use body language for better communication.

• Students shall also be able to understand voice modulation and Navarasas.

Course Outcomes:

On successful completion of this course, students should be able to:

• Freely express improvisation in non-verbal communication.

• Shall hone good acting skills and be able to emote better.

• Be able to put up a theatre act and play a key role.

• Be able to differentiate good acting and understand the importance of good lyrics, stage crafting, music, dance, costume and lighting.

Course Content:

UNIT – 1

Working on Body:

Body and its analysis. Understanding physical abilities (Anga, Pratyanga and Upanga). Challenges of the body. Using body as metaphor and language. The class's bodies as a collective, an ensemble, a collaborative team.

UNIT – 2

Sound and Movement:

Awareness of creating sound patterns, voice modulations, rhythm in speech and diaologues. Understanding the rhythm and patterns of movements like walking, framing, shaping, primitive and animal movements.

UNIT – 3

Characterization and Improvisation:

Observation of people around. Getting into the role and living it. Developing a character from establishment (pace and rhythm). Improvisation techniques of body and mind.

UNIT – 4

Group work and Production:

Develop a theme, concept or a play and include all the theatre skills, stage craft, costuming and put up an act. Choosing theme and characters.

Reference Books:

1. All about Theatre – Off stage – Chris Hogget.
2. Rangadalli Anataranga – K V Subbanna
3. The Indian Theatre – Hemendranath Das Gupta.
4. A Practical handbook for an Actor – Milisa Bruder, ee Milchel Cohn, Madeleine Oliek et al, Zigler Publisher.

G. INDIAN CLASSICAL DANCE FORMS (Bharathanatyam, Kuchipudi ,Mohiniyattam)

Prerequisites: Background of classical dance training or any other dance forms.

Note: Non-classical dancers can also join.

Course Objectives:

- To develop an understanding about the Indian classical dance forms and its universal application.
- To be able to understand the fine nuances of Classical dance.
- To understand the importance of health through Indian classical dance, strengthen the body capacity.
- To understand mythology and its characters in Indian classical dance form through lessons of Abhinaya.

Course Outcomes:

- To be able to identify and appreciate the classical dance forms.
- To be able to execute basics of Adavus with finesse.
- To be able to express through abhinaya.
- To be able to perform to perform the fundamentals in the chosen dance form.

Course Content:

Unit 1

An introduction to Indian classical dance forms: Bharatanatyam, Kuchipudi, Mohiniyattam.

Unit 2

Learning of Fundamentals: Exercises and Adavus- I (Bharathanatyam , Kuchipudi, Mohiniyattam).

Unit 3

Adavus –II (Bharathanatyam , Kuchipudi, Mohiniyattam)

Unit 4

Learn a basic composition in the chosen dance form.

Reference Books:

1. Indian classical dance forms –U S Krishna Rao,U K Chandrabhaga Devi
2. Classical Dances –Sonal Mansingh, Avinash Parischa
3. Kuchipudi – Sunil Kothari
4. Bharatanatyam An in depth study- Saroja vydyanathan
5. Mohiniyattam – Bharathi Shivaji

H. PERCUSSION INSTRUMENT (TABLA AND MRIDANGAM)

Pre-requisites: Students with background in Percussion instruments and knowledge of Rhythm/ Keen interest in studying Mridagam / Tabala.

Course Objectives:

- To understand the Rhythmology.
- To understand the importance of Laya, Taala.
- To be able to understand the fine finger techniques of playing the instrument.

Course Outcomes:

On successful completion of this course, students should be able to:

- To be able to set instrument to Sruthi.
- To be able to play the fundamentals on instrument.
- To be able to learn and perform a particular taala.

Course Content:

UNIT 1

1. Introduction to Musical Instruments
2. Percussion Instruments
3. Mridangam and its History

UNIT 2

1. Introduction to Tala System
2. Definitions of 5 jaathis and their recitation
3. Adi Talam and its various forms
4. Definitions and recitation of different gathis

UNIT 3

1. Tisra Jaathi
2. Khanda Jaathi
3. Misra jaathi
4. Sankeerna Jaathi

UNIT 4

1. Learning of Jathi Formation
2. Basic jathis
3. Jathis for Dance forms
4. Some Basic Definitions of Korvai, Teermanam etc.,

Reference Books:

1. Mridangam- An Indian Classical Percussion Drum – Shreejayanthi Gopal
2. Theory and practice of Tabala – Sadanand Naimpally.
3. Theory and practice of Mridangam – Dharmala Rama Murthy
4. The Art of the Indian Tabala – Srdjan Beronja.

V Semester

Sub Code: B19EE5010 Duration: 14 Weeks	Power System Analysis	L	T	P	C	CH
		3	0	0	3	4
Course Objectives	1. To model the power system under steady state operating condition. 2. To model and analyze the power systems under abnormal (or) fault conditions. 3. To model and analyze the transient behavior of power system when it is subjected to a fault.					
Course Outcomes	At the end of this course, Student will be able to 1. Obtain the equivalent models of different power system components 2. Analyze the symmetrical fault condition. 3. Calculate the fault current under different unsymmetrical fault conditions.					

Unit 1: Introduction to Power System **[14hrs]**
Modern Power System – basic components of a power system. Generator model, transformer model, transmission system model and load representation. Single line diagram – per phase and per unit representation – change of base.

Unit 2: Fault Analysis – Balance Faults **[14hrs]**
Importance short circuit (or) for fault analysis – basic assumptions in fault analysis of power systems. Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents.

Unit 3: Fault Analysis – symmetrical components & sequence networks, Effect of neutral, phase shift in star-delta transformer, calculation of complex power, Introduction to symmetrical components – sequence impedances – sequence networks

Unit 4: Fault Analysis – Unbalanced Faults **[8 hrs]**
Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions. Unbalanced fault analysis – problem formulation – analysis using Z-bus impedance matrix – (algorithm and flow chart).

Text Books:

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2003.

References:

1. P. Kundur, 'Power System Stability and Control, Tata McGraw Hill, Publications,1994.
2. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Book Company, 1994.

3. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', Tata McGraw-Hill Publishing Company, New Delhi, 1990.

Sub Code: B19EE5020	Switchgear and Protection	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	3	4
Prerequisites:	Basic knowledge of Electro magnetism, Ionization process, AC Machines, Transmission and Distribution					
Course Objectives	1. To introduce students to power system protection and switchgear. 2. To teach students theory and applications of the main components used in power system protection. 3. To enable the students to understand theory, construction advantages and disadvantages of various circuit breakers 4. To teach the students, the theory and construction of various protective relays and their characteristics 5. To teach students the protection systems used for Electrical machines such as Transformers, generators and Induction Motors					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the operation of switch gear and protection system. 2. Classify various types of Circuit Breakers and Relays 3. Explain the theory, construction, advantages and disadvantages of different types of Circuit Breakers and Relays. 4. Describe protection schemes for transformers, alternators and induction motors 5. List the applications of circuit breakers and relays in real life.					

Course Contents:

UNIT I: **[10 Hrs]**

Fuse: Introduction to fuse, fuse law, cut -off characteristics, Time current characteristics, HRC fuse, liquid fuse, Application of fuse

Switch Gear: Circuit breaker: Basic Principle of operation, DC and AC Circuit breaking.phenomena of arc, properties of arc, initiation, maintenance and Interruption of arc.

UNIT II: **[11 Hrs]**

Circuit Breakers: Air Circuit breakers – Air break and Air blast Circuit breakers. SF6 breaker - Preparation of SF6 gas, Puffer and non Puffer type of SF6 breakers. Vacuum circuit breakers - principle of operation and constructional details. Advantages and disadvantages of different types of Circuit breakers.

UNIT III: **[11 Hrs]**

Protective Relays: Basic definitions associated with protective Relaying. Principle of operation of Electromagnetic Relays and Classification. Over current relays - Non-directional and directional over current relays, IDMT and Directional characteristics. Differential relays – Principle of operation, percentage differential relay and its characteristics. Distance relays-Impedance relay, Reactance relay, Mho relay. Buchholz relay, Negative Sequence relay.

UNIT IV: **[10Hrs]**

Protection Schemes: Generator Protection - prime mover faults, stator and rotor faults, Merz price protection, protection against abnormal conditions - unbalanced loading, loss of excitation, over speeding. Transformer Protection - Differential protection, differential relay with harmonic restraint. Induction motor protection - Protection against phase fault, ground fault , single phasing, phase reversal and over loading.

Text Books:

1. Y.G. Paithankar and S.R. Bhide, 'Fundamentals of Power System Protection',
2. Prentice Hall of India Pvt. Ltd., New Delhi–110001, 2003
3. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.

Reference Books:

1. Sunil S. Rao, 'Switchgear and Protection', Khanna publishers, New Delhi, 1986.
2. B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', Wiley Eastern Ltd., 1977.

<table>
<tr><td>Sub Code: B19EE5030</td><td rowspan="2">High Voltage Engineering</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable the students understand various breakdown mechanisms.
2. To enable the students understand various principles of generating high DC, AC and impulse voltages.
3. To teach the students about various methods for measuring high voltages and currents.
4. To teach the students various high voltage tests performed on various electrical apparatus such as cables, insulators etc.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After the completion of the course the student will be able to:
1. Describe the principles of the generation and measurement of high voltage AC, DC and impulse voltages.
2. Describe the fundamentals of breakdown.
3. Understand discharge phenomena, to prevent them.
4. Know the origins of overvoltage and protection against them.
5. Understand insulation coordination concept</td></tr>
</table>

COURSE CONTENTS

Unit 1: Over Voltages in Electrical Power Systems **[10hrs]**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, need for generating high voltages in laboratory.

Electrical Breakdown in Gases, Solids and Liquids

Gaseous breakdown in uniform and non-uniform fields – Ionization process, Townsend's current growth equation. Streamer theory of breakdown. Paschen's law of gases, Vacuum breakdown –Breakdown in pure and commercial liquids – Breakdown mechanisms in solid dielectrics.

Unit 2: Generation of High Voltages and High Currents **[11hrs]**

HVAC- Cascade connection and working of transformers units connected in cascade. Resonant circuits- principle of operation and advantages. Tesla coil.

HVDC-Voltage doubler circuit, cock croft- Walton type high voltage DC set. Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop.
Impulse Voltages & Currents- Impulse voltage generator, Marx Impulse circuit, Triggering methods of impulse generator. Generation of switching impulse voltages. Generation of high impulse current.

Unit 3: Measurement of High Voltages and High Currents **[11Hrs]**
Electrostatic voltmeter-principle, construction and limitation. Generating voltmeter-Principle, construction. Standard sphere gap measurements of HV AC, HV DC, and impulse voltages. Potential dividers, their types and applications. Measurement of high impulse currents- Rogowsky coil and Magnetic Links.

Unit 4: **[10Hrs]**
Non-destructive High Voltage Testing: Measurable properties of dielectrics. Measurement of Dielectric properties with Schering Bridge and Mega ohm meter.
Insulation Coordination: Principle of insulation coordination on high voltage and extra high voltage power systems. Basic insulation level design systems.

Text Books :

1. M.S. Naidu and Kamaraju, 'High Voltage Engineering', 4^{th} edition, THM, 2008.
2. E. Kuffel and W.S. Zaengl, 'High Voltage Engineering Fundamentals', 2^{nd} edition, Elsevier Press, 2005.
3. C.L. Wadhwa, 'High Voltage Engineering', New Age International Private limited, 1995

Sub Code: B19EE5041	**Design of Electrical Machines**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Prerequisites	Mathematics, Electrical Machines I & II					
Course Objectives	1. To enable students to understand the application of basic electro-magnetic laws. 2. To give an insight into constructional details of internal parts of the machines 3. To enable students understand different machine parameters and develop design equations					
Course Outcomes	On completion of this course the students will be able to: 1. Be able to apply basic electro-magnetic laws to mould the laboratory modules. 2. Be able to select efficient materials for the best performance of the machine					

Course Contents:

UNIT – I
Basics of Electrical Machine Design: **[10 hours]**
Introduction, considerations for the design of electrical machines, limitations. Different types of materials and insulators used in electrical machines.
DC Generator and DC Motor Design:
Output equation, choice of specific loadings and choice of number of poles, design of Main

dimensions of the DC machines, Design of armature slot dimensions, commutators and brushes, magnetic circuit - estimation of ampere turns, design of yoke and poles- main and inter poles, field windings – shunt, series and inter poles.

Unit 2: Single Phase and Three Phase Transformers Design [12hrs]
Output equation for single phase and three phase transformers, choice of specific loadings, expression for volts/turn, determination of main dimensions of the core, types of windings and estimation of number of turns and conductor cross sectional area of Primary and secondary windings, estimation of no load current, expression for leakage reactance and voltage regulation. Design of tank and cooling tubes (round and rectangular)

Unit 3: Three Phase Induction Motor Design [10hrs]
Output equation, Choice of specific loadings, main dimensions of three phase induction motor, Stator winding design, choice of length of the air gap, estimation of number of slots for the squirrel cage rotor, design of rotor bars and end ring, design of slip ring induction motor, estimation of no load current and leakage reactance, and circle diagram.

Unit 4: Synchronous Machines [10hrs]
Output equation, Choice of specific loadings, short circuit ratio, design of main dimensions, armature slots and windings, slot details for the stator of salient and non salient pole synchronous machines. Design of rotor of salient pole synchronous machines, magnetic circuits, dimensions of the pole body, design of the field winding, and design of rotor of non salient pole machine.

Recommended Learning Resources (Text books):
1. A.K. Sawhney, 'A Course In Electrical Machine Design', Dhanpat Rai & Sons
2. V. N. Mittle, 'Design Of Electrical Machines', 4th edition

Recommended Learning Resources (Reference books):
1. M.G. Say, 'Performance And Design Of AC Machines', CBS Publishers and Distributors Pvt. Ltd.
2. R.K. Aggarwal, 'Principles of Electrical Machine Design'.
3. Shanmugasundarm, G. Gangadharan, R. Palani, 'Design Data Handbook', A Wiley Eastern Ltd.

Sub Code: B19EE5042	**Advanced Power Electronics**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To develop analytical techniques for isolated/non-isolated converters in steady state. 2. To design and simulate a basic dc-dc power supply for given specifications. 3. To describe the operation and pulse width modulation strategies in inverters. 4. To familiarize with various element of a practical power converter circuitry					
Course Outcomes	On completion of this course the students will be able to: 1. Analyze any arbitrary dc-dc converter in steady state. 2. Design the output filter components to meet the required					

	specifications. 3. Choose the appropriate switching device based on circuit operation. 4. Identify the various blocks in a practical PWM control circuitry. 5. Apply knowledge of converters for practical applications in electrical industry

COURSE CONTENTS

Unit 1: Switched Mode Power Conversion: DC-DC Converters [14hrs]

Introduction to power processing, Linear Regulator Vs Switching Regulator. IC based linear regulators: LM78xx series.
Basics of steady state analysis- Inductor Volt-second, capacitor charge balance, small ripple approximation. Principle of operation of buck, boost, buck-boost, Design of output filters components, selection of switch ratings. -Numerical problems
Discontinuous conduction Mode Operation: Buck and Boost converters.
Analysis using software tools: Simulation of DC-DC converters using MATLAB/LT Spice.

Unit 2: DC Power supplies [9hrs]

DC power supplies: fly back converter, forward converter, push-pull converter, full bridge converter, Harmonics generated by SMPS power supplies, undesirable effect on power systems, power factor. Application of DC-DC converters-Power factor correction, solar power application.
Analysis using software tools: Simulation of DC power supplies using MATLAB/LT Spice

Unit 3: Design of Magnetics & Practical Aspects of Converters [9hrs]

Review of basic magnetic theory, Design and selection of magnetic components, inductor, high frequency transformers, Ferrite core table and selection of area product – wire table – selection of wire gauge
Basics elements of PWM Control: PWM control IC and its components, Need for Driver circuit, isolation techniques.

Unit 4: Inverters and Pulse width modulation (PWM) Techniques [9hrs]

PWM Inverters: Square wave operation, Voltage control of single phase inverters - sinusoidal PWM and its Realization, harmonic analysis -Numerical problems. Current Source Inverter, Load-commutated Current Source Inverter (CSI)
Applications of inverters- Design of UPS, Grid tied PV system.

Text Books:

1. Daniel Hart, 'Power Electronics', Tata McGraw Hill, 2011
2. Ned Mohan Tore. M. Undeland and William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and Sons, 2011
3. Rashid M.H., 'Power Electronics – Circuits Devices and Applications', 3rd Edition, Pearson, 2011.
4. L. Umanand, 'Power Electronics: Essentials and Applications', Wiley India Pvt. Ltd.

Reference Books:

1. Robert W. Erickson and Dragon Maksimovic, 'Fundamentals of Power Electronics', Springer International edition.
2. D.M. Mitchell, 'DC-DC Switching Regulator Analysis', McGraw Hill

<table>
<tr><td>Sub Code: B19EE5043</td><td rowspan="2">VLSI Circuits and Design</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To give clear idea about the basics of VLSI design and its importance.
2. To know about the operating principles of MOS transistor.
3. To understand the basics of MOS process Technology.
4. To study about construction of NMOS, CMOS and Bi-CMOS based logic gates.
5. To understand the necessity of testing and the design strategy of the same</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Understand the characteristics of CMOS circuit construction.
2. Demonstrate the fundamentals of IC technology such as various MOS fabrications.
3. Calculate electrical properties of MOS circuits such as Ids -Vds relationships.
4. Design various gates, adders, Memories, using stick diagrams</td></tr>
</table>

COURSE CONTENTS

Unit 1: Introduction **[11hrs]**

Introduction to Integrated Circuit Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies; Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation, Integrated Resistors and Capacitors.

Basic Electrical Properties: Drain to source current Ids versus Vds relationships-BICMOS latch up susceptibility. MOS transistor characteristics, figure of merit, pass transistor NMOS and COMS inverters, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

Unit 2: VLSI Circuit Design Processes [**10hrs]**

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits .

Gate Level Design: Logic Gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out, Choice of layers.

Unit 3: Data Path Subsystems **[15hrs]**

Subsystem Design, Shifters, Adders, ALUs, Parity generators, Comparators, Zero/One Detectors, Counters.

Array Subsystems: SRAM, DRAM, ROM, Serial Access Memories, Content Addressable Memory.

Unit 4: CMOS Testing **[06hrs]**

CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

Text Books:

1. Douglas Pucknell & Eshragian, 'Basic VLSI Design', PHI, 3rd Edition.
2. John .P. Uyemura, 'CMOS Logic Circuit Design', Springer.

3. Neil Weste, 'Introduction to CMOS VLSI Design- A Circuits and Systems Perspective', Pearson Education, 3rd Edition.

Sub Code: B19EE5044	**Python Programming**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Prerequisites	Object Oriented Programming, HTML, XML, Web Services, Data Structures.					
Course Objectives	1. Define and explain the fundamentals of python statements to output information to the screen, assign values to variables, get numeric information entered as input and perform a counted loop. 2. Interpret the principles of object-oriented programming and the interplay of algorithms and data structures, exception handling in well-written modular code. 3. Explain advanced python programming using regular expressions and HTML processing 4. Define and explain the I/O streams and web services development using python.					
Course Outcomes	On completion of this course the students will be able to: 1. Use python interpreter for designing simple programs. 2. Differentiate between mutable and immutable types 3. Demonstrate usage of object oriented features, file and exception handling. 4. Understanding and usage of advanced features like regular expressions to solve a problem using python 5. Apply the knowledge of python and use the language scripting elements and constructs and repository of standard library, to develop real world and web based applications.					

Course Contents:

Unit-I: [11 Hrs]

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;

Unit-II: [11 Hrs]

Objects and Object−Orientation: Diving In; Importing Modules using from module import; Defining Classes; Instantiating Classes; Exploring UserDict: A Wrapper Class; Special Class Methods; Advanced Special Class Methods; Introducing Class Attributes; Private Function;

Exceptions and File Handling: Handling Exceptions; Working with File Objects; Iterating with for Loops; Using sys. modules; Working with Directories

Unit-III: [10 Hrs]

Regular Expressions: Diving In; Case Study: Street Addresses; Case Study: Roman Numerals; Using the {n,m} Syntax; Verbose Regular Expressions;

HTML Processing: Diving in; Introducing sgmllib.py; Extracting data from HTML documents; Introducing BaseHTMLProcessor.py; locals and globals; Dictionary−based string formatting;

XML Processing: Diving in; Packages; Parsing XML Unicode; Searching for elements; Accessing element attributes; Segue

Unit-IV: [10 Hrs]

Scripts and Streams: Abstracting input sources; Standard input, output, and error; Finding direct children of a node; Creating separate handlers by node type;

HTTP Web Services: Diving in; How not to fetch data over HTTP; Features of HTTP Debugging; HTTP web services; Setting the User−Agent; Handling Last−Modified and ETag; Handling redirects; Handling compressed data

Recommended Learning Resources:

1. Mark Pilgrim, Dive into Python, Copyright (C) 2000 Free Software Foundation.
2. Kenneth A. Lambert, Fundamentals of Python: First Programs (introduction to Programming), 1st Edition, CENAGE Learning.

References:

1. Mark Lutz, Learning Python, Oreilly.
2. John M. Zelle, PYTHON Programming: An Introduction to Computer Science, Franklin, Beedle & Associates.
3. Michael Dawson, Python Programming for the Absolute Beginners, 3rd Edition, CENAGE Learning.
4. Wesley J. Chun, Core Python Programming, 2nd Edition, Prentice Hall.
5. Steve Holden and David Beazley, Python Web Programming, New Riders.
6. Springer, Kent D. Lee, Python Programming Fundamentals, 2nd Edition.
7. John V. Guttag, Introduction to Computation and Programming using Python, MIT Press.

Sub Code: B19EE5051	**Operation Research**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To understand the quantitative methods for effective decision making. 2. To study the various techniques for effective decision making to solve business decision problems. 3. To understand the model formulation and applications in business decision making.					
Course Outcomes	On completion of this course the students will be able to: 1. Knowledge and understanding - Be able to understand the					

	characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type. 2. Cognitive skills (thinking and analysis) - Be able to build and solve Transportation Models and Assignment Models. 3. Communication skills (personal and academic) - Be able to design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems.

COURSE CONTENTS

Unit –I: Linear Programming **[14hrs]**

Introduction, Formulation of linear programming problem, simplex method, Big-M method, two phase simplex method

Degeneracy, Alternative optimal solutions, Duality in LPP, primal-dual relation, Formulation of dual problem, primal-dual optimal solution, Dual simplex method

Unit -II: Game Theory **[8hrs]**

Introduction to optimal strategies, solution of 2 x 2, 2 x n, m x 2 games, Concept of dominance, Graphical method of solving,

Job Sequencing: Sequencing problems, n-jobs and two machines, n-jobs and three machines, two jobs and m machines.

Unit -III: Pert- CPM Techniques [**10hrs]**

Network construction, Determining critical path & floats, Scheduling by network, project duration, Variance under probabilistic modes, prediction of date of completion, Crashing of simple networks.

Unit -IV:

Transportation Problems **[10hrs]**

Basic feasible solution by different methods, fixing optimal solutions by MODI method

Assignment Problems

Introduction & Assignment problems, Formulation, Hungarian method of solving assignment problems, travelling salesman problems

Text Books

1. Ackoff R.L and Sasieni M.W, 'Fundamentals of Operations Research', Wiley Eastern limited, New Delhi
2. Wayne L Winston, 'Operations Research Applications and Algorithms', Cengage learning, 4th edition, 2009
3. Bronson. R, 'Operations Research', Schaum's Outline Series, McGraw Hill international, 2nd edition
4. S.D. Sharma , 'Introduction to Operations Research' , Gillet, B.E., TMH 1979

Sub Code: B19EE5052	Electric and Hybrid Vehicle	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. present a comprehensive overview of Electric Vehicles 2. To introduce the applications of various motor drive roadway principles. 3. To enable students to know the characteristics of various types of batteries. 4. To present a comprehensive overview of Hybrid Electric and various Fuel cell Vehicles 5. To equip students with basic concepts to practically design/ implement and modify the existing vehicle to electric vehicle					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the configuration of a typical electric vehicle, and design , develop basic a schemes of electric vehicle 2. Choose a suitable drive motor for EV,HEV application and differentiate among different drive trains. 3. Understand the limitations and advantages of various Battery chemistries. 4. Choose proper energy storage systems for vehicle applications and develop strategies for charging various types of batteries. 5. Describe the configuration of HEV and various types of Fuel Cell Electric Vehicles and realistically implement/ design the fuel for electric vehicle.					

Course Contents:

UNIT-I: Introduction to Electric Vehicles (EVs): [10 Hrs]

Historical perspective. Air pollution and global warming. EV advantages and impacts. EV market and promotion: infrastructure needs, legislation and regulation, standardization. Comparison with Internal combustion Engine : Technology Benefits and Challenges. Electric vehicle (EV) design options: EV configurations: fixed v s. variable gearing, single- vs. multiple-motor drive, in-wheel drives. Types of Electric Vehicle and components, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV) Fuel cell electric vehicle (FCEV)

UNIT-II: Vehicle Dynamics and Motor Drives: [10 Hrs]

Calculating the Rolling Resistance, Calculating the grade Resistance, Calculating, The Acceleration Force, Finding The Total Tractive Effort, Torque Required on the Drive Wheel, EV drivetrain and components. Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor, Motor Controllers , Physical locations, Mechanical connection of motor , Electrical connection of motor EV motor drive systems: DC drives, induction motor drives, permanent-magnet synchronous motor drives, switched reluctance motor drives. Control strategies.

UNIT-III: Batteries: [10 Hrs]

Battery parameters. Types and characteristics of EV batteries. Battery testing and maintenance; charging schemes. Need of **Battery Management System,** Battery monitoring techniques, Advance Features. Open-circuit voltage and ampere- hour estimation. Battery load levelling.

UNIT-IV: Emerging EV Technologies: [10 Hrs]
Hybrid electric vehicles (HEVs): types, operating modes, torque coordination and control, generator/motor requirements. Fuel cell electric vehicles (FEVs): fuel cell characteristics, hydrogen storage systems, reformers. Alternative sources of power: super- and ultra-capacitors, flywheels.

Text Books and References:

1. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, London: Oxford University Press
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, New York: RC Press.
3. M. Ehsani, Y. Gao, S .E. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles:
4. Fundamentals, Theory and Design, CRC Press.
5. Batteryuniversity.com

Sub Code: B19EE5053	**Digital Image Processing**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To recall the mathematical & signal principles, forming the basic methods for Image processing. 2. To understand image representation, enhancement, filtering, restoration, analysis & reconstruction. 3. To know the processing techniques including various image transformations, Image reconstruction, segmentation & recognition. 4. To design & conduct imaging experiments using MATLAB. 5. To convert image from RGB to gray, black & white, remove blurring effects, noise reduction, edge detection, compression and segmentation. 6. To understand concepts and types of video and video compression standards.					
Course Outcomes	On completion of this course the students will be able to: 1. Acquire the fundamental concepts of a digital image processing system 2. Identify and exploit analogies between them, Signal analysis and processing. 3. Analyze 2D signals in the frequency domain through the Fourier transform 4. Design with MATLAB algorithms for digital image processing operations such as histogram equalization, enhancement, restoration, filtering, and de-noising					

Course Content:

Unit-1: Introduction **[11Hrs]**

Image Sampling, Quantization, Resolution, Human Visual System, Classification of Digital Images, Image Types, Image File Formats, 2D signals, Separable Sequence, Periodic Sequence, 2D convolution, 2D Z-Transforms (no derivations for properties), 2D Digital Filter, 2D Convolution using graphical Method, Circular Convolution Through matrix Analysis and its applications, 2D correlation. Light and color, Color Formation, Human Perception of color, color Model, The chromaticity Diagram.

Unit-2: Image Transforms **[10 Hrs**]

2D Discrete Fourier Transform, Properties of 2D-DFT, DCT, Image Enhancement in spatial Domain, Enhancement through point operation, Types of Point operation, Histogram Manipulation, Linear and Non Linear Grey-level Transformation, Median Filter.

Unit-3: Image Restoration and De-noising **[11 Hrs]**

Image Degradation, Types of Image Blur, Classification of Image Restoration Techniques, Blind Deconvolution and classification, Image Denoising.

Unit4: Image Segmentation and Compression **[10 Hrs]**

Classification of Image-Segmentation Techniques, Region approach to image Segmentation, Clustering Techniques, Image segmentation based on Thresholding, Edge Based Segmentation, Classification of Edges, Edge Detection. Image Compression
Scheme, Classification, Huffman Coding, JPEG

Text Books:

1. S. Jayaraman, S Esskairajan, “Digital Image Processing”, illustrated, Tata McGraw-Hill Education, 2011
2. R.C. Gonzalez and E. Woods, “Digital Image Processing” 2nd edition, Pearson Education (Asia). PTE Ltd/ Prentice Hall of India, 2004.
3. Anil K. Jain, “Fundamentals of Digital Image Processing", Pearson Education (Asia) PTE Ltd./ PrenticeHallofIndia,2004.

Reference Books:

1. Z. Liand M.S. Drew, “Fundamentals of Multimedia”, Pearson Education(Asia), PTE Ltd., 2004.
2. M. Tekalp, “Digital Video Processing”, Prentice Hall, USA, 1995.

Sub Code: B19EE5054	**Web Programming**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
	1. Understand the various steps in designing a creative and dynamic website. 2. They will have clear understanding of hierarchy of objects in HTML and XML.					

Course Objectives	3. Finally they can create good, effective and customized websites. 4. Design dynamic and interactive web pages by embedding Java Script code in HTML. Use Java Script to validate user input. 5. Know the advantages and use of different types of CSS. 6. Understand the HTML and XML DOM. Know how to use Dynamic HTML. 7. Understand server side scripting language like Perl &PHP
Course Outcomes	On completion of this course the students will be able to: 1. Describe the concepts of WWW including browser and HTTP protocol. 2. List the various HTML tags and use them to develop the user friendly web pages. 3. Define the CSS with its types and use them to provide the styles to the web pages at various levels. 4. Develop the modern web pages using the HTML and CSS features with different layouts as per need of applications. 5. Use the JavaScript to develop the dynamic web pages. 6. Use server side scripting with PHP to generate the web pages dynamically using the database connectivity. 7. Develop the modern Web applications using the client and server side technologies and the web design fundamentals.

COURSE CONTENTS

Unit 1: **[10hrs]**

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. 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 Case Study.

Unit 2: **[12hrs]**

Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML Style Cascading and Inheritance-Text Properties-Box Model Normal Flow Box Layout-Beyond the Normal Flow-Other Properties-Case Study. Client-Side Programming: The JavaScript Language-History and Versions Introduction JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers.

Unit 3: **[12hrs]**

Representing Web Data: XML-Documents and Vocabularies-Versions and Declaration -Namespaces JavaScript and XML: Ajax-DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers-Case Study-Related Technologies. Separating Programming and Presentation: JSP Technology Introduction-JSP and Servlets-Running JSP Applications Basic JSP-JavaBeans Classes and JSP-Tag Libraries and Files-Support for the Model-View-Controller Paradigm-Case Study-Related Technologies.

Unit 4: **[8hrs]**

Web Services: JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client-Describing Web Services: WSDL- Representing Data Types: XML Schema-Communicating Object Data: SOAP Related Technologies-Software Installation-Storing Java Objects as Files-Databases and Java Servlets

TEXT BOOK:

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

REFERENCES:

1. 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 II, Pearson Education, 2001.
3. Bates, "Developing Web Applications", Wiley, 2006.

Sub Code: B19EE5061 **Duration: 14 Weeks**	**Electrical Power Quality**	**L**	**T**	**P**	**C**	**CH**
		3	0	0	**3**	4
Course Objectives	1. To understand Comprehend concept of Power Quality & its issues for various electrical systems 2. To Understand effects of power quality on electrical apparatus 3. To Know different power quality improvement techniques and devices					
Course Outcomes	After learning the course the students should be able to: 1. Comprehend concept of Power Quality & its issues for various electrical systems 2. Understand effects of power quality on electrical apparatus 3. Know different power quality improvement techniques and devices					

COURSE CONTENTS

UNIT I: **[12Hrs]**

Power quality terminologies Categories & characteristics of power system electomagnetic phenomena for power quality, transients – impulsive & oscillatory, long duration & short duration voltage variations, voltage imbalance, waveform distortion, power frequency variations, power quality terms.

UNIT II: **[12Hrs]**

Harmonics & power electronic converters Calculation of harmonic currents – effects of source unbalance, circuit reactance, dc filter inductance Current harmonics in converter with inductor input filter & capacitor input filter Single phase power conversion – effects of circuit resistance, source reactance, 3rd harmonics currents, reduction of harmonics Harmonic issues for phase controlled thyristors.

UNIT III: **[12Hrs]**

Effect of harmonics on electrical apparatus Effect of harmonic on Transformer - Harmonics in No-Load Exciting Current, Harmonics due to Inrush Current, DC Magnetization Effect on Capacitor, Induction Motor, protection devices Harmonics in arc furnace loads & thyristor controlled reactor Power Quality in Distributed Generation DG technologies, Interface to the utility system, Impact of distributed generation on power quality, Operating conflicts, DG on distribution networks, Interconnection standards

UNIT IV: **[10Hrs]**

Voltage quality controllers Shunt controllers: D-SVC, D-STATCOM – operation & control Series controllers: DVR – operation & control.

Text Books and References:

1. R. Sastry Vedam & Mulukutla S. Sarma, "Power Quality : VAR Compensation in power systems" , CRC press 2009
2. Moreno-Munoz, "Power Quality: Mitigation techniques in a distributed environment"
3. Roger C. Dugan , "Electrical Power Systems Quality" , 2nd Edition, Tata Mcgraw Hill Publication
4. Derek A. Paice, "Power Electronic converter harmonics : Multipulse methods for clean power", IEEE press, 1995
5. Hirofumi Akagi, Edson Hirokazu Watanabe, Mauricio Aredes, "Instantaneous Power Theory and Applications to Power Conditioning", John Wiley & Sons, 2007.

<table>
<tr><td>Sub Code: B19EE5062</td><td rowspan="2">Electricity Regulations and Safety</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand the Indian Electricity rules 1956.
2. To understand the provisions provided in Indian Electricity Act 2003.
3. To highlight about the Electricity scenario in India
4. To provide the first hand information and knowledge on KERC & CERC guidelines for power generation, transmission and distribution</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Apply the electricity rules 1956 for electrical equipment and also power systems.
2. Apply the provisions given in Electricity act 2003 in Electrical power generation, transmission and distribution system.
3. Adopt the norms given by KERC and CERC for power system.
4. Gain knowledge on open access, power trading, power wheeling, power banking and ABT.</td></tr>
</table>

COURSE CONTENTS

Unit 1: [12hrs]

Overview of Power Sector: Electricity Scenario at National Level and State Level with Key Statistics relating to Generation, Transmission and Distribution of power.
Organizational Set up and Introduction to Electricity Laws – A brief discussion on functional set up of power sector at national and state level and connectivity among different statutory entities and introduction to EA 2003, EC 2001 and KER Act 1999.
Over View of Regulations Governing Electricity Generation and Transmission – A brief description of Key regulations issued by CERC and KERC on Generation and Transmission activity.
Over View of Regulations Governing Distribution & Trading - A brief description of key regulations issued by CERC and KERC on Distribution and Trading activity.

Unit 2: [12hrs]

Provisions relating to Electricity Generation in Act 2003 and related case studies Sl. No. 7, 8, 9, 10 & 11 of Electricity ACT 2003.
Provisions relating to Grid Operation in Act 2003 and related case Studies Sl. No. 25, 26,27,28, 29, 30, 31, 32, 33 & 34 of Electricity ACT 2003
Provision of Power generation by Distributed generations (DG) and interconnection with grid norms from Central Electricity Authority Grid code 2010

Unit 3: [12hrs]

Provisions Relating to Electricity Transmission and related cases Sl. No. 38, 39, 40 & 41 of Electricity ACT 2003
Provisions Relating to Electricity Distribution in Act 2003 and related case studies Sl. No. 42, 43, 55, 56 & 135 of Electricity ACT 2003
Key Technical Aspects relating to supply of electricity and supply code

Unit 4: [12hrs]

Safety in Supply of Electricity - Regulations and Case studies - Safety Regulations issued by CEA. Electricity Trading and Power Business Trading Regulations issued by CERC and KERC, & Case Studies
Electricity Tariffs – Provisions in the Act, related regulations and case studies Sl. No. 61, 62, 63, 64 & 65 of Electricity Act 2003, Open excess, wheeling & banking of power, Availability Based Tariff (ABT)

Text Books:

1. Electricity Act 2003, Kamal Publishers; 2017 edition (2017).

2. The Electricity Rules, 2005 & the Indian Electricity Rules, 1956 (Latest Bare Act),
3. Central Electricity Authority Grid code 2010, http://www.cea.nic.in/reports/regulation/tech_std_reg.pdf.
4. Website http://bescom.org/en/wheeling-bankingopen-access/
5. Website http://www.forumofregulators.gov.in/data/study/ study on analysis of tariff orders & other orders of state electricity regulatory commissions.pdf

Sub Code: B19EE5063 **Duration: 14 Weeks**	**Embedded Systems and IOT**	**L**	**T**	**P**	**C**	**CH**
		3	0	0	**3**	4
Course Objectives	1. Provide knowledge about the basics of embedded systems and embedded system design 2. Describe Internet-of-Things and design principles 3. Explain the ease of prototyping and production, and think of deployment for the community. 4. Gain expertise in integrating sensing, actuation and software 5. Give knowledge about internet principles and techniques for writing embedded code					
Course Outcomes	On completion of this course the students will be able to: 1. Explain the basics of embedded systems and design embedded systems 2. Design and Develop Internet-of-Things based applications 3. Develop prototypes of Internet-of-Things based applications, and deploy for the usage of the community. 4. Integrate sensing, actuation and software 5. Write embedded code for constrained sensor devices					

COURSE CONTENTS

Unit 1: Introduction to Embedded Systems **[10hrs]**
Embedded systems, Processor embedded in to system, Embedded hardware units and software system, Examples of embedded system, System on Chip, Complex system design and processors, Design process and examples in Embedded systems, Classifications of embedded systems, Skills required for embedded system designer.

Unit 2: The Internet of Things: An Overview & Design Principles **[10hrs]**
Introduction to IOT, Wireless sensor networks, Applications of WSN, Roles in WSN, Calm and Ambient technology, Magic as Metaphor, Privacy: Keeping Secrets; Web Thinking for Connected Devices.

Unit 3: Prototyping IOT Devices **[12hrs]**
Prototyping Embedded Devices: Electronics: Sensors, Actuators, Scaling Up the Electronics; Embedded Computing Basics; Arduino; Raspberry pai, Beagle board ; **Prototyping Online Components:** Getting Started with an API :Mashing Up APIs ,Scraping ,Legalities, Writing a New API , Security ,Implementing the API ,Using Curl to Test, Going Further ;Real-Time Reactions :Polling ,Comet ; (**Self-study** :Other Protocols: MQ Telemetry Transport ,Extensible Messaging and Presence Protocol ,Constrained Application Protocol).

Unit 4: Internet Principles and Techniques for Writing Embedded Code [10hrs]

Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP; IP Addresses: DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses; TCP and UDP Ports: An Example: HTTP Ports,
(**Self-study:** Other Common Ports ;Application Layer Protocols :HTTP , HTTPS; Encrypted HTTP, Performance, , Libraries, Debugging).

Case studies

a. Current challenges in IOT.
b. Battery life for IOT devices.
c. Memory management for IOT devices.

Text Books:

1. Raj Kamal 'Embedded systems, 2nd edition, McGraw-Hill, 2008.
2. IoT in 5 days Antonio Liñán Colina, Alvaro Vives, Antoine Bagula, Marco Zennaro and Ermanno Pietrosemoli Revision 1.0 March 2015.
3. Adrian McEwen, Hakim Cassimally, 'Designing the Internet of Things', Wiley, 2014.

Reference Books:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, 'The Internet of Things: Key Applications and Protocols', Wiley, 2015.
2. Kurose, James F Ross, Keith W, 'Computer networking: a top-down approach', 5th edition, international edition, Boston, Mass Pearson, cop. 2010.
3. Frank Vahid, Tony Givargis, 'Embedded System Design: A Unified Hardware/Software Introduction', Wiley, 2006.
4. 'Design Automation for Embedded Systems', Springer.
5. IEEE, IEEE Internet of Things Journal
6. Elsevier, Journal of Network and Computer Applications.
7. Elsevier, Computer Law & Security Review
8. ACM, ACM Transactions on Internet Technology (TOIT)

Sub Code: B19EE5464	Artificial Intelligence	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. To study the concepts of Artificial Intelligence. 2. To learn the methods of solving problems using Artificial Intelligence. 3. To introduce the concepts of machine learning.					
Course Outcomes	On completion of this course the students will be able to: 1. Knowledge of what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence. 2. Apply Artificial Intelligence techniques for problem solving. 3. Explain how Artificial Intelligence enables capabilities that are beyond conventional technology					

Course Content:

UNIT I - Introduction to Al **[11 Hrs]**

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized production system- Problem solving methods- Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

UNIT II-Representation of Knowledge **[11 Hrs]**

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III-Knowledge Inference **[10 Hrs]**

Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory.

UNIT IV-Planning and machine learning **[10 Hrs]**

Basic plan generation systems - Strips -Advanced plan generation systems - K strips - Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

TEXT BOOKS

1. Kevin Night, Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, McGraw Hill- 2008. (Unit-1,2,4,)
2. Dan W. Patterson, “Introduction to AI and ES ”, Pearson Education, 2007. (Unit-3)

REFERENCES

1. Peter Jackson, “ Introduction to Expert Systems ”, 3rd Edition, Pearson Education, 2007.
2. Stuart Russel, Peter Norvig “ AI – A Modern Approach ”, 2nd Edition, Pearson ducation 2007.

Sub Code: B19EE5070	Power Electronics Lab	L	T	P	C	CH
Duration: 14 Weeks		0	0	2	2	3
Course Objectives	1. To get an overview of different types of power semi-conductor devices and their static characteristics. 2. To learn about the analog and digital triggering circuit for SCR. 3. To compare the performance of phase controlled rectifiers for various loads. 4. To study the operation and speed control of motors using DC-DC converter and AC Voltage controller. 5. To learn the different modulation techniques of pulse width modulated inverters.					
Course Outcomes	1. Acquire a basic knowledge of solid state electronics devices and its characteristics of SCR, IGBT and power MOSFETs. 2. Design circuit using electronic components such as resistors, capacitors, diodes and transistors. 3. Analyze electronic circuits such as control rectifiers, inverters, choppers & ac voltage regulators. 4. Describe the role of Power Electronics as an enabling technology in various applications.					

List of Experiments:

1. Conduct an experiment on SCR to plot its VI characteristics.
2. Conduct an experiment on MOSFET and IGBT plot their static characteristics
3. Conduct an experiment on half wave & full wave rectifier by triggering SCR using synchronized UJT relaxation Oscillator to plot the graph of output voltage Vs delay angle (α).
4. Conduct an experiment on half controlled rectifier & trigger the SCRs using digital firing scheme to plot the graph of output voltage Vs delay angle (α).
5. Conduct an experiment on Single phase fully controlled rectifier with R and RL loads & plot the graph of output voltage Vs delay angle (α).
6. Conduct an experiment on AC voltage controller using TRIAC and DIAC combination connected to R and RL loads to obtain the output voltage.
7. Conduct an experiment on separately excited DC motor using an IGBT chopper to control its speed.
8. Conduct an experiment on DC motor to control its speed using single phase semi converter.
9. Conduct an experiment on universal motor to control its speed using AC voltage controller.
10. Demonstrate an experiment on IGBT based single phase full bridge inverter connected to R load to study its principle of operation.
11. Simulation of speed control of DC motor using single phase controlled rectifier using MATLAB/SIMULINK.
12. Simulation of Buck/Boost converter using PSIM software.

<table>
<tr><td>Sub Code: B19EE5080</td><td rowspan="2">Electrical Machines Laboratory- II</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration :14 Weeks</td><td>0</td><td>0</td><td>2</td><td>2</td><td>3</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable the student to understand the working of DC and synchronous machines.
2. To enable the students to conduct testing on different types of electrical machines.
3. To enable the students to analyze the operation of electric machines under different loading conditions
4. To equip the students with the knowledge of synchronization of alternators.</td></tr>
<tr><td>Course outcomes</td><td colspan="6">At the end of this course, Student will be able to:
1. Calculate the voltage regulation of alternator
2. Determine the .efficiency of various DC Machines
3. Understand the starting and connecting procedures of synchronous generators, and to obtain the 'V' curves of synchronous motors.
4. Obtain the load characteristics of DC Motors and generators
5. Demonstrate the speed control of DC Motor</td></tr>
</table>

List of Experiments:

1. Determination of regulation of alternator by Synchronous Impedance method; Determination of regulation of alternator by zero power factor method; 'V' and 'Λ' curves of Synchronous Motor; Measurement of Xd & Xq of synchronous machine;
2. Parallel Operation of 3 Phase Alternator with infinite Bus Bar
3. Determination of efficiency of DC machine through Hopkinson s Test.
4. Speed control of DC motor by Ward-Leonard method
5. magnetization characteristic of separately excited DC generator and self-excited dc machines
6. Retardation Test on DC motor
7. V and inverted V curves of synchronous motor
8. Field Test on DC series Machines.
9. Slip test on synchronous generator
10. Swinburne's test on dc motor

<table>
<tr><td>Course Code</td><td rowspan="2">Soft Skill</td><td>Course Type</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Hrs./Wk.</td></tr>
<tr><td>B19EE5090</td><td>RULO</td><td>0</td><td>0</td><td>2</td><td>2</td><td>2</td></tr>
</table>

Note: The students will have to undergo Skill Development course being conducted by the School / Training and Placement Centre of the University.

Course Code	Skill Development	Course Type	L	T	P	C	Hrs./Wk.
B19EE5X10		RULO	1	0	1	**2**	2

VI Semester

<table>
<tr><td>Sub Code: B19EE6010</td><td rowspan="2">Computer Aided Power System Analysis & Stability</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>QSPre-Requisites</td><td colspan="6">Power system Analysis</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable students to understand the basics of network topology and its relevance in Power System Analysis
2. To enable students to understand the analysis of power system network topologies.
3. To enable students to learn the concept of power flow and its analysis by different methods
4. To enable students to understand different methods of stability analysis by different techniques</td></tr>
<tr><td>Course Outcome</td><td colspan="6">On successful completion of the course, student will be able to:
1. Identify the incidence of elements of given power system network.
2. Solve different examples related to network topology.
3. Identify state of the power system through different load flow techniques.
4. Demonstrate stability of power system through different methods.</td></tr>
</table>

Unit 1: Network Topology **[10hrs]**
Introduction, Elementary graph theory – oriented graph, tree, co-tree, basic cut-sets, basic loops; Incidence matrices – Element-node, Bus incidence, Tree-branch path, Basic cut-set, augmented cut-set, Basic loop and Augmented loop, Primitive network – impedance form and admittance form.

Unit 2: Load Flow Studies **[12hrs]**
Introduction, Power flow equations, Classification of buses, Operating constraints, Data for load flow, Gauss-Seidal Method – Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence; Newton Raphson's Method – Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only). Algorithm for Fast Decoupled load flow method, Comparison of Load Flow Methods.

Unit 3: Stability Analysis **[10hrs]**
Importance of stability analysis in power system planning and operation – classification of power system stability – angle and voltage stability – simple treatment of angle stability into small-signal and large-signal (transient) stability. Single Machine Infinite Bus (SMIB) system: Development of swing equation – Equal area criterion for transient stability evaluation and its applications.

Unit 4: Transient Stability Studies **[10hrs]**
Numerical solution of Swing Equation – Point-by-point method, Modified Euler's method, Runge-Kutta method, Milne's predictor corrector method. Representation of power system for transient stability studies – load representation, network performance equations. Solution techniques with flow charts.

Text Books:

1. Stag G. W and EI-Abiad, A. H, ‘Computer Methods in Power System Analysis’, McGraw Hill International Student Edition, 1968.
2. Pai, M. A, ‘Computer Techniques in Power System Analysis’, TMH, 2nd edition, 2005.
3. Nagrath, I. J., and Kothari, D. P, ‘Modern Power System Analysis’, TMH, 3rd Edition, 2003.
4. Singh, L. P, ‘Advanced Power System Analysis and Dynamics’, New Age International (P) Ltd, New Delhi, 2001.

Reference Books:

1. Dhar, R. N, ‘Computer Aided Power System Operations and Analysis’, TMH, 1984
2. Haadi Sadat, ‘Power System Analysis, TMH, 2nd Edition, 12th reprint, 2007

Sub Code: B19EE6020	**Computer Aided Electrical Drawing**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	1	4	5
Course Objectives	1. To understand the basics of concept of engineering drawing through AUTO CAD software. 2. To provide an overview of various sectional views of electrical machines. 3. To understand the basic sense of measurement. 4. To provide an insight into various dimensions of equipment used in transmission and distribution.					
Course Outcomes	On completion of this course the students will be able to: 1. Work with Auto CAD 2D classic and execute the basic commands of auto cad software 2. Draw the isometric and orthographic views of given objects 3. Draw the sectional views of Electrical Machines 4. Differentiate between single and three phase systems 5. Implement the knowledge of CAD and EE drawing in design of real time application					

COURSE CONTENTS

Unit 1 : Introduction to Computer Aided Drawing [12 Hrs]

Launching AutoCAD, Choosing Auto CAD classic workspace**,** Understanding basic toolbars, Drawing setting commands , Basic commands, Coordinate systems in Auto CAD, different types of lines, Dimensioning systems ,Methods of dimensioning diameters, radius, angular, Aligned dimensioning , Linear dimensioning, Radial dimensioning, Dimension style.(The dimensioning can be done with each one example), Isometric projections, isometric projections of rectangular objects like cube , prism, pyramids, cone, cylinder and sphere. Isometric projection of step block V block, cross. Orthographic projections , projection of point in all quadrants ,projection of straight lines, projections of triangular, square, pentagonal, hexagonal and circular in current positions. Description of sectional views i.e., plan view, elevation view, end view with one e.g.

Unit 2: Electrical Machines **[12 Hrs]**
Electrical machine assembly drawing using designs data or sketches or both.

a) Transformers Assembly - sectional views of single and three phase Core and Shell type Transformers.
b) Alternator Assembly – sectional views of stator and rotor separately.
c) D.C. Machine Assembly- sectional views of yoke, armature and commutator dealt separately. (Demo)
d) Induction Motor Assembly - sectional views of stator and rotor separately. (Demo)

Unit 3: Winding diagrams **[12 Hrs]**
Developed winding diagrams of D.C. machines – Simplex and multiplex double layer Lap and Wave windings. Developed winding diagrams of A.C. machines Integral and Fractional slot double layer Lap and Wave windings.

Unit 4: Diagrams of Transmission & Distribution Equipment's **[12 Hrs]**
Draw: Single line diagrams of various Substations,(Transformer substations only), Transmission Towers-110/220 KV single circuit and double circuit with dimensions, 220KV 'Y' Type single circuit Steel tower, Pin insulator 11KV, 33 KV Underground Cable for 11KV single core and three core Electrical Wiring plan of a residential building to be wired up with AEH installation (Load calculation, Heating and Lighting Circuit), Electrical wiring plan of an Electric laboratory using standard symbols , Plate &Pipe Earthing.

Text Books :

1. M Yogesh, BS Nagaraja, N Nandan, 'Computer Aided Electrical Drawing', First edition PHI 2014
2. SF Devalapur, 'Electrical Drafting', EBP, Seventh edition, 2006

Reference Books :

1. MS Indira ,V D Shankarlal , D Buela, 'CAD for Electric Engineers', First Edition, Elsevier learning, 2014
2. K R Goplalkrishna, 'Engineering Drawing', 2nd Edition
3. S K Bhattacharaya, 'Electrical Engineering Drawing', New age international publishers (Revised Second edition), 2010
4. https://sites.google.com/site/caedbymaheshkumar/

Sub Code: B19EE6030	Control Engineering	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. To understand the methods of representation of systems and their transfer function models, reduction of block diagrams to obtain the transfer function. 2. To understand the time response of system and its importance in the design of controllers. 3. To understand the importance of frequency response of the system in					

	the stability analysis of the same 4. To model the given system using state variable method
Course Outcomes	On completion of this course the students will be able to: 1. Represent the system by its transfer function 2. Demonstrate the time domain specifications of the given system 3. Determine the stability of given system using different frequency response analysis methods. 4. Draw the state space model of the given system

COURSE CONTENTS

Unit 1: Modeling of control system and their representations [10hrs]

Basic elements in control systems – classification of systems, Open and closed loop systems – Electrical analogy of mechanical systems

Block diagram: Block diagram representation, reduction techniques – Signal flow graphs.

Unit 2: Time response and controller characteristics [10hrs]

Time response – Time domain specifications – Types of test input – I and II order system response –Effect of adding zero to second order system steady state Error & coefficients

Controllers: Classification of controllers-P, PI, PID modes of feedback control, effect of integral and derivative control on the system performance.

Unit 3: Frequency response and stability analysis [10Hrs]

Frequency response – -advantages of frequency domain analysis- Bode plot, Relative and absolute stability, Frequency response of closed loop system.

Stability analysis: Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin.

Unit 4: State space analysis of control system [10Hrs]

State space representation electrical & mechanical systems, computation of transfer function from the state model, controllability and observability

Text Books:

1. I.J. Nagrath and M. Gopal, ‘Control Systems Engineering’, New Age International Publishers, 2003.
2. Syed hasan saeed, ‘Automatic control systems’, publishers of engineering and computer books, new Delhi, 6^{th} edition,2012.
3. Benjamin C. Kuo, ‘Automatic Control systems’, Pearson Education, New Delhi, 2003.

Reference Books:

1. K. Ogata, ‘Modern Control Engineering’, 4th edition, PHI, New Delhi, 2002.
2. Norman S. Nise, ‘Control Systems Engineering’, 4th Edition, John Wiley, New Delhi, 2007.
3. Samarajit Ghosh, ‘Control systems’, Pearson Education, New Delhi, 2004
4. M. Gopal, ‘Control Systems, Principles and Design’, Tata McGraw Hill, New Delhi, 2002.

Sub Code: B19EE6041	**Testing and Commissioning of**	**L**	**T**	**P**	**C**	**CH**

Duration: 14 Weeks	Electrical Equipment	3	0	0	3	4
Course Objectives	1. To enable students to understand the standard specifications of various electrical equipment as per BIS(Bureau of Indian Standard) 2. To enable the students to understand standard tests for installation of various electrical equipment as per BIS(Bureau of Indian Standard) 3. To enable the students to understand standard commissioning tests various electrical equipment as per BIS(Bureau of Indian Standard) 4. To enable the students to understand standard performance tests of various electrical equipment as per BIS(Bureau of Indian Standard)					
Course Outcomes	On completion of this course the students will be able to: 1. Be able to describe the standard specifications of various electrical equipment. 2. Be able to describe the standard tests, specifications for installation of various electrical equipment 3. Be able to describe the commissioning tests on various equipment 4. Be able to describe the performance tests on various equipment					

COURSE CONTENTS

Unit 1: Transformers **[10hrs]**

Specifications: Power and distribution transformers as per BIS standards.

Installation: Location, site, selection, foundation details (like bolts size, their number, etc.), code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings and general inspection.

Commissioning tests: Following tests as per national & International Standards, volt ratio test, earth resistance, oil strength, Bucholz & other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, load & temperature rise test.

Specific Tests: Determination of performance curves like efficiency, regulation etc,

Unit 2: Synchronous Machines **[10hrs]**

Specifications: As per BIS standards.

Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control, drying out.

Commissioning Tests: Insulation, Resistance measurement of armature & field windings, waveform & telephone interference tests, line charging capacitance test.

Performance tests: Various tests to estimate the performance of generator operations, slip test, maximum lagging current, maximum reluctance power tests, sudden short circuit tests, transient & sub transient parameters, measurements of sequence impedances, capacitive reactance, and separation of losses, temperature rise test, and retardation tests.

Factory tests: Gap length, magnetic eccentricity, balancing vibrations, bearing performance

Unit 3: Induction Motors **[10hrs]**

Specifications: for different types of motors.

Installation: Location of the motors (including the foundation details), shaft & alignment for various coupling, fitting of pulleys & coupling, drying of windings.

Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing.

Electrical Tests: Insulation test, earth resistance, high voltage test, starting up, failure to speed up to take the load, type of test, routine test, factory test and site test (in accordance with ISI code) **Specific Tests:** Performance & temperature raise tests, stray load losses, shaft alignment, and re-rating & special duty capability.

Unit 4: Switch Gear & Protective Devices **[10hrs]**
Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests.

Text Books:
1. S. Rao, 'Testing & Commissioning Of Electrical Equipment',
2. B .V. S. Rao, 'Testing & Commissioning Of Electrical Equipment'

Reference Books:
1. Relevant Bureau of Indian Standards
2. H. N. S. Gowda, 'A Handbook on Operation and Maintenance of Transformers'
3. Transformer & Switch Gear Handbook -Transformers-BHEL, J &P, J & P

Sub Code:B19EE6042	**Energy Storage Systems**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. To Validate the Necessity of Energy Storage and to study various types of storage systems. 2. To understand the use of fuels for storage Load management, Space conditioning, Transportation, Utility system, Variable energy sources, Role of different energy forms, Energy quality, Energy efficiency, Energy and power densities. 3. To achieve the ability to converse about the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics. Able to analyze the cost effectiveness and eco-friendliness of Fuel Cells					
Course Outcomes	At the end of this course, Student will be able to 1. Explain and use different modes of energy storage 2. Design and use of fuel cell for energy storage 3. Perform calculation regarding energy efficiency					

Course Content

Unit 1: Energy Demands and Energy Sources **[11hrs]**
World energy consumption. Energy in developing countries. Firewood crises. Indian energy sources. Non-conventional renewable energy sources. Potential of renewable energy sources. Solar energy types. Wind energy. Wave, tidal and OTEC. Super-conductors in power system.

Unit 2: Need of Energy Storage and Different Modes of Energy Storage **[11hrs]**
Potential energy: Pumped hydro storage; KE and Compressed gas system: Flywheel storage, compressed air energy storage; Electrical and magnetic energy storage: Capacitors, electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage. Solar Ponds for energy storage

Unit 3: Magnetic and Electric Energy Storage Systems **[10hrs]**

Superconducting Magnet Energy Storage (SMES) systems; Capacitor and Batteries: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube.

Unit 4: Fuel Cell Basics **[10hrs]**

Fuel cell definition, Difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cells, Fuel cell thermodynamics and its efficiency, Electrochemical kinetics, Butler-Volmer equation. Types of fuel cells and its chemistries – AFC, PAFC, PEMFC, MCFC and SOFC – merits and demerits. Fuel cells- global research development trends and application of PEMFC in automobile industry and application SOFC in stationery. Current issues in PEMFC.

Text Books:

1. Johannes Jensen Bent Squrensen, "Fundamentals of Energy Storage", John Wiley, NY , 1984.
2. S Srinivasan, "Fuel Cells: From Fundamentals to Applications", Springer 2006

References:

1. O'Hayre, SW Cha, W Colella and FB Prinz, "Fuel Cell Fundamentals", Wiley, 2005
2. Xianguo Li, "Principles of Fuel Cells", Taylor and Francis, 2005
3. J Larminie and A Dicks, "Fuel Cell Systems Explained", 2nd Edition, Wiley,2003

Sub Code: B19EE6043	**Electrical Engineering Materials**	**L**	**T**	**P**	**C**	**CH**
Duration:14 WEEKS		3	0	0	3	4
Course Objectives	1. To impart the knowledge of conducting, dielectric, insulating and magnetic materials and their applications. 2. To impart the knowledge of superconducting materials and their applications 3. To impart the knowledge of plastics and materials for Opto - Electronic devices. 4. To impart knowledge on electrical engineering materials used for special applications & Modern techniques involved in material studies					
Course Outcome	On successful completion of the course, student will be able to: 1. Understand various types of electrical & electronic materials & their applications. 2. Understand about magnetic and superconductive materials with their applications. 3. Understand about properties of Dielectric & various types of insulating materials. 4. Understand the special applications of the materials & modern techniques used for materials study.					

COURSE CONTENT

Unit 1: **[11Hrs]**

Introduction to Electrical and Electronic Materials: Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, Requirement of Engineering materials, Classification of solids on the basis of energy gap, Products – working principle and materials, Types of engineering materials, Levels of material structure. Spintronics and Spintronic materials, Ferromagnetic semiconductors, Left handed materials.
Conductors: Conductor materials, Factors affecting conductivity, Thermal conductivity, Heating effect of current, Thermoelectric effect, Seebeck effect, Thomson effect, Wiedemann – Franz law and Lorentz relation, Problems .

Unit 2: **[11Hrs]**
Magnetic Materials: Introduction, Types of magnetic materials, Soft and hard magnetic materials, High energy magnetic materials, magnetostriction.
Superconductive Materials: Concept of superconductors, Meaning of phenomenon of superconductivity, Properties of superconductors, Types of superconductors, Critical magnetic field and critical temperature, Effects of Isotopic mass on critical temperature, Silsbee rule, Depth of penetration and coherence length. Ideal and Hard superconductors, Mechanism of super conduction, London's theory for Type I superconductors, GLAG theory for Type I superconductors, BCS theory. Applications and limitations

Unit 3: **[10Hrs]**
Dielectrics: Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss. Dielectrics polarization under static fields- electronic ionic and dipolar polarizations, behavior of dielectrics in alternating fields, Factors influencing dielectric strength and capacitor materials.
Insulating materials: Inorganic materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and Bakelite), resins and varnishes, liquid insulators (transformer oil) gaseous insulators (air, SF_6 and nitrogen) and ageing of insulators.

Unit 4: **[10Hrs]**
Materials for Special applications: Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, and sintered alloys for breaker and switch contacts.
Modern Techniques for Materials studies: Optical microscopy, Electron microscopy, Photo electron spectroscopy, Atomic absorption spectroscopy, magnetic resonance, nuclear magnetic resonance, electron spin resonance and ferromagnetic resonance.

Text Books:

1. Electrical Engineering Materials, Kapoor PL, Khanna Publications.
2. Advanced Electrical and Electronics Materials; Processes and Applications K.M. Gupta Nishu Gupta Wiley First Edition, 2015
3. MEMS & MOEMS Technology & applications, P. Rai-Choudary (Editor), PHI,2009.

Reference Books:

1. Electronic Engineering Materials R.K. Shukla Archana Singh McGraw Hill 2012
2. Electrical Properties of Materials L Solymar et al Oxford 9th Edition, 2014
3. Electrical Engineering Materials A.J. Dekker Pearson 2016

4. Principle of Electronic Materials and Devices S.O. Kasap McGraw Hill 3rd Edition2010

<table>
<tr><td>Sub Code: B19EE6044</td><td rowspan="2">MEMS Technology</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration:14 WEEKS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Pre Requisites</td><td colspan="6">Basic Physics, Chemistry, Electronics and Mechanics, Basics of analog and digital sensors.</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To gain basic knowledge on overview of MEMS (Micro electro mechanical System)
2. To understand various fabrication techniques.
3. To gain knowledge of design, analysis, fabrication and testing the MEMS based components</td></tr>
<tr><td>Course Outcome</td><td colspan="6">On successful completion of the course, student will be able to:
1. Be familiar with the important concepts applicable to MEMS,their fabrication.
2. Be fluent with the design, analysis and testing of MEMS.
3. Apply the MEMS for different applications.
4. Describe the limitations and current challenges in microsystems technology
5. Describe the physics,chemical,biological and engineering principles involved in the design and operation of current and future micro devices</td></tr>
</table>

COURSE CONTENTS

UNIT-I: Overview of MEMS & Microsystems: [11hrs]
MEMS & Microsystems, Typical MEMS and Micro system products — features of MEMS, The multidisciplinary nature of Microsystems design and manufacture, Applications of Microsystems in automotive industry, health care industry, aerospace industry, industrial products, consumer products and telecommunications.

UNIT-II: Scaling Laws in Miniaturization and Transduction Principles in MEMS & Microsystems: [11hrs]
Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling electrostatic forces, electromagnetic forces, electricity.
Introduction, Micro sensors thermal, radiation, mechanical, magnetic and bio — sensors, Micro actuation, MEMS with micro actuators.
.

UNIT III: Microsystems Fabrication Process: [10hrs]
Introduction, Photolithography, Ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process, LASER micromachining.

UNIT-IV: Micro System Design and Modelling: [11 hrs]
Introduction, Design considerations: Process design, Mechanical design, Modeling using CAD tools: ANSYS / Multiphysics or Intellisuite or MEMS CAD, Features and Design considerations of RF MEMS, Design considerations of Optical MEMS (MOEMS), Design and Modeling: case studies - i) Cantilever beam ii) Micro switches iii) MEMS based SMART antenna in mobile

applications for maximum reception of signal in changing communication conditions and iv) MEMS based micro mirror array for control and switching in optical communications.

Text books:

1. Tai Ran Hsu, **“MEMS and Micro Systems : Design and Manufacture”**, Tata McGraw Hill, 2002
2. Boca Raton, **“MEMS and NEMS: Systems, Devices and Structures”**, CRC Press, 2002
3. J. W. Gardner and V. K. Vardan, **“Micro Sensors MEMS and SMART Devices”**, John Wiley, 2002
4. N. Maluf, **“Introduction to Micro Mechanical Systems Engineering, Artech House”**,
5. Norwood, MA, 2000.

<table>
<tr><td>Sub Code: B19EE6045</td><td rowspan="2">Big Data Analytics and Cloud Computing</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 weeks</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To make the Learners to Understand Hadoop Distributed File system and examine MapReduce Programming
2. To Explore Hadoop tools and manage Hadoop with Ambari
3. Introduce cloud computing and provide knowledge in different layers of cloud computing such as: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)
4. Describe various cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology, service technology.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon successful completion of this course, students will be able to
1. Master the concepts of HDFS and MapReduce framework
2. Investigate Hadoop related tools for Big Data Analytics and perform basic Hadoop Administration
3. Explain the cloud computing concepts such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)
4. Use various cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology; service technology</td></tr>
</table>

COURSE CONTENTS

Unit –I: [11 Hrs]

Hadoop Distributed File System Basics, Running Example Programs and Benchmarks, Hadoop MapReduce Framework, Map Reduce Programming

Unit –II: [10 Hrs]

Essential Hadoop Tools, Hadoop YARN Applications, Managing Hadoop with Apache Ambari, Basic Hadoop Administration Procedures

Unit-III: **[11 Hrs]**
Introduction to Cloud Computing**:** Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges.
Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

Unit-IV: **[10 Hrs]**
Cloud Computing Technologies: Broadband networks and internet architecture, data center technology, virtualization technology, web technology, multitenant technology, service technology
Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication, Ready-made environment

Text books:
1. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351
2. Anil Maheshwari, “Data Analytics”, 1st Edition, McGraw Hill Education, 2017. ISBN-13: 978-9352604180
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood Cloud Computing: Concepts, Technology & Architecture PHI, 2013.
4. Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, Distributed and Cloud Computing, MK, 2012.

Reference Books:
1. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", 1stEdition, Wrox Press, 2014ISBN-13: 978-8126551071.
2. Eric Sammer, "Hadoop Operations: A Guide for Developers and Administrators", 1st Edition, O'Reilly Media, 2012.ISBN-13: 978-9350239261.
3. Dan C. Marinescu, Cloud Computing: Theory and Practice, MK
4. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
5. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing- Principles and Paradigms, Wiley .

Sub Code: B19EE6051	**Power System Planning and Reliability**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To Introduce Concepts of Power System Planning 2. To Introduce Concepts of Load Forecasting 3. To Illustrate and Study The Concepts of Generation Planning 4. To Illustrate The Processes Of Transmission And Distribution Planning 5. To Introduce The Concepts of Demand Side Management & Energy Conservation 6. To Introduce The Concepts of Power System Reliability And Policies Involved					
Course Outcomes	On completion of this course the students will be able to:					

	1. Describe The Process Of Power System Planning and Load Forecasting 2. Visualize The Concepts Involved In Generation Planning 3. Realize The Importance Of Renovation And Modernization of Existing Power Plants 4. Identify The Objectives And Principles Involved In Transmission And Distribution Planning 5. Visualize The Concepts Of Power System Reliability 6. Describe The Concepts Pertaining To Financial And Techno – Economic Evaluation Of Power System

COURSE CONTENTS

Unit 1: System Planning & Load Forecasting [12 Hrs]

Introduction, Structure of Power System, Objectives & Factors Affecting System Planning, National and Regional Planning, Short Term Planning, Medium Term Planning, Long Term Planning, Planning Tools, Electricity Regulations, Classification of Load and Features, Objectives of Load Forecasting, Load Growth Patterns, Load Forecasting Methods – Extrapolation and Co – Relation Techniques, Peak Load Forecasting, Reactive Load Forecasting, Weather Sensitive Load Forecasting and Non – Weather Sensitive Load Forecasting

Unit 2: Generation Planning [12 Hrs]

Conventional and Non – Conventional Energy Sources, Objectives and Factors Affecting Generation Planning, Integrated Resource Planning, Generation Mix, Concept of Co – Generation, Loss of Load, Loss of Energy, Concept of Scheduled Outage, Automatic Generation Control (AGC), Renovation and Modernization of Power Plants

Unit 3: Transmission & Distribution Planning [12 Hrs]

Difference between Transmission and Distribution System, Single – Line Diagram of Radial Distribution System and Ring Main Distribution System, General Layout of Sub – Stations, Objectives of Transmission Planning, Principles of Distribution Planning, Selection of Transmission Voltage, Importance of Right – of – Way (ROW) Calculation, Advantages of HVDC Transmission System, Concept of FACTS, Rural Electrification, Role of Energy Storage in Power System, Demand Side Management and Techniques, Importance of Energy Conservation and Concept of Smart Grid

Unit – 4: Power System Reliability & Policies [12 Hrs]

Concept of Power Quality, Voltage Disturbances and their Features, Factors Responsible for Outages, Functions of Power Quality Metering, System Adequacy, System Reliability, System Security, CEA Reliability Criteria for Transmission Planning, Power Sector Finance and Financial Planning, Economic Analysis and Techno – Economic Viability and Concept of Rational Tariff

Text Books:

1. Electrical Power System Planning by A. S. Pabla; Macmillan India Ltd.
2. Power System Planning (2012) by R.L. Sullivan; Tata McGraw Hill Publishing Company Ltd.

Reference Books:

1. Reliability Evaluation of Power System (1986) by Roy Billinton & Ronald N. Allan; Springer Publication, 1986.
2. Modern Power System Planning (1994) by X. Wang & J.R. McDonald; McGraw Hill Book Company

<table>
<tr><td>Sub Code: B19EE6052</td><td rowspan="2">Modelling & Simulation of Electrical Machines</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 weeks</td><td>3</td><td>0</td><td>0</td><td>3</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand the concept of 2-axis representation of an Electrical machine.
2. To know the concepts of representing transfer function model of a DC machine.
3. To know the representation of 3-phase induction motor in various reference frames
4. To know the modeling of 3-phase synch. Motor in 2- axis representation.
5. An understanding of modeling and behavior of synchronous machines
6. To understand the importance reluctance motor and its principle</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon successful completion of this course, students will be able to
1. Determine the torque developed in a salient pole synchronous machine using the park’s transformation and identify contribution of saliency torque-damping torque and excitation torque.
2. Determine the developed torque in an electrical machines using the concepts of filed energy and co-energy and determine the dynamic model of a DC Machine
3. Learn the different types of reference frame theories and transformation relationships.
4. Students understand the relationship between real and reactive power control with application to the equivalent circuit of a synchronous machines
5. Determine the torque developed in a salient pole synchronous machine using the park’s transformation and identify contribution of saliency torque-damping torque and excitation torque.
6. Determine the dynamic model of an induction machine based on the dq0 transformation and determine instantaneous torque developed in an induction machine-which leads to advanced control strategies such as vector control and direct torque control.
7. Familiarize the modeling of electrical machines through equivalent circuit parameters and understand the variation in load change.</td></tr>
</table>

COURSE CONTENT

Unit – I **[10 Hrs]**

Energy state functions. Basic principles of electromechanical energy conversion, general expressions of generated voltage and force/torque; basic modeling of electrical machine from coupled circuit point of view; techniques of transformations, general volt ampere and torque equations under stationary and rotating reference from instantaneous symmetrical components and generated operational equivalent circuits, space vector concepts.

Unit – II **[10 Hrs]**

Modelling of D.C. Machines: Analysis under motoring and generating, simulation for transient and dynamic conditions, voltage build up in generators, effects of load change, run-up and dynamic operators of motors under different excitations, response under load change, reversal and braking.

Unit – III **[10 Hrs]**

Modeling of Synchronous Machines: d-q- transformations fixed to field structure-steady and dynamic equations, phasor diagrams for cylindrical rotor and salient pole machines, electromagnetic and reluctance torques, response under short circuit conditions, sub transient, transient and steady state conditions, simulation of vector controlled synchronous motors, computer simulation using mathematical software's.

Unit – IV **[10 Hrs]**

Modeling of Induction Machines: Equations under stationary and rotating reference frames, derivation of equivalent circuits, correlation of inductances, run-up transients, dynamics under load change, computer simulation to predict dynamic response, simulation of induction motors under soft start; VVVF and vector controlled drives. Unbalanced and asymmetrical operations, symmetrical components and rotating field theory – modeling and simulation of single phase motors. Modeling and analysis of Permanent Magnet, Switched Reluctance and Stepper Motors

Text Books:

1. Bernard Adkins, "The General Theory of Electrical Machines", Chapman & Hall Ltd.
2. Paul C. Krause, "Analysis of Electric Machinery", McGraw Hill.
3. Fitzgerald and Kingsley, "Electric Machinery".

Reference Books:

1. C. V. Jones, "Unified Theory of Electrical Machines", Butterworths Publishers.
2. D. C. White and H. H. Woodson, "Electromechanical Energy Conservation", McGraw Hill.
3. P. Kopylov, "Mathematical Models of Electric Machines", Mir Publisher.
4. O'Simmons and Kelly, "Introduction to Generalized Machine Theory".
5. Hancock, "Matrix Analysis of Electric Machinery".

Sub Code: B19EE6053	**Industrial Instrumentation and Automation**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. Learn about the types of transducers for industrial applications. 2. Bring out the various measurements involved in Power Plants. 3. Familiarize the student with the methods of monitoring different					

	parameters like speed, vibration of turbines & their control 4. Know about the tools like PLC, DCS, and SCADA
Course Outcomes	On completion of this course the students will be able to: 1. Select instruments and transducers for various physical variables. 2. Get an insight on data acquisition, processing and monitoring system. 3. Design various signal conditioning systems for transducers. 4. Understand the programming realization of PLC

COURSE CONTENTS

Unit 1: Introduction to Process Control **[12 hrs]**

Block diagram of process control loop, definition of elements. Sensor time response - first and second order responses. Review of Transducers: Characteristics and Choice of transducer- factors influencing choice of transducer.

Applications of Transducers - Displace measurement: Resistance potentiometer, Capacitive and Inductive. Capacitive differential pressure measurement- Torsional, shearing stress and rotating shaft Torque measurement using strain gauge. Flow measurement: Hotwire anemometer, constant resistance Constant current type Eddy current sensors, Variable reluctance tachometers Phase measurement. Analog and digital phase detectors.

Unit 2: Signal conditioning circuits **[12hrs]**

Instrumentation amplifiers, Unbalanced bridge. Bridge linearization using op amp Precision rectifiers, Log amplifiers, Charge amplifiers, Isolation amplifier, Switched capacitor circuits, Phase sensitive detectors, Noise problem in instrumentation and its minimization.

Measurements in Power Plants: Electrical measurements – current, voltage, power, frequency, power factor. Non electrical parameters- flow of feed water, fuel, air and steam with correction factor for temperature- steam pressure & steam temperature –drum level measurement-radiation detector – smoke density measurement – dust monitor.

Unit 3: Monitoring & Control in Power Plants **[12hrs]**

Speed, Vibration, Shell temperature monitoring and control – steam pressure Control – lubricant oil temperature control –Pollution monitoring- cooling system.

Overview of Automation System: Architecture of Industrial Automation Systems, Different devices used in Automation Actuators, definition, types, selection. Pneumatic, Hydraulic, Electrical, Electro-Pneumatic and valves, shape memory alloys.

Unit 4: Introduction to Sequence Control **[12hrs]**

PLCs - Working, Specifications of PLC Onboard/Inline/Remote IO's, Comparison of PLC & PC, Relay Ladder Logic- PLC Programming- realization of AND, OR logic, concept of latching, Introduction to Timer/Counters, Exercises based on Timers, Counters. Basic concepts of SCADA, DCS and CNC.

Text Books:

1. Curtis D. Johnson, 'Process Control Instrumentation Technology', 7th Edition, Pearson Edition, Pearson Education, New Delhi, 2002 / PHI.
2. DVS. Murthy, 'Transducers and Instrumentation' Second Edition, PHI Learning Pvt. Ltd New Delhi ,2013

3. K Krishnaswamy, M. Ponni Bala, 'Power Plant Instrumentation', Second Edition, PHI Learning Pvt. Ltd, New Delhi, 2013
4. Madhuchhanda Mitra, Samarjit Sengupta, 'Programmable Logic Controllers and Industrial Automation An Introduction', Penram International Publishing (India) Pvt. Ltd., 2009

Reference Books:

1. Doeblin E.O, 'Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, Newyork, 1992
2. G.K. McMillan, 'Process/Industrial Instrument and control and hand book' McGraw Hill, New York,1999.
3. R K Jain, Mechanical & Industrial Measurements, Khanna Publishers, New Delhi, 1995

Sub Code: B19EE6054	**Fundamentals of Robotics**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	At the end of the course the student should be able to 1. Classify Robots and anatomy. 2. Actuators and Kinematics. 3. Sensors and vision systems used in robots. 4. Robot Programming.					
Course Outcomes	On completion of this course the students will be able to: 1. Summarize the basic applications and advantages of using robots in the industry.(a,b,c,d) 2. Do the robot motion analysis. (a,b,c) 3. Relate mathematical modeling in robots. .(a,b,c,d) 4. Recognize the different types of sensors and cameras used in the field of robotics. .(a,b,c,d) **5.** Write robot programs (a,b,c,d,e,.f)					

COURSE CONTENTS

UNIT-1: Introduction of Robotics **[10hrs]**

Introduction–Robot Anatomy– Common robot configurations, robot motions, Work Volume Robot drive systems, Control systems and Dynamic performance, Precision, end effectors, Basic control system concepts and models Robot Applications:- Manufacturing Industry, Agricultural, Medical, Military, Space exploration.

UNIT- 2: Sensors **[12hrs]**

Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor-encoders, tachometers, Acceleration sensors, Force and Pressure sensors piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors. Machine Vision systems : Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation.

UNIT- 3: Actuators and Kinematics **[10hrs]**

Comparison of hydraulic, electric, pneumatic actuators, Hydraulic actuators, Electric motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics. Rotation and Translation of robotics, Euler angle representation for xyz frames. Homogeneous Transformations.

UNIT- 4 : Robot Programming **[10hrs]**

Methods of Robot programming, A robot program as a path in space, methods of defining positions in space, motion interpolation, wait, signal and delay commands, branching, Robotic languages, constants variables and other data objects, motion command send effectors and sensor commands, program control and subroutines

TEXT BOOKS:

1. Mikell P Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Oderey, " Industrial Robotics", Technology, programming and Applications, McGraw Hill, USA 1986.
2. James G. Keramas, "Robot Technology Fundamentals" Cengage Learning, 1999

REFERENCE BOOKS:

1. Fu K. S., Gonzelez R. C., Lee C. S. G., Robotics: Control, Sensing, Vision, Intelligence" , McGraw Hill Book Co., International edition, 2008.
2. Yorem Koren, "Robotics for Engineers", McGraw-Hill Publication, International edition, 1987
3. Craig, J. J., "Introduction to Robotics: Mechanics and Control", Pearson Prentice-Hall Publications, 3rd edition, 2005.
4. Schilling R. J."Fundamentals of Robotics, Analysis and Control",, Prentice-Hall Publications, Eastern Economy edition, 2007
5. Appu Kuttan K. K., "Robotics" I.K. International Publications, First Edition, 2007
6. R. K. Mittal, I. J. Nagrath, "Robotics and Control" Tata-McGraw-Hill Publications, 2007.

Sub Code: B19EE6055	**Programming in Java**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. Describe Java language syntax and semantics required for understanding Java programs (applets and applications) 2. Illustrate the usage of a Java-enabled browser and/or the applet viewer to execute Java applets along with Java Application Programming Interface and Java multi-class programs 3. Design, implement, test, and debug Java applications written using basic concepts such as primitive data types, various operators, control structures, single-subscripted arrays, and Java classes 4. Explain the Java applications written using applets and object-based programming techniques including classes, objects and inheritance					
Course Outcomes	On completion of this course the students will be able to:					

	1. Analyze the principles and concepts of object-oriented programming; 2. Use a Java-enabled browser and/or the applet viewer to execute Java applets 3. Use the Java interpreter to run Java applications 4. Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design. 5. Describe, modify and debug Java programs using primitive data types, various operators, control structures, single-subscripted arrays, multi-class and object-based programming techniques including classes, objects and inheritance

COURSE CONTENTS

Unit 1: **[10hrs]**

Primitive Data Types and Arithmetic: Data, Data Storage, Identifiers, Syntax, Variables and Constants, the Format of a Simple Program, Arithmetic, Operator Precedence, Casting,
Objects: Introduction to Objects, The String Class, The Anatomy of a Simple Program Revisited, The AVI Package, The Window Class, Input to a Dialog Box, Converting Strings to Numbers, Command Line Arguments, Errors

Unit 2: **[12hrs]**

Object-Oriented Programming: Abstract Data Type, Constructors, Instance Methods, Class Methods, Scope and Lifetime of Identifiers, Software Development, Object-Oriented Program Design, the AVI Package Revisited
Selection: More AVI Classes, If..else Statement, Nested If Statement, Conditional Expressions, Else if Statements, Boolean Data Type, Switch, Wrapper Classes, Yet another AVI Class!, The This Object.

Unit 3: **[12hrs]**

Repetition and One-Dimensional Arrays: Loop Structure, While Loop, Do..while Loop, Increment/Decrement Operators, For Loop, Which Loop?, Arrays Revisited, Declaring and Initializing One-Dimensional Arrays, Using Arrays, Our Last AVI Class: Check Boxes, Formatting Numbers for Output
Advanced Concepts with Classes: Inheritance, An Example of Inheritance, Overriding Superclass Methods, Polymorphism, Instance of Operator, Shadowed Variables, Inner Classes, Abstract Methods and Classes, Interfaces, Constructors Revisited, Instance Methods Revisited, Object Properties, Comparing Objects, Copying Objects, Passing Objects as Parameters, Garbage Collection and Object Finalization

Unit 4: **[8hrs]**

Exceptions and Streams: Introduction, Exception Classes, Catching an Exception, Catching Multiple Exceptions, Creating Your Own Exception Class, Throwing an Exception, Finally Blocks, Using Exception Handling, Stream Input and Output, The Stream Tokenizer Class, Text File Processing, The File Dialog,

Text Books:

1. Barry J. Holmes and Daniel T. Joyce, ‘Object-Oriented Programming With Java’, second Edition, Jones and Bartlett Publishers,2000
2. Dale Skrien, ‘Object-Oriented Design Using Java’, McGraw-Hill Higher Education, 2009

3. Danny Poo, 'Object-Oriented Programming and Java', Second Edition, Springer, 2008

Reference Books:

1. Cay Horstmann, 'Big Java',2nd Edition, John Wiley and Sons
2. Herbert Schildt, 'The Complete Reference Java J2SE', 5th Edition, TMH Publishing Company Ltd, New Delhi
3. H.M. Dietel and P.J. Dietel, 'Java: How to Program', Sixth Edition, Pearson Education/PHI
4. Cay. S. Horstmann and Gary Cornell, 'Core Java 2, Vol 1, Fundamentals', Seventh Edition, Pearson Education/PHI
5. Iver Horton, 'Beginning in Java 2', Wrox Publications

Sub Code: B19EE6061	**Smart Grid**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure. 2. To familiarize the power quality management issues in Smart Grid. 3. To familiarize the high-performance computing for Smart Grid applications					
Course Outcomes	On completion of this course 1. Students will develop more understanding on the concepts of Smart Grid and its present developments. 2. Students will study about different Smart Grid technologies. 3. Students will acquire knowledge about different smart meters and advanced metering infrastructure. 4. Students will have knowledge on power quality management in Smart Grids 5. Students will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.					

COURSE CONTENTS

UNIT – I

Introduction to Smart Grid **[12Hrs]**

Concept of Smart Grid, Definitions, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Smart Grid Vision & Roadmap for India, Present development & International policies in Smart Grid, Smart Cities, Pilot projects in India.

Smart Grid Technologies: Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Phase Measurement Unit (PMU). Smart Substations, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid (V2G), Grid to vehicles (G2V),

UNIT – II

Smart Meters and Advance Metering Infrastructure **[12Hrs]**

Introduction to Smart Meters, Advanced Metering Infrastructure (AMI), Real Time Prizing, Automatic Meter Reading (AMR), Outage Management System (OMS) Smart Sensors, Smart Appliances, Home & Building Automation, Geographic Information System (GIS). Smart storage technologies: Battery (flow and advanced), SMES, Super Capacitors, Pumped Hydro, Compressed Air Energy Storage (CAES) and its comparison.

UNIT – III **[12Hrs]**

Microgrids

Concept of Microgrid, need & applications of Microgrid, Microgrid Architecture, DC Microgrid, Formation of Microgrid, Issues of interconnection, protection & control of Microgrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Smart Microgrid Renewable Green Energy System, modelling of PV and wind systems, islanding

UNIT – IV

Communication Technology for Smart Grid **[12Hrs]**

Communication Architecture of SG, Wide Area Measurement System (WAMS), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols.

Text books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai “Integration of Green and Renewable
2. Energy in Electric Power Systems”, Wiley
3. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand
4. Response”, CRC Press.
5. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama,
6. “Smart Grid: Technology and Applications”, Wiley Publications.
7. Stuart Borlase, “Smart Grids-Infrastructure, Technology and Solutions”, CRC Press,
8. Taylor and Francis group
9. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu and Akihiko Yokoyama, “Smart
10. Grid Technology and applications”, Wiley Publications.
11. James Momoh, “Smart Grid-Fundamentals of design and analysis”, Wiley Publications.

Reference books:

1. Nikos Ziargyriour, “Micro grid, Architecture and Control”, IEEE Press, Wiley Publications.
2. Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press, Taylor and Francis group.
3. Lars T. Berger and Krzysztof Iniewski, “Smart Grid-Applications, Communications and Security”, Wiley Publications.
4. Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert, “Substation Automation (Power Electronics and Power Systems)”, Springer Publications.
5. Stephen F. Bush, “Smart Grid-Communication Enabled Intelligence for the Electric Power Grid”, IEEE Press, Wiley Publications
6. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, “Electrical Power System Quality”, 2nd Edition, McGraw Hill Publication.

Sub Code: B19EE6062	Reactive Power Management	L	T	P	C	CH
Duration:14 weeks		3	0	0	3	4
Pre Requisites	Power system, Power quality, Power Electronics					
Course Objectives	1. To understand the need for reactive power Compensation. 2. To understand the various types of Compensators for reactive power management. 3. To focus on reactive power co-ordination and management of reactive of reactive power in Distribution side.					
Course Outcome	On successful completion of the course, student will be able to 1. Identify different methods of reactive power compensation types of load patterns and loss reduction methods in distribution lines. 2. Analyze different types of compensations. 3. Identify the quality of power supply and reactive power coordination. 4. Analyze reactive power management in Distribution side.					

Course contents

UNIT-I: Reactive power compensation **[10Hrs]**

Need for Reactive Power compensation – reactive power characteristics. Ideal compensator, Practical compensation – power factor correction and voltage regulation in single phase system, phase balancing and power factor correction of unsymmetrical loads– examples

UNIT-II: Passive and active compensators **[12Hrs]**

Introduction, Uniformly distributed fixed compensation, Passive shunt compensation, Control of open circuit voltage by shunt reactance, Reactance of shunt reactors, multiple shunt reactors along the line.

Series compensation: Objectives and practical limitations, Symmetrical line with mid-point series capacitor and shunt reactor, Power transfer characteristics and maximum transmissible power for a general case, Fundamental concepts of compensation by sectioning. Principles of Static Compensation: Principle of operation of thyristor controlled reactor, Thyristors switched capacitor. Series Capacitors: Introduction, protective gear, reinsertion schemes, Varistor protective gear

UNIT-III: Reactive power coordination **[10Hrs]**

Reactive power coordination: Objective, Mathematical modeling, Operation planning, transmission benefits. Basic concepts of quality of power supply: Disturbances, steady – state variations, effects of under voltages, frequency, Harmonics, radio frequency and electromagnetic interferences.

UNIT-IV: reactive power management **[10Hrs]**

Demand side management: Load patterns, basic methods of load shaping, power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

Distribution side Management: System losses, loss reduction methods, examples, Reactive power planning: Objectives, Economic Planning, capacitor placement and retrofitting of capacitor banks.

TEXT BOOKS:

1. T.J.E. Miller, Reactive power control in Electric power systems, John Wiley and Sons, 1982
2. D.M. Tagare, Reactive power Management, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

REFERENCE BOOKS:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, Reactive Power Compensation: A Practical Guide, Wiley, April, 2012.
2. Power System Stability and Control, P. Kundur, TMH, 9th reprint, 2007.
3. Power System Voltage Stability, Carson. W. Taylor, McGraw-Hill, Inc.

Sub Code: B19EE6063	**Advanced Electrical Machines**	**L**	**T**	**P**	**C**	**CH**
Duration:14 weeks		3	0	0	3	4
Course Objectives	1. Know the concepts of Special type of electrical machines. 2. Learn about the different sensors used in Brushless DC Motors 3. Draw the characteristics of special type electrical machines 4. Understand the different control schemes for and PMSM **5.** Model the electrical machines with voltage, current, torque and speed equations.					
Course Outcome	On successful completion of the course, student will be able to 1. Analyze the characteristics of different types of PM type Brushless DC motors and to design suitable controllers 2. Apply the knowledge of sensors used in PMSM which can be used for controllers and synchronous machines. 3. Evaluate the steady state and transient behavior Linear induction motors 4. Analyze the different controllers used in electrical machines to propose the suitability of drives for different industrial applications. 5. Classify the types of DC Linear motors and apply the knowledge of controllers to propose their applications in real world.					

Course contents

UNIT I: Polyphase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power) **[10Hrs]**

UNIT II: Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications. Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits. **[10Hrs]**

UNIT III: Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PMAC motors, brushless dc motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators. **[10Hrs]**

UNIT IV: Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, linear force, and applications. **[10Hrs]**

Text Books:

1. T.J.E. Miller – Brushless PM and Reluctance Motor Drives, clarendon Press Oxford
2. Jacek Gierasewing - P. M. motor technology, Marcel Dekker.
3. R. Krishnan – Electric Motor Drives, PHI.

References:

1. P.S. Bimbhra "Generalized Theory of Electrical Machines" Khanna Publishers.
2. P.C. Sen "Principles of Electrical Machines and Power Electronics" John Wiley & Sons, 2001
3. G.K. Dubey "Fundamentals of Electric Drives" Narosa Publishing House, 2001

Sub Code: B19EE6064	**Analog and Digital Communication Systems**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To introduce analog communication and learn the techniques of amplitude modulation and single side band modulation of analog wave 2. To learn vestigial and frequency modulation techniques of analog wave 3. To introduce to digital communication 4. To learn digital waveform coding techniques					
Course Outcomes	After completion of the course, the student shall able to: 1. Describe and Differentiate different modulators of AM , DSBSC, SSB 2. Describe and Differentiate VSB and FM modulation schemes 3. Able to understand the fundamentals of digital communication schemes 4. Employ various digital waveform digital coding and modulation schemes					

Course contents

PART A: ANALOG COMUNICATION

Unit-1: Amplitude Modulation & Single Side Band Modulation (SSB) [11 Hrs]

Introduction, AM: Time-Domain Description, Frequency – Domain Description. Generation of AM Wave: Square Law Modulator. Detection of AM Waves: Square Law Detector. Double Side Band Suppressed Carrier Modulation (DSBSC): Time Domain Description, Frequency-Domain Representation, and Generation of DSBSC Waves: Balanced Modulator. Coherent Detection of DSBSC Modulated Waves. Single Side-Band Modulation, Frequency-Domain Description of SSB Wave, Phase Discrimination Method for Generating an SSB Modulated Wave. Demodulation of SSB Waves

Unit-2: Vestigial Side Band Modulation (VSB) & Frequency Modulation (FM) [10 Hrs]
VSB: Frequency Domain Description, Generation of VSB Modulated Wave, Coherent detection of VSB
FM: Basic Definitions, FM, Narrow Band FM, Wide Band FM, Transmission Bandwidth of FM Waves, Generation of FM Waves: Indirect FM And Direct FM. Demodulation of FM Wave- Balanced Frequency discriminator.

PART B: DIGITAL COMMUNICATION

Unit 3: Digital Communication Fundamentals [11 Hrs]
Digital communication-advantage, medium of transmission, block diagram of digital communication, Sampling theorem, Natural sampling, Flat top sampling, sample and hold circuit, Quadrature sampling of band pass signal, Quantization noise and SNR.

Unit 4: Waveform Coding and Digital Modulation Techniques [10 Hrs]
Waveform Coding Techniques: Time division multiplexing, Line coding , Differential pulse code modulation, Delta modulation, Adaptive delta modulation, Coding speech at Low bit rate, Introduction of Delta modulation errors (granular and slope overload).
Digital Modulation Techniques: Pulse Code Modulation, Coherent binary modulation techniques with constellation diagrams-Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Multiple access-TDMA, FDMA, CDMA

TEXT BOOKS:

1. Simon Haykins, "An Introduction to Analog and Digital Communication", John Wiley, 2003
2. Simon Haykin, "Digital Communication Systems", John Wiley publication, 3rd edition, 2008
3. Simon Haykins, "Communication Systems", John Willey, 3rd Edition, 1996

REFERENCE BOOKS:

1. Simon Haykin, "Digital and Analog Communication Systems", John Wiley publication, 3 rd edition, 2008.
2. K. Sam Shanmugam, "An introduction to analog and digital Communication system", John Wiley publication, 3rd edition, 2008.
3. Bernad Sklar, "Digital Communication", Pearson education 2007. 4. T L Singal, "Digital Communication", McGraw Hill Education 2015
4. B. P. Lathi, "Modern digital and analog Communication systems", Oxford University press, 3rd Edition, 2005.

Sub Code: B19EE6065	**Cryptography & Network Security**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. Explain the concepts of Cyber security 2. Illustrate key management issues and solutions. 3. Familiarize with Cryptography and very essential algorithms					

Course Outcomes	On completion of this course the students will be able to: 1. Discuss cryptography and its need to various applications 2. Design and develop simple cryptography algorithms 3. Understand cyber security and need cyber Law

Course Contents

Unit-1: **[10 Hrs]**

Introduction - Cyber Attacks, Defense Strategies and Techniques, Guiding Principles, Mathematical Background for Cryptography - Modulo Arithmetic's, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem, Basics of Cryptography - Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties, Secret Key Cryptography – Product Ciphers, DES Construction, Modes of Operation, MAC and Other Applications, Attacks, Linear Cryptanalysis

Unit-2: **[10 Hrs]**

Public Key Cryptography and RSA – RSA Operations, Why Does RSA Work?, Performance, Applications, Practical Issues, Public Key Cryptography Standard (PKCS), Cryptographic ash - Introduction, Properties, Construction, Applications and Performance, The Birthday Attack,

Discrete Logarithm and its Applications - Introduction, Diffie-Hellman Key Exchange, Other Applications, Elliptic Curve Cryptography and Advanced Encryption Standard - Elliptic urve Cryptography, Applications, Practical Considerations, Advanced Encryption Standard (AES).

Unit-3: **[10 Hrs]**

Key Management - Introduction, Digital Certificates, Public Key Infrastructure, Identity–ased Encryption, Authentication–I - One way Authentication, Mutual Authentication, Dictionary Attacks, Authentication– II – Centralized Authentication, The Needham-Schroeder Protocol, Kerberos, Biometrics, IPSec-Security at the Network Layer – Security at Different layers: Pros and Cons, IPSec in Action, Internet Key Exchange (IKE) Protocol, Security Policy and IPSEC, Virtual Private Networks, Security at the Transport Layer - Introduction, SSL Handshake Protocol, SSL Record Layer Protocol, Open SSL.

Unit-4: **[10 Hrs]**

IEEE 802.11 Wireless LAN Security - Background, Authentication, Confidentiality and Integrity, Viruses, Worms, and Other Malware -Preliminaries Viruses, Worm Features, Internet Scanning Worms, Topological Worms, Web Worms and Case Study, Firewalls – Basics, Practical Issues, Intrusion Prevention and Detection - Introduction, Prevention Versus Detection, Types of Instruction Detection Systems, DDoS Attacks Prevention/Detection, Web Service Security – Motivation, Technologies for Web Services, WS- Security, SAML, Other Standards.

Text Books:

1. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition

Reference Books:

1. Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay, Mc-GrawHill, 3rdEdition, 2015
2. Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition
3. Cyber Law simplified- Vivek Sood, Mc-GrawHill, 11threprint , 2013
4. Cyber security and Cyber Laws, Alfred Basta, NadineBasta, Mary brown, ravindra kumar, Cengage learning

Sub Code: B19EE6070	**Power System Simulation Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		0	0	2	2	3
Prerequisites:	Knowledge of transmission and distribution systems, computer techniques for power system analysis, power system analysis and stability.					
Course Objectives	1. To provide basic knowledge of software packages like MATLAB and MIPOWER for power system studies. 2. To adopt the coding skill to build the mathematical models of power system blocks. 3. To adopt the studied theoretical concepts of transmission and distribution systems for calculation of Ybus, and ABCD parameter calculation. 4. To study the stability issues of electrical machines. 5. To provide the basic knowledge of load flow analysis. 6. To equip students with the knowledge of fault and transient stability analysis. 7. To enable the students to evaluate the different generation systems for economic operation.					
Course Outcomes	After completion of the course, the student shall able to: 1. Express the real world problems into mathematical models 2. Evaluate the given case study to get the desired results. 3. Apply theoretical concepts to get transmission and distribution system models. 4. Interpret the result of stability analysis. 5. Write the coding for different load flow analysis techniques and also able to verify the results using MIPOWER software. 6. Discuss optimal scheduling of thermal power plants on the base of results from MIPOWER Software.					

List of lab experiments:

1. Y Bus formation for power systems with and without mutual coupling, by singular transformation.
2. Y Bus formation for power systems by inspection method .
3. ABCD parameters: Formation for symmetric π/T configuration. Verification of AD-BC=1 Determination of efficiency and regulation
4. Determination of power angle diagrams, reluctance power, excitation, emf and regulation for salient and non-salient pole synchronous machines.
5. To obtain swing curve and to determine critical clearing time and regulation for a single machine connected to infinity bus through a pair of identical transmission lines under 3-

phase fault on one of the lines for variation of inertia constant/line parameters /fault location/clearing time/pre-fault electrical output.

6. Write a program to perform load flow analysis for GS

Using Mipower Software

1. Load flow analysis using Gauss Siedel method, NR method for both PQ and PV buses.
2. Load flow analysis using fast decoupled method for both PQ and PV buses.
3. Symmetrical and unsymmetrical fault analysis
4. Transient stability analysis.

<table>
<tr><td>Sub Code: B19EE6080</td><td rowspan="2">Control System Laboratory</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration :14 Weeks</td><td>0</td><td>0</td><td>2</td><td>2</td><td>3</td></tr>
<tr><td>Course Objectives:</td><td colspan="6">1. To enable students to understand the usage of discrete components and operation of measuring and testing equipment.
2. To give an insight into usage of software packages like MATLAB/SCILAB for the realization of physical modules without actually exciting them.
3. To enable the student to understand the importance of transfer function in control system</td></tr>
<tr><td>Course outcomes:</td><td colspan="6">At the end of this course, Student will be able to:
1. Be able to understand the usage of measuring and testing equipment for different applications.
2. Be able to feel the hands on experience.
3. Be able to learn to formulate mathematical models for other physical quantities</td></tr>
</table>

List of Experiments:

1. a) Design and test a second order system RLC circuit for a given natural frequency ω_n and damping ratio ζ

   b) Determine experimentally the various performance parameters of a second order system and compare it with theoretical and simulated values.
2. To determine experimentally the frequency response of a second-order system and evaluation of frequency domain specifications.
3. Estimate the effect of open loop gain on the stability and transient response of closed loop system by using Root locus
4. Study the effect of P, PI, PD and PID controller on the step response of a feedback control system (using control engineering trainer/process control simulator). Verify the same by simulation.
5. Using MATLAB/SCILAB examine the relationships between open loop frequency and closed loop transient response
6. Design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response.
7. Design RC lag compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response.

8. Design RC lag-lead compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response.
9. a) Conduct an experiment to draw the speed – torque characteristic of a two - phase A.C. servomotor.
   b) Conduct an experiment to draw speed torque characteristic of a D.C. servomotor.
10. Using MATLAB/SCILAB verify the effect of the input wave form and system type on steady state errors.
11. Conduct an experiment to draw to synchro-pair characteristics

Course Code	**Soft Skill**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs./Wk.**
B19EE6090		RULO	2	0	0	2	2

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

Sub Code: **B19EE6X20**	**MOOC / SWAYAM**	**L**	**T**	**P**	**C**	**CH**
		2	0	0	2	2

Note: Students shall choose to take up any online course of four credits as guided by the school or shall have to undergo internship of four weeks duration, the details of which are provided here under.

MOOC/ SWAYAM:

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.

A student shall register and successfully complete any of the courses available on SWAYAM.

Student shall inform the MOOC/SWAYAM coordinator of the school about the course to which he/she has enrolled. The minimum duration of the course shall be not less than 40 hours and of 4 credits. The student should submit the certificate issued by the SWAYAM to the MOOC/SWAYAM coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University.

Internship: Minimum of four weeks duration internship should be carried out by the student either in industry or in an R&D organization, including educational institutes with excellent research culture. In case, if a student is unable to secure internship either in industry or in an R&D organization, a project may be carried out within the university. The student is expected to submit a formal report at the end of the internship programme. The student shall be awarded the marks for internship based on the (a) presentation and (b) comprehensive viva by the panel of examiners constituted by the school

Course Code	**Skill Development**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs./Wk.**
B19EE6X20		RULO	1	0	1	2	2

VII Semester

Sub Code: B19EE7010	Project Phase – I	L	T	P	C	CH
Duration: 14 Weeks		0	1	1	2	2
Course Objectives	1. To Articulate a clear research question or problem and formulate a hypothesis 2. To identify and demonstrate appropriate research methodologies and know when to use them 3. To define, articulate and use terminology, concepts, and theory in their field and know how to use them 4. To use library and other tools to search for existing body of research relevant to their topic 5. To know existing body of research relevant to their topic and explain how their project fits 6. To identify and practice research ethics and responsible to conduct in research					
Course Outcomes	On completion of this course the students will be able to: 1. Define research problem and formulate the hypothesis 2. Demonstrate research methodologies 3. Define terminology and understand the concepts related to the same 4. Do rigorous literature survey based on the problem defined 5. Compare the existing body of research and their proposed work 6. Practice research ethics 7. To document the problem definition, objectives and research methodology chosen to proceed in the form of Synopsis					

GUIDELINES

Guidelines for the preparation of the Report: As per the University Guidelines
Guidelines for the Evaluation:

1. Student has to submit a synopsis and give the preliminary presentation during C1 which carries 20% of the total marks
2. Students has to submit a report which is the documentation of the literature survey carried out and need to give a presentation of the project work , during C2, which carries 20% of the total marks
3. Students has to submit Project phase 1 report and need to give a presentation of the project work, during C3, which carries 60% of the total marks
4. All the above reports must undergo a plagiarism check which should not exceed 25% and failing which lead to resubmission.

Sub Code: B19EE7020	Signal Processing	L	T	P	C	CH
Duration: 14 Weeks		2	1	0	3	4

Course Objectives	1. Understanding the fundamental characteristics of signals and systems. 2. Understand general signals and system properties and linear and time-invariant systems 3. Apply digital signal processing fundamentals. 4. What are the key DSP concepts and how do they relate to real applications? 5. Master the representation of discrete-time signals in the frequency domain, using z-transform, discrete Fourier transform (DFT), and cosine transform. 6. Understand the implementation of the DFT in terms of the FFT, as well as some of its applications 7. Learn the basic forms of FIR and IIR filters, and how to design filters with desired frequency responses. 8. Appreciate relationships between first order low pass, and high pass filters, and between second-order Peaking and Notching filters. Design digital filters using MATLAB
Course Outcomes	On completion of this course the students will be able to: 1. Represent discrete-time signals analytically and visualize them in the time domain. 2. Understand convolution sum and integral 3. Understand the meaning and implications of the properties of systems and signals. 4. Understand the Transform domain and its significance and problems related to computational complexity. 5. Be able to specify and design any digital filters using MATLAB

COURSE CONTENTS

Unit 1: Introduction to signals & systems **[12hrs]**

Introduction, Definitions of signals and a system, Classification of signals, Basic operations on signals, Elementary signals viewed as interconnections of operations, Properties of systems. Convolution-integral & sum.

Unit 2: Z Transform and Inverse Z transform **[10hrs]**

Z-transform & Properties of ROC, Properties of Z-transforms, Inversion of Z-transform methods - power series and partial expansion, Transforms analysis of LTI systems - transfer function, Stability and causality.

Unit 3:

3a. Discrete Fourier Transforms **[12hrs]**

Definitions, properties-linearity, shift, symmetry etc, circular convolution –periodic convolution, use of tabular arrays, circular arrays, linear convolution –two finite duration sequence, one finite & one infinite duration, overlap add and save methods..

3b. Fast Fourier Transforms Algorithms

Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithms, algorithm, inverse decimation in time and inverse decimation in frequency algorithms

Unit 4: Design of IIR&FIR Digital Filters **[12hrs]**
Introduction, impulse invariant & bilinear transformations, all pole analog filters-Butterworth & Chebyshev, design of digital Butterworth & Chebyshev, frequency transformations FIR: Introduction, windowing, rectangular, modified rectangular, Hamming, Hanning, blackman window(excluding Kaiser window).

.

Text Books:

1. Simon Haykin and Barry Van Veen, 'Signals and Systems', John Wiley & Sons, 2nd edition, 2008
2. Michel J Roberts, 'Fundamentals of Signals and Systems ', TMH, 2nd Edition, 2010.
3. Proakis, 'Digital Signal Processing Principle, Algorithm & application', Pearson, 4th edition, 2009.
4. Sanjeet. K. Mitra, 'Digital Signal Processing', TMH, 3rd Edition, 2009.

Reference Books:

1. Johnny R. Johnson, 'Introduction to Digital Signal Processing', PHI, 2009.
2. Openheim, 'Discrete Time Signal Processing', Pearson 2nd edition, 2009.
3. S. Salivahanan, A. Vallaraj, C. Gnanapriya, 'Digital Signal Processing', TMH, 2nd Edition, 2010.
4. Ifeachor Emmauel, 'Digital Signal Processing', Pearson education, 2nd Edition, 2006.
5. Ludeman, John Wiley, 'Fundamentals of Digital Signal Processing', 3rd Edition, 2008
6. Alan V Oppenheim, Alan S. Willsky and S. Hamid Nawab, 'Signals and Systems', PHI, 2nd edition, 2009.
7. H P Hsu and others, 'Signals and Systems' , Schaums Outline Series, TMH, 2nd Edition, 2008

Sub Code: B19EE7031	**Advanced Control Engineering**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	1. To Understand the basics of mathematical modeling 2. To model any given system using state variable method 3. To obtain the transfer function from the state model, Eigen values and Eigen vectors of the given system 4. To test the controllability & observability of the given system 5. To determine the stability of the given non-linear system by Liapunov's methods					
Course Outcomes	On completion of this course the students will be able to: 1. Construct the state model of any given system by using phase variables and physical variables 2. Estimate Eigen values and Eigen vectors for the given system. Also determine transfer function from the state model 3. Test the controllability & observability of the given system 4. Determine the stability of the given non-linear system by Liapunov's methods					

COURSE CONTENTS

Unit 1: Modern Control Theory **[12 Hrs]**

Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems: State space representation using physical-phase and canonical variables, Characteristic equation - Eigen values and Eigen vectors - Invariance of Eigen values -Diagonalization - Jordan Canonical form

Unit 2: System Response **[10 Hrs]**

Transfer function from state model - Transfer matrix - Decomposition of transfer functions Direct, cascade and parallel decomposition techniques - State transition matrix computation- Solution of state equation

Unit 3: System Models **[08 Hrs]**

Concepts of controllability and observability - Kalman's and Gilbert's tests - Controllable and observable phase variable forms

Unit 4: Liapunov's stability **[10 Hrs]**

Liapunov stability analysis - Stability in the sense of Liapunov - Definiteness of Scalar Functions – Quadratic forms - Second method of Liapunov - Liapunov stability analysis of linear time invariant systems

Text Books:

1. Katsuhiko Ogata, 'Modern Control Engineering', Prentice Hall of India Private Ltd., New Delhi, Third Edition, 2002.
2. Nagrath I J and Gopal M, 'Control Systems Engineering', New Age International Publisher, New Delhi, 2006.
3. Gopal M, 'Digital Control and State Variable Methods', Tata McGraw-Hill Publishing Company Limited, New Delhi, India, Second Edition, 2003.
4. Nise S Norman, 'Control Systems Engineering', John Wiley & Sons, Inc, Delhi, Third edition, 2000.
5. Benjamin C Kuo, 'Automatic Control Systems', John Wiley & Sons, Inc., Delhi, 2002.

Reference Books:

1. Vidyasagar .M, 'Nonlinear system analysis', Prentice Hall Inc., New Jersey 2002
2. Singiresu S. Rao, 'Applied Numerical Methods', Prentice Hall, Upper Saddle River, New Jersey, 2001.
3. Jean-Jacques E. Slotine, Weiping Li, 'Applied Nonlinear Control', Prentice Hall Inc., New Jersey, 2004.

Sub Code: B19EE7032	**Electrical Energy Conservation**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	1. To understand the present energy scenario of energy generation and to understand the gap between energy supply & demand 2. To make students to understand the need for energy conservation to save the primary fuel for future generation and also to reduce the environmental burden. 3. To provide an overview of various energy conservation					

	opportunities for electrical equipment. 4. To study the importance of energy conservation for reduction of environmental burden. 5. To understand the importance of energy security and energy growth by implementation of energy conservation measures
Course Outcomes	On completion of this course the students will be able to: 1. Understand the energy losses in different equipment and control the losses 2. Develop capability in measurement and analysis of data to conserve energy. 3. Conduct performance test on electrical equipment and calculate the energy efficiency of equipment. 4. Develop the awareness on controlling of environmental pollution through implementing energy conservation measures. 5. Become an energy auditor and conduct energy audit

COURSE CONTENTS

Unit 1: Energy management **[12 Hrs]**

Energy sources, Types of Energy generation systems, Primary fuel and secondary fuel, Gap between energy supply and demand, Energy Conservation Act 2001, Energy audit, Types of energy audits, Preliminary energy audit, Detailed energy audit, Instruments used for energy audit, Energy conservation opportunities, Classification of energy conservation measures, Energy economic feasibility study, simple payback period, time value of money, cash flow, cost to benefit ratio, Reduction of environmental pollution, Energy audit reporting, Star labeling of electrical appliances and problems.

Unit 2: Demand and Power factor management **[10 Hrs]**

Demand management and Power factor management: Maximum demand, two part tariff, demand controller, concept and application of TOD metering system, smoothening of demand curve, fixed reactive power compensation, automatic reactive power compensation, APFC panels, economics of reactive power compensation and problems

Unit 3: Illumination system **[10 Hrs]**

Types of lamps used, principle of discharge lamps, performance of fluorescent lamps, compact fluorescent lamps, Lamps efficacy, Colour rendering index (CRI), Installed load efficacy ration (ILER), Types of street lights, Sizing of lighting equipments, Conventional coil wound ballasts, Electronic ballasts, Effect of voltage variation on lighting equipment, illumination level for different applications, LED lighting system and problems.

Unit 4: Electric Equipment **[12 Hrs]**

Energy conservation in motors: load factor, speed, efficiency, power factor, energy efficient motor, different speed control techniques, variable frequency drives, soft starters, rewinding of motors, and variation of power supply parameters like voltage variation, voltage unbalance and problems.
Energy conservation in transformers: Voltage ratio, loading of transformers, on-load & off load tap changers, power factor on secondary, unbalanced load on secondary, transformer management and problems.
Energy conservation in Air-conditioning system and Air compressors

Text Books & Reference Books:

1. S. Rao and B.B. Parulekar, ‘Energy Technology’, 4th edition, Khanna Publishers, 2005.
2. Eastop & Croft D.P, ‘Energy Efficiency for Engineers and Technologist’, Logman Scintific & Technical, ISBN-0-582-03184, 1990.
3. Reay D.A., ‘Industrial Energy Conservation’, 1st edition, Pergaman Press, 1977.
4. Amit K. Tyagi, ‘Handbook on Energy Audits and Management’, TERI, 2003.
5. J.B. Gupta, ‘Generation, transmission and utilization of electric power’, Kataria Publication, New Delhi, 1986.

<table>
<tr><td>Sub Code: B19EE7033</td><td rowspan="2">Computer Control of Electrical Drives</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>2</td><td>1</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Prerequisites</td><td colspan="6">Mathematics, Industrial drives (DC & AC Drives), Power Electronics</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Concept of development of microcomputer control of drives
2. Explain the architectural features of micro computers and digital implementation of drives
3. Discuss different types of compensators, digital firing schemes for power electronic devices.
4. Discuss micro controllers and micro computers for the control of AC/DC drives.
5. Simulate/Use power electronic devices for control of drives</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">1. Acquire knowledge on micro-computer control of various AC-DC Drives
2. Acquire knowledge on different types of digital firing schemes and compensators for power electronic devices.
3. Apply the knowledge of microcomputers and microcontrollers for the control of drives</td></tr>
</table>

Course Contents:

UNIT-I: Micro-Controllers in Electrical Drives [10hrs]

Merits and demerits of Microcomputer Control of Electric Drives, The Microcomputers adopted for control of electrical drives, relative features and architecture, Review of power converters useful for DC and AC drives (GTO, BJT, MOSFET, IGBT, MCT, IGCT), ratings, comparison and their applications, sensing circuits required for microprocessor based control (voltage, current, frequency and speed), Block diagram of power integrated circuit for DC Motor drives.

UNIT-II: AC Motor Drives [10hrs]

General classification and National Electrical manufacturer Association (NEMA) classification,
special control of induction motors with variable voltage, constant frequency, constant voltage variable frequency, (V/f) constant operation, drive operating regions, Microcomputer control of current source fed synchronous motor drive, digital firing circuit , optical encoder , four quadrant operation of synchronous motor drive .

UNIT-III: Microcontroller Control of Drives [12hrs]

Different types of Digital firing schemes for converters, Microcomputer control of converter fed DC motor drives (Digital Leonard control system), Automatic current regulating loop , automatic speed regulating loop and over all algorithm , Basic principle of vector control of Induction motors, phasor diagram and digital block diagram, microcomputer control of vector control of Induction motor. Electromagnetic interference (EMI) and line power quality problems

UNIT-IV: Expert System Based Control of Drives [10hrs]
(Only block diagram approach) Expert System shell, design methodology, ES based P-I tuning of vector controlled drive system, Fuzzy logic control for speed controller in vector control drives structure of fuzzy control in feedback system.

Text Books & References:

1. "A Microcomputer Control of Power Electronics and Drives", B.K Bose, 1987 edition, IEEE press.
2. "Power Electronics and Variable Frequency Drives Technology and Applications", B K Bose, IEEE Press, 1997.
3. Badri Ram "Fundamentals of Microprocessors and Applications", Dhanpat Rai, 2001.
4. W. Leonard "Control of Electric Drives", Springer Verlag, 2001.
5. Haitham Abu-Rub, Atif Iqbal, Jaroslaw Guzinski "High Performance Control of AC Drives", Wiley, 2012

Sub Code: B19EE7034	**Advanced Microcontrollers**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Prerequisites:	Basics of computer organization, basics of ALP and C programming.					
Course Objectives	1. Understand the architectural features and instruction set of MSP430, Arduino and ARM Cortex M3. 2. Program MSP430,Arduino and ARM Cortex M3 using the various instructions and C language for different applications. 3. To demonstrate the interfacing of various devices to the microcontrollers					
Course Outcomes	On completion of this course the students will be able to: 1. To recognize the architecture MSP430 microcontroller. 2. To program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled using the microcontroller. 3. To develop the ability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller. 4. Apply the knowledge gained for Programming Arduino for different applications. 5. Describe the architectural features and instructions of 32 bit microcontroller ARMCortex M3. 6. Apply the knowledge gained for Programming ARM Cortex M3 for different application					

Course Contents:

UNIT-I: MSP430 Microcontroller **[11hrs]**

MSP430 Architecture: Introduction –Where does the MSP430 fit, outside view, inside view-Functional block diagram, Memory, Central Processing Unit, Memory Mapped Input and Output, Clock Generator,
Exceptions: Interrupts and Resets, MSP430 family.
Addressing Modes & Instruction Set-Addressing Modes, Instruction set**,** Constant Generator and Emulated Instructions, Program Examples.

UNIT-II: Arduino Microcontroller **[11hrs]**

Arduino Hardware, software tool, Programming and Applications: Introduction -Arduino IDE tool and family of Arduino boards, Getting Started with IDE, Making the Sketch Do Your Bidding, Mathematical Operators, Serial Communications, Simple Digital and Analog Input, Getting Input from Sensors, Physical Output **.**

UNIT III: Arm Microcontroller **[11hrs]**

ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM,
Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence

UNIT-IV: ARM Cortex M3 Instruction Sets and Programming: **[10 hrs]**

Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming.

Text Books:

1. John Davies, “MSP430 Microcontroller Basics”, Elsevier, 2010 (Indian edition available).
2. Michael Margolis, “Arduino Cookbook”, 2^{nd} –Edition , 2013,Publisher:O’reilly Media Inc,ISBN:978-1-449-31387-6
3. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes,

Sub Code: B19EE7035	**Software Testing**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		2	1	0	3	3
Prerequisites	Software Engineering					
Course Objectives	1. To describe various terminologies of software engineering and testing. 2. To examine fundamental software processes and the activities involved. 3. To understand various software process models and the process activities involved in software engineering and system engineering.					

	4. To enable students distinguish between verification and validation process in software. 5. To understand the black box testing strategy.
Course Outcomes	On completion of this course the students will be able to: 1. Describe the terminologies of software engineering and testing 2. Apply the principles of Professional and ethical responsibilities in software engineering practices. 3. Understand various software process models and the process activities involved in software engineering and system engineering. 4. Distinguish between verification and validation process in software. 5. Understand the black box testing strategy.

Course Contents: This course introduces to the concept of software engineering and the contribution of software testing towards it. It examines fundamental software processes and the activities involved in it. This course emphasises the need for the software testing, especially with regard to critical system. The process of verification and validation and the different types of testing done on a system is introduced. The process of black box testing is introduced and described briefly.

COURSE CONTENTS:

Unit 1 **[12 Hrs]**

Introduction: Definition and terminology used in software engineering and software testing, FAQs in Software engineering, Professional and ethical responsibility, Socio-Technical systems-emergent properties, Systems engineering.

Software processes: Software process models-waterfall model, evolutionary, CBSE, process activities

Unit 2 **[12 Hrs]**

Software Testing: Psychology of testing, economics of testing, software testing principles. principles of SDLC and Testing, Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies.

Examples: Generalized pseudocode, the triangle problem, the commission problem, The SATM system.

Unit 3 **[12 Hrs]**

Verification & Validation: definitions of V & V, planning V &V, software inspection.

Software testing –system testing, - integration testing, release testing, performance testing; component testing – interface testing.

Unit 4 **[12 Hrs]**

Black box testing techniques: Boundary value analysis, Robustness testing, worst case testing-triangle problem. Equivalence partitioning- classes, triangle problem, Decision table-technique-triangle problem.

Self-learning component:

White box testing, automated testing tools

Recommended Learning Resources (Text books):

1. Ian Summerville; Software Engineering; 8th Edition; Pearson Education; 2007.(unit 1,3)
2. Glenford J. Myers, The Art of Software Testing, John Wiley & Sons 1979 (unit 2)
3. P.C. Jorgensen, Software Testing A Craftman s Approach , CRC Press 1995(unit 2,4)

Recommended Learning Resources (Reference books):

1. William E. Perry, Effective Methods for Software Testing (2nd Edition), John Wiley & Sons 2000.
2. Boris Beizer, Software Testing Techniques (2nd Edition) , Van Nostrand Reinhold1990.

Sub Code: B19EE7041	**HVDC**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	1. To understand the basic concepts underlying High Voltage dc Transmission. 2. To introduce the various topologies of the power electronics circuits 3. To emphasize the significance of HVDC Transmission and its modern trends and applications. 4. To educate the general principle of HVDC control and harmonic elimination in HVDC Systems					
Course Outcomes	On completion of this course the students will be able to: 1. Identify significance of DC over AC transmission system, types and application of HVDC links in practical power systems. 2. Understand the operation of HVDC conversion technology. 3. Analyze different converters.3, 6 and 12 pulse converter. 4. Analyze AC/DC system interactions and know the operation and control of various MTDC systems. 5. Model AC/DC system and protection for HVDC system against transient overvoltage and over currents apply					

COURSE CONTENTS

UNIT I INTRODUCTION [10Hrs]

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems

UNIT II ANALYSIS OF HVDC CONVERTERS [10Hrs]

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes

UNIT III CONVERTER AND HVDC SYSTEM CONTROL [10Hrs]

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS [10Hrs]

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – Modeling of DC/AC converters, Controller Equations-Solutions of AC/DC load flow —Simultaneous method-Sequential method. case study.

TEXT BOOKS & REFERENCES:

1. HVDC Power Transmission Systems: Technology and system Interactions, K.R. Padiyar, New Age International (P) Limited.
2. J Arrillaga, "*High Voltage Direct current Transmission*", Peter Peregrinus Ltd, UK.
3. EW Kimbark, "*Direct Current Transmission*", Wiley-Interscience, New York.
4. HVDC Transmission, S. Kamakshaiah, V. Kamaraju, The McGraw Hill Companies.

<table>
<tr><td>Sub Code: B19EE7042</td><td rowspan="2">Operation & Control of Power Systems</td><td>L</td><td>T</td><td>P</td><td>C</td><td>CH</td></tr>
<tr><td>Duration:</td><td>2</td><td>1</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Pre Requisites</td><td colspan="6">Power system Analysis, Computer Techniques in Power system analysis & Stability</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models and Load Frequency Control (LFC).
2. To provide the knowledge of Economic Operation & Unit Commitment used in the power system.
3. To provide the knowledge of Power System security & state estimation.
4. To provide the knowledge of SCADA and the concepts of Deregulation</td></tr>
<tr><td>Course Outcome</td><td colspan="6">On successful completion of the course, student will be able to:
1. Model and design the Components for generator Control loops.
2. Understand the importance of economic operation & Unit Commitment in power system.
3. Understand the different techniques used to provide security to power system.
4. Understand about SCADA system, Electricity market &power system de-regulation.</td></tr>
</table>

COURSE CONTENTS

Unit-1: Automatic Generation Control [11Hrs]

Automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model. Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of A VR, ALFC of single area systems, concept of control area, multi-area systems, POOL operation-two area systems, tie-line bias control.

Unit-2: Economic Operation of Power Systems & Unit commitment [11Hrs]

Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Iterative techniques; Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula,
Statement of the Unit Commitment problem, need and importance of unit commitment, Constraint in Unit Commitment, Unit Commitment solution methods-Priority lists method, Forward Dynamic Programming method(excluding problem), Spinning reserve.

Unit-3: Power System security [6Hrs]

Introduction, factors affecting power system security, Security analysis, Contingency Selection, Techniques for contingency evaluation-D.C. load flow and fast decoupled load flow.

System Monitoring & Control [6Hrs]
Introduction , Basis of power system state estimation(PSSE), mathematical description of PSSE process, minimization technique for PSSE, Least Square estimation, Error and detection in PSSE, System security and emergency control.

Unit 4: SCADA and Power System De-Regulation [8Hrs]
Introduction- SCADA, Motivation for restructuring of power systems- Electricity market entities model benefits of deregulation- Terminology-Deregulation in Indian power sector-Operations in power markets-Power pools-Transmission networks and electricity markets.

Text Books:

1. Nagrath, I. J., and Kothari, D. P, ‘Modern Power System Analysis’, TMH, 3rd Edition, 2003.
2. A.J. Wood & B.F. Woollenberg, ‘Operation and Control’, John Wiley Power Generation, 2nd edition.

Reference Books:

1. P. Venkatesh. B.V. Manikandan, S. Charles Raja, A. Srinivasan, ‘Electrical power systems: Analysis, security, Deregulation’, PHI 2012.
2. A. Chakravarthi and S. Halder, ‘Power System Analysis Operation and Control ‘, PHI, 3rd Edition.
3. O I Elgerd, ‘Electric Energy Systems’, Mc Graw-hill.

Sub Code: B19EE7043	Non-Conventional Energy Sources	C	L	T	P	CH
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	5. To analyze the environmental and cost economics of using renewable energy sources compared to fossil fuels. 6. To understand the solar geometry required to estimate the					

	solar radiation. 7. To estimate maximum power available in wind. 8. To introduce various renewable energy conversion technologies like Biomass, Geothermal, Ocean energy. 9. To introduce Magnetohydrodynamic system and energy storage systems
Course Outcomes	On completion of this course the students will be able to: 5. Select the appropriate renewable energy as an alternate for conventional power in any application. 6. Design solar PV module for any given application. 7. Deduce maximum power available in any given location. 8. Acquire the knowledge of modern energy conversion technologies. 9. Understand characteristics of the storage systems

COURSE CONTENTS

Unit 1:
[12hrs]

Introduction: Energy Sources and their availability, renewable energy sources, Prospects of renewable energy sources.

Energy Scenario: Energy needs of India – Energy consumption patterns – Worldwide Potentials of these sources – Energy efficiency – Energy security – Energy and its environmental impacts – Global environmental concern – Kyoto Protocol.

Unit 2:
[12hrs]

Solar Energy: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems);

Solar thermal Systems – Types of collectors – Collection systems – Applications – Photo Voltaic (PV) technology – Solar cells – Cell technologies – Characteristics of PV systems – Equivalent circuit – Building integrated PV system and its components – Sizing and economics – Peak power operation – Standalone and grid interactive systems.

Wind Energy: Energy available from wind, General formula, Lift and drag. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, Advantages and Disadvantages of WECS.

Unit 3:
[12hrs]

Bio Mass Energy: Biomass conversion technologies bio mass generation, classification of Bio Gas Plants, Factors affecting Biogas generation, Biomass program in India.

Geothermal Energy: Sources of Geothermal energy Estimation of Geothermal Power, Geothermal Power Plants, Geothermal energy in India and Prospects.

Ocean Energy: Ocean thermal energy conversion(OTEC), Principle of OTEC system, Methods of OTEC power generation, site selection, Prospects of ocean energy in India, – Principle of Tidal Power, Tidal Power Plant, Prospects in India.

Unit 4:
[12hrs]

MHD & Hydrogen Energy: Basic Principle of MHD (magnetohydrodynamic) system, advantages, Power OUTPUT of MHD Generation, future Prospects. Principle and classification of fuel cell energy, hydrogen as alternative fuel for Generation of Electrical Energy & applications.

Energy Storage: Battery – Types – Equivalent circuit – Performance characteristics – Battery design – Charging and charge regulators – Battery management – Fly wheel energy relations – Components – Benefits over battery – Storage systems – Ultra capacitors.

Text Books :

6. Rai, G. D., 'Non-Conventional Energy Sources', Khanna Publishers, 5th edition.
7. D.P Kothari, K.C.Singla, Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies', PHI Publications.
8. Bansal Keemann, Meliss, 'Renewable energy sources and conversion technology', Tata McGraw Hill.

Reference Books:

1. Mittal, 'Non-conventional Energy Systems', Wheelers Publication.

Ramesh R & Kumar K U, 'Renewable Energy Technologies', Narosa Publishing House

Sub Code: B19EE7044	**Optical Fibre Communication**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		2	1	0	3	3
Course Objectives	1. Conceptualize and analyze mathematically propagation of optical					

	signals over optical Fiber cables. 2. Conceptualize the degradation of signals during propagation of optical signals over optical fiber. 3. Explain the construction and characteristics of optical sources and detectors. 4. Analyze various techniques for coherent transmission and system performance factors in optical Communication system.
Course Outcomes	After completion of the course, the student shall able to: 1. Conceptualize and analyze mathematically propagation of optical signals over optical Fiber cables. 2. Conceptualize the degradation of signals during propagation of optical signals over optical fiber. 3. Explain the construction and characteristics of optical sources and detectors. 4. Analyze various techniques for coherent transmission and system performance factors in optical Communication system.

Course Contents:

Unit-1: Overview to Optical Fiber Communication [11 Hrs]

Electromagnetic spectrum, Optical spectral Bands, Multiplexing Techniques, WDM concepts, General system, Advantages and Applications of fiber optic transmission systems, Optical laws and Definitions - TIR , Numerical Aperture, Acceptance angle, Fiber Modes and Configurations, Step-index and Graded-index fiber, Single mode and Multi-Mode fibers, Modal Concepts - V Number, Average optical power, Cutoff wavelength, Modes supported by SI and GI fiber, MFD, Fiber Materials

Unit-2: Signal Distortion in Optical Fibers [10 Hrs]

Attenuation, Scattering Losses – Concepts of Rayleigh, Mie, Brillouin and Raman Scattering, Fiber Bend Loss, Dispersion – Concepts of Modal Dispersion, Material Dispersion, Waveguide Dispersion, Polarization Mode Dispersion, Optical Amplifier – Principle Operation of EDFA, Fiber to Fiber Joints, Fiber Connectors – Butt Joint Connector, Expanded Beam Connector, Fiber Couplers – FBT coupler, Star coupler using FBT technique, Fiber Splicing Techniques

Unit 3: Optical Transmitter and Receiver [11 Hrs]

Semiconductor Physics background, Optical sources – LED structures, Materials, Laser Diodes –Modes & threshold conditions, Construction and Principle operation of Semiconductor Laser, Concepts of Fabry-Perot resonator, Optical Detectors – Physical Principle of PIN and APD, Definitions – Photo Detector Noise, Detector Response Time, Comparison of Photo Detectors, Optical Receiver – Fundamental Receiver Operation, Receiver sensitivity, Quantum Limit, Eye diagrams, Concepts of Coherent detection.

Unit 4: OFC System Design Considerations [10 Hrs]

Analog Links – Overview of Analog Links, CNR, Multichannel Transmission Techniques, Link Parameters Definitions – Gain, Noise Figure, SFDR, Digital Links – Simplex Point to point link, System Considerations, Link Power Budget and Rise Time Budget with examples, Power Penalties, Modal noise, Mode-Partition Noise ,Reflection Noise, Chirping

TEXT BOOKS:

1. Gerd Keiser, ‘Optical Fiber Communications’, TMH, 4th Edition, 2008
2. John M. Senior, ‘Optical Fiber Communications’, Pearson Education, 3rd Edition, 2009

REFERENCE BOOKS:

1. D.K. Mynbaev, S.C. Gupta and Lowell L. Schemer, “Fiber Optic Communications”, Pearson Education, 2005
2. G. P. Agarawal, “Fiber Optics Communication Systems”, John Wiley New York, 1997
3. Joseph C Palais ,“Fiber Optic Communication”, 4th Edition, Pearson Education

Sub Code: B19EE7045 **Duration: 14 weeks**	**Computer Network Concepts and Protocols**	**L** 2	**T** 1	**P** 0	**C** 3	**CH** 3
Prerequisites	Fundamentals of Computer Science, Digital Principles and Computer Organization.					
Course Objectives	1. Describe the concept of Protocol Stacks (OSI and TCP/IP), data communication with packet switching and virtual circuit networks. 2. Give knowledge about network topologies and Ethernet standards 3. Explain various media access techniques, error detection and correction mechanisms 4. Familiarize the students with routing and error reporting protocols 5. Gain expertise in transport layer and application layer standards and protocols.					
Course Outcomes	After completion of the course, the student shall able to: 1. Use protocol stacks (OSI and TCP/IP) for developing data communication applications 2. Apply error detection & correction strategies for data transmission 3. Establish network of computing devices using topology and Ethernet standards 4. Experiment routing protocols and error reporting protocols 5. Design and develop communication applications using TCP/UDP standards					

Course Contents:

Unit – I: **[11 Hrs]**

Introduction to Data Communication and Networking: Internet history and Internet today, Data Communications, Networks, Protocols & Standards, 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.

Unit – II: **[11 Hrs]**

Concepts of Multiplexing, FDM, WDM, TDM, Line coding methods, Digital Modulation techniques, **Networking Devices:** Digital Subscriber Line Modems, Cable Modems, Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways.
Error Detection and Correction: Introduction, cyclic Codes: Cyclic redundancy code generation for checksum. Frames, Packets, Point-to-Point Protocol, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token passing.

Unit-III: **[11 Hr]**
Network Topologies, Classification of Networks, Protocols, PPP, IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.11, Architecture, MAC Sublayer, Addressing Mechanism. IPv4 addresses, IPv6 addresses, transition from IPv4 to IPv6.

Unit-IV: **[11 Hrs]**
Standards and Protocols: User Datagram Protocol (UDP): UDP Segment, Transmission Control Protocol (TCP): TCP Segment, Connection Set up, Application of TCP and UDP. TCP Congestion Control.
Domain Name System (DNS): Name/Address Mapping, DNS Message Format. Remote Login Protocols: TELNET Protocol and SSH Protocol. Electronic Mail (E-Mail), World Wide Web (WWW).
Basic concepts of FTP, GSM, LTE, MPLS, VPN, ATM, Bluetooth. WiFi, WiMax.

Recommended Learning Resources:

1. Behrouz A Forouzan: Data Communications and Networking, 4th Edition, McGraw – Hill, 2006
2. Nader F. Mir: Computer and Communication Networks, Pearson Education, 2009

Sub Code: B19EE7060	Signals Processing Laboratory	L	T	P	C	CH
Duration: 14 Weeks		0	0	2	2	3
Course Objectives	The main objectives of this course are to: 1. Design & implementation on various DSP operations using MATLAB. 2. Demonstrate convolution and filtering operations using DSP processor. 3. To design and implementation of IIR and FIR filters for given frequency specifications. 4. To help the students in developing software skills.					
Course Outcomes	On completion of this course the student will be able to: 1. Demonstrate the concept of sampling. 2. Compute the convolution of the pair of signals in time domain. 3. Determine the impulse response of IIR Filter and FIR Filter. 4. Design of Butterworth and Chebyshev filter for different specification.					

A. List of Experiments using MATLAB:

1. Perform the Linear convolution of any two given sequences in time domain.
2. Computation of N point DFT of a given sequence using the definition of DFT and plot magnitude and phase spectrum, and verify using built in function (using FFT).

3. Perform the Circular convolution of two given sequences in time domain.
4. Perform Circular convolution of any two given sequences in frequency domain by using DFT and IDFT. 5. Obtain the Auto correlation and cross correlation of a given sequence and verify its properties.
5. Verification of Sampling theorem.
6. Design of digital Low-pass and High-pass Butterworth IIR filter to meet the given specifications using Bilinear transformations.
7. Design of digital Low-pass and High-pass Chebyshev IIR filter to meet the given specifications using Bilinear transformations.
8. Design of digital Low-pass FIR filter to meet the given specifications using windowing technique.

B. List of Experiments using DSP Processor:

1. Linear convolution of two given sequences.
2. Circular convolution of two given sequences.
3. Computation of N-point DFT of a given sequence.
4. Solving a linear constant coefficient difference equation.
5. Audio applications such as to plot time and frequency spectrum, display of microphone output plus a cosine using DSP. Read a wav file and match with their respective spectrograms.

Sub Code: B19EE7070	**Relay and High Voltage Lab**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Weeks		0	0	2	2	3
Course Objectives:	1. To make the students gain the knowledge of operation of over current, under voltage relays. 2. To measure HVAC and HVDC using spheres. 3. To analyze the characteristics of fuse.					
Course outcomes	At the end of this course, Student will be able to: 1. Develop skills to measure HVAC and HVDC parameters. 2. To understand the operation of different relays					

<u>List of Lab Experiments:</u>

1. Determination of current time characteristics of electro mechanical over current relay.
2. Determination of current time characteristics of Microcontroller based over current relay.
3. Determination of operating characteristics of Microcontroller based Under voltage relay.
4. Observing the operation of Motor protection Relay for various faults.
5. Observing the operation of Negative Sequence Relay.
6. To draw operating characteristics of fuse under constant current and constant length conditions.
7. Determination of break down strength of liquid dielectric.
8. Measurement of HVAC using standard spheres.
9. Measurement of HVDC using standard spheres.
10. Measurement of HVAC for different electrode configurations.
11. Field mapping using Electrolytic tank for capacitor model.

Sub Code: B19EE705X	Open Elective -Subject	L	T	P	C	CH
Duration :14 Weeks		3	0	0	3	3
Course Objectives:	4. To make the students gain the knowledge of operation of over current, under voltage relays. 5. To measure HVAC and HVDC using spheres. 6. To analyze the characteristics of fuse.					
Course outcomes	At the end of this course, Student will be able to: 3. Develop skills to measure HVAC and HVDC parameters. 4. To understand the operation of different relays					

VIII Semester

Sub Code: B19EE8010	Project Phase - II	L	T	P	C	CH
Duration :14 Weeks		0	1	7	8	16
Course Objectives:	1. Identify and practice research ethics and responsible to conduct in research 2. To know and apply problem solving skills to constructively address research setbacks 3. To work collaboratively with other researchers, using listening and communication skills 4. To work autonomously in an effective manner and setting and meeting deadlines 5. To reflect on their own research, identifying lessons learned, strengths, and ways to improve 6. To communicate confidently and constructively with fellow graduate students and faculty as mentors 7. To explain their research to others in the field and to broader audiences through research presentations 8. To articulate the relevance of their research to their coursework and professional future, synthesizing their research, academic, and professional interests and goals 9. To identify and describe what they could expect as a graduate student 10. To reflect constructively on their research experience in making decisions about their future.					
Course outcomes	At the end of this course, Student will be able to: 1. Apply relevant knowledge and skills, within the main area, to a given problem - within given constraints, 2. Analyze and discuss complex inquiries/problems and handle larger problems independently even with limited information 3. Evaluate and critically assess one's own and others' scientific results 4. Document and present one's work with strict requirements on structure, format, and language usage 5. Identify one's need for further knowledge and continuously develop one's own knowledge					

GUIDELINES

Guidelines for the preparation of the Report: As per the University Guidelines

Guidelines for the Evaluation:

1. The student must meet the guides minimum once a week and give the project progress and also discuss the hardware progress with guides.
2. The guides have to maintain the attendance report and also the progress of the students

projects.

3. Student has to submit a progress report -I and give the presentation during IA1 which carries 15% of the total marks
4. Students has to submit a progress report -II and give the presentation of the project work during IA2, which carries 15% of the total marks
5. Students has to submit a progress report -II and give the presentation of the project work during IA3, which carries 10% of the total marks
6. Students have to submit the Project Thesis and need to give a presentation of the project work and face Viva-Voce during Semester end exam (SEE), which carries 60% of the total marks
7. All the above reports must undergo a plagiarism check which should not exceed 25% of similarity index and failing which lead to resubmission.

Sub Code: B19EE8021	**Trouble Shooting of Common Electrical Appliances**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	4
Course Objectives	1. To teach safety rules , important tools used in trouble shooting 2. To teach different types of wires & wire splicing, termination. 3. To teach usage of important electrical meters which are used in the process of trouble shooting. 4. To teach probable faults, causes & remedies on some common electrical equipment.					
Course Outcomes	On completion of this course the students will be able to: 1. Understand safety rules , important tools used in trouble shooting 2. Understand different types of wires & wire splicing , 3. Understand the usage of important electrical meters which are used in the process of trouble shooting. 4. Find out faults, causes and remedies for common electrical equipment.					

COURSE CONTENTS

Unit 1: Safety rules & Tools **[10hrs]**

Introduction , safety precautions, safety rules, screw driver , pliers, wire stripper, pocket knife, hammers, chisels, hand & Electric drill, hack saw, Rawlplug tool, neon tester, test lamp, switch board.

Unit 2: Wires, wire splicing and termination **[10hrs]**

Sizes of wires, stranded wires, types of wires, rubber covered, taped, braided, compounded wire, western union splice(joints) DOL starter for 3-Phase Induction motor. Control of Domestic motor- pump set.

Unit 3: Usage of meters **[10hrs]**

Ammeter, voltmeter, ohm meter (multi meter) megger, earth tester. Measurement of Earth resistance.

Domestic wiring, two & 3- way control of a lamp, Fluorescence lamp set, Sodium vapor lamp.

Unit 4: Probable Faults, Causes, and remedies on common Electric Equipment's [12hrs]
Mixer grinder, Table fan and ceiling fan , Electric iron, 3-Phase Induction motor,
Text Books:

1. S.L. Uppal, 'Electrical wiring Estimation & costing', Khanna Publications, 5th edition, reprint, 2006
2. Madhvi Gupta, 'Installation, Maintenance & Repair of Electrical Machines & Equipment', Kataria & Sons, 1st Edition, 2014.

Reference Books:

1. Philip Kiameh, 'Electrical equipment Hand book trouble shooting & maintenance', McGraw Hill, Chicago, 2003.

Sub Code: B19EE8022 Duration: 14 Weeks	Introduction to Flexible AC Transmission Systems	L	T	P	C	CH
		2	1	0	3	4
Course Objectives	1. To emphasis the need for FACTS controllers. 2. To review the static devices for series and shunt control. 3. To study the operation of controllers for enhancing the transmission capability.					
Course Outcomes	**On completion of this course the students will be able to:** 1. Describe the need of flexible AC transmission and the associated problems. 2. Describe the characteristics, applications and modeling of series and shunt FACTS controllers. 3. Analyze the interaction of different FACTS controller with the power system.					

COURSE CONTENTS

Unit 1: AC Transmission Line and Reactive Power Compensation [8hrs]
Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controller

Unit 2: Voltage Sourced Converters [12hrs]
Power semiconductor devices: types of high power devices, principle of high power device characteristics and requirements, power device material, diode, MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT).
Voltage sourced converters: Basic concepts, single-phase full wave bridge converter operation, and square wave voltage harmonics for a single-phase bridge 3-phase full wave converters.

Unit 3: Static Series Compensators [8hrs]
GCSC, TSSC, TCSC and SSSC, objectives of series compensation, variables impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators.

Unit4: Self and Line Commutated Current Source Converter **[12hrs]**

Basic concepts, 3 phase full wave rectifier, thyristor based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter.

STATIC SHUNT COMPENSATORS SVC AND STATCOM: Objective of shunt compensation, methods of controllable Var generation, Static Var Compensator (SVC) and STATCOM, comparison between SVC and STATCOM.

Text Books:

1. N.G. Hungorian & Laszlo gyugyi, 'Understanding Facts - Concepts and technology of flexible AC Transmission system', IEEE Press, standard publisher, 2001.

Reference Books:

1. S. Rao, 'EHV - AC, HYDC Transmission & Distribution Engineering', Khanna publishers, 3rd edition 2003.
2. K.R. Padiyar, 'FACTS - Controllers in Power Transmission distribution', New age publishers, 2007.

Sub Code: B19EE8023	**Wireless Communication**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	4
Prerequisites	Fourier analysis, Linear Systems, Probability Theory, Introductory Modulation and Antenna Theory					
Course Objectives	1. Know the characteristic of wireless channel 2. Understand the concepts behind various digital signaling schemes for fading channels 3. Understand the various multipath mitigation techniques 4. Understand Wireless Networks 5. Understand Wireless LAN and Bluetooth Technology					
Course Outcomes	On completion of this course the students will be able to: 1. Characterize wireless channels (a, b) 2. Design and implement various signaling schemes for fading channels (a, b, d, e) 3. Compare multipath mitigation techniques and analyze their performance (a, b, d) 4. Compare various types of wireless networks (a, b, d)					

<u>Course Contents:</u>

Unit- 1: Wireless Channels **[11Hrs]**

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

Unit-2: Multipath Mitigation Techniques [10Hrs]
Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

Unit-3: Satellite Networks and Wireless Application Protocol [11Hrs]
Satellite networks: Satellite parameters and configuration, Capacity allocation,
Wireless system operations and standards: Cordless systems, Wireless local loop, Mobile IP and Wireless Application Protocol:

Unit- 4: Wireless LAN and Bluetooth Technology [10Hrs]
Wireless LAN Technology: Infrared LANs, spread spectrum LANs, Narrowband Microwave LANs,
Wi-Fi- and the IEEE 802.11 Wireless LAN standard: IEEE 802 architecture, IEEE 802.11 Architecture and services, Medium access control, Physical layer, other IEEE 802 standards, Wi-Fi protected access, Bluetooth and IEEE 802.15: Radio specification, Baseband specification, Link manager specification

Text Books:

1. Rappaport, T.S**., "Wireless communications",** Second Edition, Pearson Education, 2010**.**
2. Andreas. F. Molisch**, "Wireless Communications",** John Wiley – India, 2006**.**
3. William Stallings**, "Wireless Communication and Networks",** Second Edition, Pearson, 2013.

Reference Books:

1. David Tse and Pramod Viswanath**, "Fundamentals of Wireless Communication",** Cambridge University Press, 2005.
2. Behrouz A. Forouzan**, " Data Communication and Networking",** McGraw- Hill Higher Education, Second edition, 2000.

Sub Code: B19EE8024	**Machine Learning and Applications**	**L**	**T**	**P**	**C**	**CH**
		2	1	0	3	4
Prerequisites	Students must have studied Data Structure, Algorithms and Mathematics					
Course Objectives	1. Study the basic theory underlying machine learning. 2. Explain machine learning algorithms to solve problems of moderate complexity for data analysis. 3. Describe the concept of Genetic Programming and Artificial Neural Network. 4. Discuss the implementation of Machine learning algorithms and modules.					
Course Outcomes	On completion of this course the students will be able to: 1. Explain the basics of machine learning concepts. 2. Implement machine learning algorithms for intelligent applications. 3. Apprehend how to perform evaluation of learning algorithms and model					

	selection.

Course Contents

Unit-1: [11 Hrs]

Introduction: Well-Posed Learning Problems, Designing a Learning System, Perspectives and Issues tin Machine Learning Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, and Reinforcement Learning. Supervised Learning. Concept Learning and the General-to-Specific Ordering: A Concept Learning Task, Concept Learning as Search, FIND-S.

Unit-2: [11 Hrs]

Dimensionality Reduction: Subset Selection, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis. Classification.

Unit-3: [10 Hrs]

Clustering: Introduction**,** kmeans, nearest neighbor, expectation maximization algorithm, Supervised learning after clustering, hierarchical clustering, choosing the number of clusters. Decision Tree Learning.

Unit-4: [10 Hrs]

Artificial Neural Networks: Introduction, Perceptions, Multilayer Networks and the Backpropagation Algorithm. Reinforcement Learning: Introduction, Learning task ,Q-learning. Design and Analysis of Machine Learning Algorithms and experiments using WEKA//Rapid Miner Tool

Recommended Learning Resources (Text Books):

1. Tom Mitchell: Introduction to Machine Learning Chapters 1, 2, 3, 4, 6, 8, 9.1 to 9.4, 13
2. Ethem Al paydin: Second edition MIT press McGraw-Hill Chapters 1, 2, 6, 7, 19
3. William W Hsieh Machine Learning Methods in the Environmental Sciences, Neural Networks, Cambridge University Press.

Reference Books:

1. Ethem Al paydin: Introduction to Machine Learning, Second edition MIT press, 2010. Chapters 1, 2, 6, 7, 19.
2. Yoshua Bengio and Aaron Courville, Deep Learning -Ian Good fellow, MIT Press book, 2016
3. Richard O. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
4. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

The laboratory exercises will include use of various machine learning algorithm for data classification, data regression, clustering using WEKA Tools.

The list of experiments are:

The Weka tool should be taught to the students:

1) Introduction to WEKA, installation of WEKA Tool and demonstration.
2) Perform data preprocessing.
3) Perform classification to the dataset.
4) Perform Clustering using k-means for the contact lens dataset.
5) Perform Logic Regression for Iris data set.
6) To Visualize the results using the Tool.
7) To Analyze the results using the Tool.
8) Apply ID3 decision tree algorithm to House database.
9) Apply CART decision tree algorithm To IRIS database.

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:

a. Willingness to learn
b. Self motivation
c. Team work
d. Communication skills and application of these skills to real scenarios
e. Requirement of gathering, design and analysis, development and testing skills
f. Analytical and Technical skills
g. Computer skills
h. Internet searching skills
i. Information consolidation and presentation skills
j. Role play
k. 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 Electrical and Electronics Engineering is not only the knowledge in the subject, but also the ability take just decisions and skills to perform 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 Electrical and Electronics Engineering 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 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.

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university
2. Be regular and punctual to classes
3. Study regularly and submit assignments on time
4. Be respectful to your Teaches/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammunition etc

Registrar
REVA University
Bengaluru - 560 064

REVA UNIVERSITY
Bengaluru, India

School of Computing and Information Technology

B.Tech. Computer Science and Information Technology

2019-20 Batch

HANDBOOK

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

School of Computing and Information Technology

B.Tech. Computer Science and Information Technology

2019-20 Batch

HANDBOOK

B.Tech (Computer Science & Information Technology) Program

Handbook

2019

Registrar
REVA University
Bengaluru - 560 064

Rukmini Knowledge Park,
Kattigenahalli, Yelahanka, Bangalore - 560 064
Phone No: +91-080-66226622, Fax: 080-28478539

Rukmini Educational
Charitable Trust

www.reva.edu.in

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 ofopportunity. 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 tobe 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. S. Y. Kulkarni
Vice-Chancellor, REVA University

PREFACE

I Congratulate and welcome all the students to the esteemed School of Computing and Information Technology (C &IT). You are in the right campus to become a computer technocrat. With the rising needs of automation and better living for the humanity, computer software and hardware technologies are rapidly developing, thus giving scope to generate more human resources in the areas of computers and IT. The B Tech and M Tech Curriculum in the School are designed to cater to the requirements of industry and society. The curriculum is designed meticulously in association with persons from industries (TCS, CISCO, MPHASIS, etc.), academia and research organizations (IISc, IIIT, Florida University, Missouri S & T University, etc). 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.

This handbook presents the B Tech Curriculum. The course is of 4 years duration and split into 8 semesters. A student has to earn 192 credits to obtain the award, where credits are spread across the semesters. These credits are split among foundation core, hard core, and soft core courses. Soft core courses provide flexibility to students to choose the options among several courses as per the specialization, such as, Data Engineering, System Design and Computing, applications of computing, Software systems, Communication / Networking are taught in first two and half years. Later, advanced courses are introduced in subsequent semesters for pursuing specialization.

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

1. Choice based course selection and teacher selection.
2. Studies in emerging areas like Machine Learning, Artificial Intelligence, Big-Data and Data Analytics, Cloud Computing, Python/R Programming, IoT and Cybersecurity,Advanced Java, Network security,Mobile Application development, Advanced Web Technology, Augmented and Virutal Reality,Block chain technology and computer vision.
3. Short and long duration Internships.
4. Community to pursue MOOC course as per the interest.
5. Attain global and skill certification as per the area of specialization.
6. Self-learning components.
7. Experiential, Practice, Practical, and project based learning.
8. Mini projects and Major projects.
9. Soft skills and Skill development courses.

The School has well qualified faculty members in the areas of foundations of computer science and information technology, like computer networks, image processing, pattern recognition, Big Data and Data Analytics, Data Mining, Machine learning, artificial intelligence, cybersecurity, IoT, cloud computing, Java, Web Technology, Mobile Application development, Data Compression and software systems, Virutalization, Wireless Sensor and Mobile networks, High Performance Computing. There are several state of art laboratories for the purposes of academics and research activities in the aforementioned areas of Computer Science and Information Technology.

Prof. Sunilkumar S. Manvi
Director, School of Computing and IT

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, setup 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 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 No. 80 dated 27thFebruary, 2013. The University is recognised by UGC under Sec 2 (a) and empowered under Sec.22 of the UGC Act, 1956 to award degrees in any branch of knowledge. 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 27 Post Graduate Degree programs, 29 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 494 Scholars pursuing research leading to PhD in 24 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 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, 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, Counsellors 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 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 in presence of dignitaries, faculty members and students gathering and the first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO on the occasion of Founder's Day Celebration, 6th January, 2016 and the second "REVA Life Time Achievement Award" for the year 2016 has been awarded to Shri. Shekhar Gupta, Renowned Journalist on the occasion of Founder's Day Celebration, 6th January, 2017.

REVA organises 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 rightspirit, 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 prizesin academic, cultural and sports activities are also recognised 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 organises yoga camps for villagers around.

Within short span of time, REVA University has been recoged as a fast growing university imparting quality higher education to the youth of the country ans received many awards, ranks, and accolades from various agencies, institutions at national and international level. These include: Asia'sGreatest 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, 6^{TH} Rank in the Super Excellence category by GHRDC, 6^{TH} 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.

About School of Computing and Information Technology (C & IT)

The School has a rich blend of experienced and energetic 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 following two full-time undergraduate programs: B Tech in Computer Science and Engineering and B Tech in Computer Science and Information Technology and the following three postgraduate programs: M Tech in Data Science, M Tech in Computer Networks and Engineering and M Tech in Computer Science and Engineering (Both Full-time and Part-time). In addition, the school has a unique academic collaboration with the University of Alabama in Huntsville to jointly offer an MS program in Computer Science. In addition, the school has a research center in which students can conduct cutting edge research leading to a PhD degree.

Curricula 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 aim to createquality 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 computing 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. Following are the vision, mission, program educational objectives and program outcomes.

Vision

To create a pool of high-caliber technologists and researchers in computer science 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 and strong ethical values.

Mission

- Create a center of excellence where new ideas flourish and from which emerge tomorrow's researchers, scholars, leaders and innovators.
- Provide quality education in both theoretical and applied foundations of computer science, information technology and related inter-disciplinary areas and to train students to effectively apply the education to solve real-world problems.
- Amplify students' potential for life-long high-quality careers and give them a competitive advantage in the ever-changing and challenging global work environment of the 21st century.
- Forge research and academic collaboration with industries and top global universities in order to provide students with greater opportunities.
- Support the society by encouraging and participating in technology transfer.

Advisory Board

Sl. No.	Name and Designation of the Members
1.	Mr. Himesh Misra, Program Director, IBM Innovation Center, IBM India Private Limited Bengaluru-560017
2.	Dr. Rajkumar Buyya, Director, Cloud Computing and Distributed Systems Laboratory Department of Computing and Information Systems University of Melbourne, Australia
3.	Mr. Nagaraj Kulkarni, Director, COMPEGENCE, Bengaluru
4.	Dr. Venkatesulu Dondeti, Group Head, Wipro Technologies Sholinganallur, Chennai
5.	Dr. Rabi N Mahapatra, Professor, Department of CS&E Texas A&M University, College Station, USA
6.	Dr. Heggere S Ranganath, Professor and Chair, Computer Science Department University of Alabama in Huntsville Huntsville, AL 35899, USA
7.	Mr. Mrityunjay Hiremath, Director, AMD Inc. USA, Bengaluru
8.	Dr. Manjunath Joshi, Professor Dheerubhai Ambani Institute of Information and Communication Technology Gandhinagar
9.	Dr. K. Gopinath, Professor, Dept. of Computer Science and Automation IISc., Bengaluru
10.	Dr. S. S. Iyengar, Professor, Louisiana State University (LSU), USA.

B. Tech (Computer Science & Information Technology) Program

Programme Overview

Computer Science and Information Technology (CS & IT) 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 Information Technology (CS & IT) 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 information technology 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 information techonology 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 information technology, an undergraduate programme to create motivated, innovative, creative and thinking graduates to fill ICT positions across sectors who can conceptualize, design, analyse, and develop ICT applications to meet the modern day requirements.

The B. Tech. in Computer Science and Information Technology 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 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 ICT sector makes this programme unique.

PROGRAM EDUCATIONAL OBJECTIVES

The programme helps to develop critical, analytical, innovative, creative and problem solving abilities amongst its graduates. The programme makes the graduates employable as Software Engineers across sectors. With further education and earning of higher level degrees help the graduates to pursue a career in academics or scientific organisations as researchers.

The Programme Educational Objectives are to prepare the students to:

1. Be software engineers to work in ICT, manufacturing, agriculture or any sectors that has computer application
2. Act as administrators in public, private and government organisations with further training and education
3. Pursue for higher degrees to work in colleges, universities as professors or as scientists in research establishments or business administrators
4. Be conversant with environmental, legal, cultural, social, ethical, public safety issues
5. Work as a member of a team as well as lead a team
6. communicate effectively across team members and work under constraints
7. Set his/her own enterprise with further training
8. Adopt lifelong learning philosophy for continuous improvement

PROGRAM OUTCOMES

After undergoing this programme, a student will be able to:

a) Apply the principles of computing, computational theories, computer architecture, operating systems, computer languages and software engineering.
b) Develop applications using modern concepts like deep learning, machine learning, artificial intelligence, cloud computing, networking, Network Security, Internet of Things, Big Data, Data Analytcs, Data Mining, Wireless Networks,Mobile application development,Augmented and virtual reality,advanced web technology,cryptography and network security, real time systems etc.
c) Manage the software, hardware & networks in any industry.
d) Design and develop server components
e) Develop software for peripheral computing devices such as printers, modems and scanners
f) Design and implement algorithms for operating systems like windows, linux etc.
g) Coordinate with project managers on production efforts to ensure that projects are completed on time and within budget.
h) Adapt to cultural, environmental, sustainability and ethical issues
i) Communicate across teams verbally, visually and by writing
j) Choose appropriate online programmes for further learning, participate in seminars and conferences
k) Analyze best practices, standards and their applications.
l) Create an effective project plan.

B Tech (Computer Science & Information Technology) Program

Scheme of Instruction

(effective from Academic Year 2019)

Sl. No	Course Code	Course Title	Course Type	Credit Pattern and Value					Weekly Contact Hours	Teaching School/ Dept.
				L	T	P	J	C		
FIRST SEMESTER:										
1	B19IT1010	Multivariable Calculus and Linear Algebra	HC	4	0	0	0	4	4	CIT/Mat
2	B19IT1020	Chemistry	HC	3	0	0	0	3	3	Chemistry
3	B19IT1030	Problem Solving with Programming	HC	3	0	0	0	3	3	CIT
4	B19IT1040	Basic Electrical and Electronics Engineering	HC	4	0	1	0	5	6	EE
5	B19IT1050	Environmental Science	FC	2	0	0	0	2	2	Chemistry
6	B19IT1060	Technical English-1	FC	0	0	2	0	2	4	Arts and Humanities
7	B19IT1070	Problem Solving with Programming Lab	HC	0	0	2	0	2	2	CIT
8	B19IT1080	Chemistry Lab	HC	0	0	2	0	2	2	Chemistry
9	B19IT1090	Skill Development-1	HC	0	0	0	0	1	2	UIIC/CIT
		Total						**24**	**28**	
Note: 1) Workshop lab and Mechanical Engineering Labs, Civil Engineering labs along with building construction techniques to be introduced to students by having one day tour to such schools. (2) Industrial visits will be organized for a day to Public/Private Sectors in Bengaluru.										
SECOND SEMESTER:										
1	B19IT2010	Probability and Statistics	HC	4	0	0	0	4	4	CIT/Mat
2	B19IT2020	Physics	HC	3	0	0	0	3	3	Physics
3	B19IT2030	Python Programming	HC	3	0	0	0	3	3	CIT
4	B19IT2040	Technical English-2	FC	0	0	2	0	2	4	Arts & Humanities
5	B19IT2050	Indian Constitution and Professional Ethics	FC	2	0	0	0	2	2	Law
6	B19IT2060	Computer Aided Engineering Drawing Lab	HC	0	0	2	0	2	4	ME
7	B19IT2070	Python Programming and Applications Lab	HC	0	0	2	0	2	2	CIT
8	B19IT2080	Physics Lab	HC	0	0	2	0	2	2	Physics
9	B19IT2X10	Skill Development-2	HC	0	0	0	0	1	2	UIIC/CIT
10	B19IT2X20	Sports/Yoga/Music/Dance/Theatre	RULO	0	0	2	0	2	2	Others
		Total						**23**	**28**	
Note: (1) Industrial visits may be organized for a day to Public/Private Sectors in Bengaluru. (2) All the students must										

participate in a Mini Project Exhibition (Application of Programming Skills to Solve the Problems) and Hackathon (Coding Skills based on C/C++); Synopsis of project to be submitted before IA 1.										
THIRD SEMESTER										
1	B19IT3010	Digital Logic Design	HC	3	0	1	0	4	5	CIT
2	B19IT3020	Computer Organization and Architecture	HC	3	0	0	0	3	3	CIT/ECE
3	B19IT3030	Object Oriented Programming with Java	HC	3	0	0	0	3	3	CIT
4	B19IT3040	Data Structures	HC	3	0	0	0	3	3	CIT
5	B19IT3050	Discrete Mathematics and Graph Theory	HC	3	0	0	0	3	3	CIT/Mat
6	B19IT3060	Software Engineering	HC	3	0	0	0	3	3	CIT
7	B19IT3070	Data Structures Lab	HC	0	0	2	0	2	2	CIT
8	B19IT3080	Object Oriented Programming with Java Lab	HC	0	0	2	0	2	2	CIT
9		Skill Development-3	HC	0	0	0	1	1	2	UIIC/CIT
10	B19IT3X10	Soft Skills-1	HC	0	0	2	0	2	2	Placement
Total								**26**	**28**	
Note: (1) Awareness workshop on free and open source tools and commercial tools for Computer Science and Engineering application development has to be conducted. (2) Industrial visits may be organized for a day to Public/Private Sectors in Bengaluru. (3) MOOCs/Global Certification on Java Programming which will be considered as an assignment for Programming with Java-(B19IT3030)										
FOURTH SEMESTER :										
1	B19IT4010	Design and Analysis of Algorithms	HC	3	0	0	0	3	3	CIT
2	B19IT4020	Information and Communication Theory	HC	3	0	0	0	3	3	CIT
3	B19IT4030	Database Management System	HC	3	0	1	0	4	5	CIT
4	B19IT4040	Operating Systems	HC	3	0	1	0	4	5	CIT
5	B19IT405X	Soft core -1 (SC-1)	SC	-	-	-	-	3	3	CIT
6	B19IT4060	Unix Programming Lab	HC	0	0	2	0	2	2	CIT
7	B19IT4070	IoT Lab	HC	0	0	2	0	2	2	CIT
8	B19IT4080	Skill Development-4	HC	0	0	0	1	1	2	UIIC/CIT
9	B19IT4X10	Soft Skills-2	HC	0	0	2	0	2	2	Placement
Total								**24**	**27**	
Note: (1) All students must participate in a Miniproject Exhibition and Hackathon; Synopsis of the project must be submitted before IA 1. (2) Industrial visits may be organized for a day to Public/Private Sectors in Bengaluru. (2) MOOCs/Global Certification on Data Structures and Algorithms or DAA which will be considered as an assignment for Design and Analysis of Algorithms (B19IT4010).										

FIFTH SEMESTER										
1	B19IT5010	Computer Networks	HC	3	0	0	0	3	3	CIT
2	B19IT5020	Cloud Computing and Big Data	HC	3	0	0	0	3	3	CIT
3	B19IT5030	Web Application Development	HC	3	0	0	0	3	3	CIT
4	B19IT5040	Machine Learning	HC	3	0	0	0	3	3	CIT
	B19IT505X	Softcore - 2 (SC-2)	SC	-	-	-	-	3	3	CIT
5	B19IT506X	Softcore - 3 (SC-3)	SC	-	-	-	-	3	3	CIT
6	B19IT5070	Web Application Development Lab	HC	0	0	2	0	2	2	CIT
7	B19IT5080	Machine Learning Lab	HC	0	0	2	0	2	2	CIT
8	B19IT5090	Skill Development -5	HC	0	0	0	1	1	2	UIIC/CIT
9	B19IT5X10	Soft Skills-3	HC	0	0	2	0	2	2	Placement
Total								**25**	**26**	

Note:
(1) Industrial visits may be organized for a day to Public/Private Sectors in Bengaluru. (2) MOOCs/Global Certification on cloud computing which will be considered as an assignment for Cloud Computing and Big Data (B19IT5020). (3) Miniproject should be done by a group of 3-4 members; Synopsis must be submitted before IA 1.

SIXTH SEMESTER										
1	B19IT6010	Artificial Intelligence	HC	4	0	0	0	4	4	CIT
2	B19IT6020	Business Intelligence and Process Management	HC	4	0	0	0	4	4	CIT
3	B19IT6030	Information and Network Security	HC	4	0	0	0	4	4	CIT
4	B19IT604X	Softcore - 4 (SC-4)	SC	-	-	-	-	4	4	CIT
5	B19IT605X	Softcore - 5 (SC-5)	SC	-	-	-	-	4	4	CIT
6	B19IT606X	Softcore - 6 (SC-6)	SC	-	-	-	-	4	4	CIT
7	B19IT607X	Softcore - 7 (SC-7)	SC	-	-	-	-	4	4	CIT
8	B19IT6080	Skill Development-6	HC	0	0	0	1	1	2	UIIC/CIT
9	B19IT6090	Soft Skills-4	HC	0	0	1	0	1	2	Placement
Total								**30**	**33**	

Note:
(1) All students must participate in a Mini-project exhibition and Hackhathon: Synopsis to be submitted in fifth semester. (2) Industrial visits may be organized for a day to Public/Private Sectors in Bengaluru. (3) MOOCs/Global Certification on AI (or Relevant Titles) which will be considered as an assignment for Artificial Intelligence (B19IT6010)

SEVENTH SEMESTER

1	B19IT7031	Open Elective	OE	3	-	-	-	3	3	CIT
2	B19IT704X	Softcore - 8 (SC-8)	SC	4	-	-	-	4	4	CIT
3	B19IT705X	Softcore - 9 (SC-9)	SC	4	-	-	-	4	4	CIT
4	B19IT8010	Internship/Skill Development /Global Certification Program / MOOC	HC	-	-	-	-	6	6	CIT/others
5	B19IT7080	Project Work and Dissertation Phase 1	HC				1	5	5	CIT
Total								**22**	**22**	

Note: (1) The project work phase-1 of project dissertation of 8th semester will begin in 7th semester, where student has to form a project group and perform literature survey and define the problem, identify tools and technologies to be used. (2) Options for 8th semester must be selected in 7th semester. (3) Open Electives, namely 'Internet Computing & Applications' and 'Data Structures with C' are offered for students belonging to Schools other than Computing and Information Technology. The students of B.Tech in Computer Science and Engineering shall have to choose one of the Open Electives offered by any other School.

EIGHTH SEMESTER:

1	B19IT803X	Softcore-10 (SC-10)	SC	4				4	4	CIT
2	B19IT8020	MOOC	HC	4				4	4	CIT
3	B19IT8040	Project Work and Dissertation Phase-2	HC	-	-	-	10	10	10	CIT
Total								**18**	**18**	
Total Credits for all Eight Semesters:								**192**	**192**	

Note: (1) Internship must be for atleast 2 months to be considered for 6 credits. Internships abroad will also be considered for the credits. (2) Global certification program students must obtain a certificate to attain 85 to 100% marks based on relative performance. If not eligible for certificate, they will have to undergo examination at school level for 80% marks, and marks will be awarded based on examination performance; such a program will be considered as Skill Development Program. (3) SC-12: It may be covered as a crash course before the commencement of 8th semester to pave the way for internship and project work.

Total Credits = 192

Code for the representation of the Softcore /Specialization Groups

A: Communication Infrastructure and Networking, B: Web Technologies, C: Systems and Software Development, D: Artificial Intelligence and Data Analytics, E: Other

SOFTCORES LIST:

Soft-Core Group	Sem	Specialization				
		Communication Infrastructure and Networking(A)	Web Technologies(B)	Systems and Software Development(C)	Artificial Intelligence and Data Analytics(D)	Others(E)
SC-1	IV	Digital Communications B19IT4051 (3:0:0)		System Software B19IT4053 (3:0:0) Advanced Unix Programming B19IT4052 (3:0:0)	Advanced IoT Programming B19IT4054 (3:0:0)	
SC-2	V		Mobile application development B19IT5051 (3:0:0)	Object Oriented Analysis and Design B19IT5052 Embedded System Design B19IT5053 (3:0:0)	Operation Research B19IT5054 (3:0:0)	Microcontroller and Interfacing B19IT5055 (3:0:0)
SC-3	V	Digital Signal Processing B19IT5061 (3:0:0)		Parallel Processing and Algorithms, B19IT5062 (3:0:0) Object Oriented Programming with C++, B19IT5063 (3:0:0) Principles of Programming languages B19IT5064 (3:0:0)		
SC-4	VI	Cyber Security B19IT6041 (4:0:0)	Advanced Web Technology, B19IT6042 (4:0:0) Advanced Java Programming B19IT6043 (4:0:0)	Real Time Systems, B19IT6044 (4:0:0) Advanced DBMS B19IT6045 (4:0:0)		
SC-5	VI			Finite Automata and Formal Languages, B19IT6051 (4:0:0) System Modeling	Computer Vision, B19IT6053 (4:0:0) Data Mining and Warehousing B19IT6054	

				and Simulation B19IT6052 (4:0:0)	(4:0:0)	
SC-6	VI	Wireless and Mobile Networks B19IT6061 (4:0:0)		High Performance Computing B19IT6062 (4:0:0)	Pattern Recognition, B19IT6063 (4:0:0) Web & Text Mining B19IT6064 (4:0:0)	Research Methodology B19IT6065 (4:0:0)
SC-7	VI	Advanced Computer Networks B19IT6071 (4:0:0)		UI/UX Design B19IT6072 (4:0:0)	Computer Graphics and Animation B19IT6073 (4:0:0)	Project and Risk Management B19IT6074 (4:0:0)
SC-8	VII	Advanced Storage Area Networks B19IT7041 (4:0:0) Network Programming B19IT7042 (4:0:0)	Multimedia System B19IT7043 (4:0:0)	C# and. Net B19IT7044 (4:0:0)		
SC-9	VII		Multimedia Computing and Networks B19IT7051 (4:0:0)		Data Analytics using R B19IT7052 (4:0:0) Deep Learning B19IT7053 (4:0:0)	Introduction to Genomic Sciences B19IT7054 (4:0:0)
SC-10	VIII	Software Defined Networks and Network Function Virtualization B19IT8031 (4:0:0)	Augmented and Virtual Reality B19IT8032 (4:0:0)		Natural Language Processing B19IT8033 (4:0:0)	Human Computer Interaction B19IT8034 (4:0:0)

B Tech (Computer Science & Information Technology) Program

Detailed Syllabus

(effective from Academic Year 2019)

FIRST SEMESTER

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/Wk
B19IT1010	Multivariable Calculus and Linear Algebra	HC	4	0	0	0	4	4

Prerequisites:

Knowledge of limits, continuity, differentiation, integration, matrices, determinants, and geometry.

Course Description:

This course covers basic concepts of calculus and linear algebra particularly in power series expansion of functions, techniques to solve undefined forms, angle between the polar curves, solving system of equations and to find the inverse of matrix.

Course Objectives:

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 that 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):

On successful completion of this course, the student will be able to:

CO1: Outline the applications of scalar product and vector product of two or more vectors.

CO2: Estimate the angle between polar curves that can be applied for any programming instructions related to graphical representations.

CO3: Apply the radius of curvature of the curves that can be best suited for machine learning techniques with big data analytics.

CO4: Develop larger applications of Industry strength using algebra and calculus theory.

Course Content:

UNIT- 1

Introduction to Vector Calculus: Definition and types of vectors, algebra of vectors, scalar (or dot) product of two vectors, scalar product of three vectors and vector product of three vectors.

Differential Calculus-1:Successive differentiation- nth derivatives of standard functions (no proof) simple problems, Leibnitz Theorem (without proof) and problems, Taylors 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.

Self-Learning Components:

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

Text books:

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.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	H				M			H						
CO2	H				M			M			L			
CO3	H				M			M			L			
CO4	H				M			M			L			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Solve the following System of Linear Equations using Octave Software Tool.
   2W+5X-Y+4Z=0, W+X+Y+Z=0, 4W-3X+6Y+Z=0, 2W-5X-3Y-Z=7

2. Solve the following system of equations by SCILAB Software Tool
   3x+2y+7z=4; 2x+3y+z=5; 3x+4y+z=7

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT1020	**Chemistry**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Pre University Chemistry, Physics and Mathematics.

Course Description:

This course provides the fundamental knowledge of basic principles of Engineering chemistry which is required for basic foundation in Engineering Education irrespective of branch. The course also provides the introduction to the electrochemistry concepts like Cell reactions, Fuel cells and its applications, Battery technology, Polymer materials and Nano-materials.

Course Objectives:

The objectives of this course are to:

1. Explain the basic concepts of Electrons with respect to Atomic, Molecular Structure and Periodicity
2. Describe the concepts of electro chemical cells, fuel cells and factors that influence Batteries and applications of semiconductors and P-N junction modelling of PV-Cell.
3. Discuss the mechanism of corrosion, types of corrosion, controlling and metal finishing
4. Illustrate the use of some of the engineering materials like Nano, Polymers in various applications.

Course Outcomes:

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

CO1. Acquire the knowledge about the concepts of chemistry in respect to Atomic and Molecular structure.

CO2. Assess the knowledge of band theory conductors, semiconductors, super conductors for electronic devices and chip design

CO3. Apply the knowledge of corrosion science and metal finishing which is essential for the construction of PCBs and Circuits.

CO4. Make use of engineering materials like Nano, Polymers to develop various applications.

Course Content:

UNIT-1:Electrons in Atomic, Molecular Structure and Periodicity : Electrons in Atomic, molecular structure: Classical to quantum mechanical transition, Origin of quantum mechanics, dual nature of light and matter, concept of quantization – Max Planck, Einstein, de Broglie, Schrödinger wave equation, particle in a box (1D)-Energy solutions, wave nature and quantum states of electron, orbital wave functions in bond formation (H2).

Periodic Properties: Effective nuclear charge, penetration of orbital, atomic and ionic sizes, ionization energies, electron affinity and electro negativity.

UNIT-2: Energy Storage and Conversion Devices : Battery: Introduction to electrochemistry, Basic concepts of Cells and Battery, Battery characteristics –primary (Leclanche Cell), secondary (Lead-Acid), Lithium batteries, Advantage of use of Li as electrode material (Lithium & Lithium ion), Electrochemical Capacitor.

Fuel cells: Difference between battery and fuel cell, types of fuel cells- construction working, applications, advantages& limitations of Solid oxide fuel cells and phosphoric acid fuel cell. Photovoltaic cell: Band structure of solids and the role of doping on band structures. Properties of Silicon, advantages, P-N Junction diode, antireflective coatings. Construction, working of photovoltaic cells, applications, advantages and disadvantages.

UNIT-3: Science of Corrosion and its Control: Corrosion: Electrochemical theory of corrosion, Types of Corrosion- Differential metal corrosion, Differential aeration corrosion (Pitting & water line),

Boiler corrosion, and Grain boundary corrosion, Factors affecting rate of corrosion-Primary, secondary. Corrosion control: Galvanizing & tinning, cathodic protection & Anodic Protection. Metal Finishing: Theory of electroplating. Effect of plating variables on the nature of electro deposit- electroplating process, Electroplating of gold. Electro less plating of Copper and PCB.

UNIT 4: Chemistry of Engineering Materials: Semiconducting and Super Conducting materials: Principle and some example.Magnetic material: Principle and types of magnetic materials-applications of magnetic materials in storage devices. Polymers-Introduction, Polymer composites (carbon fiber and Kevlar, synthesis, advantages, applications).Conducting polymers: Mechanism, synthesis and applications of polyacetyline, polyaniline. Liquid Crystals: Introduction, classification and applications.

Nanomaterials-Introduction – Definition, classification based on dimensionality (1D, 2D and 3D), quantum confinement (electron confinement). Size dependent properties- surface area, magnetic properties (GMR phenomenon) and thermal properties (melting point). Properties of Carbon Nanomaterials (mention of - Fullerenes, Graphene, Carbon nanotubes).

Self-learning component: Molecular orbitals of diatomic molecules. Alkaline Fuel Cell, Introduction to Electromagnetic spectrum, Czocharlski method, Pourbaix diagram (Al, Fe). Inorganic Coatings and aromaticity, Crystal field theory and transition metal ions and their magnetic properties, HSAB Concepts, molecular geometries Inhibitors, Types of polymerization, Applications of nano materials- in various fields, Glass transition temperature (tg) - definition, significance. Structure and Property relationship – tensile strength and plastic and elastic deformation.

Text books:

1. *SS Dhara, "A Text book of Engineering Chemistry" , S. Chand Publications, New Delhi, 12th Edition, 2014.*
2. *Shashichawla, "Text Book of Engineering Chemistry", Dhanapath Rai & Co Publications, Reprint Edition 2013.*
3. *P.W. Atkins, "Physical Chemistry", Oxford university press, 11thEdition, 2017.*
4. *Shikha Agarwal, "EngineeringChemistry: Fundamentals and Applications", Cambridge University Press, 2016*
5. *O.G.Palanna,"Engineering Chemistry", Tata McGraw Hill, 1stEdition, 2009.*
6. *M.G.Fontana., "Corrosion Engineering", Tata McGraw Hill, 3rd Edition, 2017.*

Reference books:

1. *V.R. Gowrikar, N.N. Vishwanathan and J. Sreedhar, "Polymerchemistry", Wiley eastern ltd.*
2. *Charles P. Poole Jr., Frank J. Owens, "Introduction to Nanotechnolog"y, Wiley India Publishers.*
3. *Krishan K Chawla," Composite materials: Science and Engineering", Springer International edition, 2nd edition.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	L							M			H			
CO2	L							M			H			
CO3			L					M			H			
CO4			L					M			H			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT1030	**Problem Solving with Programming**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Course Description:

The objectives of this course is to make students learn basic principles of problem solving, present the syntax and semantics of the "C" language, implement through C language using constructs offered by the language.

Course Objectives:

Objectives of this course are to:

1. Explain the different programming constructs of C to be used for a given application.
2. Illustrate the use of structures and unions for solving the real world problems.

3. Demonstrate the use of pointers and file operations for solving the real world problems.
4. Describe the basic concepts of computer graphics that can be used to solve a given problem using command line arguments.

Course Outcomes (CO's):

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

CO 1: Identify the constructs of C to be used for a given application.

CO 2: Develop a C program to solve a given problem using structures and unions.

CO3: Design a C program to solve a given problem using pointers and file operations.

CO 4: Demonstrate the use of basic concepts of computer graphics for a given problem using command line arguments.

Course Content:

UNIT -1:

Fundamentals of problem solving and introduction to C-language: Algorithm and flowchart & advantages of algorithm (pseudo code),basic flow chart symbols**,** structure of C program with example**, C** language & its features, C tokens, data types in C **,**variables, constants, input / output functions
Operators:(unary operator, assignment operator, arithmetic operator, relational operators, logical operators &bitwise operator, conditional operator, increment and decrement operator, special operator).
Expressions &statements: Postfix, primary, prefix, unary, binary, ternary & assignment

UNIT-2:

Branching constructs
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, difference between while and do while for loop.
Arrays: one dimensional array, two dimensional array, searching techniques, sorting.

UNIT -3:

Functions: function definition, types of functions, location of function in a program, structure of a function, parameter passing mechanisms, call by value & call by address.
Strings: string operations with and without using inbuilt string functions (string length, string compare, string copy, string concatenation, string reverse).

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.

Self Learning Component:

Fundamentals of computer graphics: output primitives – Line, Circle and Ellipse drawing algorithms - Attributes of output primitives, Two dimensional Geometric Transformation.
Inline Assembly Language Program: Simple inline assembly, Extended Assembly Syntax Microsoft C Compiler.
Command Line Arguments: argc, argv with simple examples.

Text books:

1. *B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, PRENTICE HALL SOFTWARE SERIES,2005.*
2. *Herbert Schildt, C: The Complete Reference, 4th edition, TATA McGRAW Hill,2000.*
3. *B.S. Anami, S.A. Angadi and S. S. Manvi, "Computer Concepts and C Programming: A Holistic Approach", second edition ,PHI,2008.*
4. *NanjeshBennur, Dr. C.K.Subbaraya, "Programming in C", 2nd Edition, Excellent Publishing House, 2015.*

Reference books

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

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	M													
CO2				M										
CO3	M													
CO4		H									H		H	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. What will be the value of the variables at the end in each of the following code statements:
   int a=4^4
   int a=23.34
   a = 10 b = a + a++
   a=-5 b=-a
2. Write a C program to find the area and perimeter of a circle.
3. Write a C program that accepts the salary and age from the user and displays the same on the screen as output.

4. For the following values, write a program to evaluate the expression
   z = a*b+(c/d)-e*f;
   a=10
   b=7
   c=15.75
   d=4
   e=2
   f=5.6
5. Write a program to evaluate the net salary of an employee given the following constraints: Basic salary : $ 12000 DA : 12% of Basic salary HRA : $150 TA : $120 Others : $450 Tax cuts – a) PF :14% of Basic salary and b) IT: 15% of Basic salary Net Salary = Basic Salary + DA + HRA + TA + Others – (PF + IT)
6. Approximately what is the line #include <stdio.h> at the top of a C source file for?
7. What is the difference between the constants 7, '7', and "7"?
8. What is the difference between the constants 123 and "123"?
9. What is the function of the semicolon in a C statement?
10. Write a program to print this triangle:

```
*
**
***
****
*****
******
*******
********
*********
**********
```

11. Write a program for the following
    a) A file name is command line argument. Display the contents of the file where each word will be displayed on a new line. Display proper message if file does not exist.
    b) Display no. of ovals stored in the file.
    c) Display no. of “the” stored in the file.
    d) Copy contents of the file to another file.
12. Following is the menu to be displayed to the user. On selecting a choice display appropriate result. Number should be accepted from the user. Menu
    a. Prime Factors
    b. Leap Year
    c. Sum of all digits
    d. Number in reverse order
13. Accept any string from the user. Convert case of the string to lower / upper using pointers. (if entered string is in lower case convert it to uppercase and vice versa.)
14. Match the following:

Column A	Column B
8	Invalid Identifier Names
10.34	Integer Constants
A B C	Character Constants
abc	Double
23	Floating Point Numbers
12112134.86868686886	Valid Identifier Names
_A1	
$abc	
'A'	

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT1040	**Basic Electrical and Electronics Engineering**	**HC**	**4**	**0**	**1**	**0**	**5**	**6**

Prerequisites:

Fundamentals in Engineering, Mathematics and Physics.

Course Description:

This course in Electrical Engineering covers basic concepts of electrical engineering and electromagnetism. The course also introduces the student to the working AC and DC Circuits. The course also helps the student understand 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:

The objectives of this course are to:

1. Explain the basics of electrical and electronics engineering terminologies.
2. Demonstrate the use of single and three phase systems.
3. Illustrate the applications of simple logic functions using basic universal gates.
4. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.

Course Outcomes:

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

CO1: Describe the basics of electrical engineering terminology and the usage.

CO2: Differentiate between single and three phase systems and learn the working of the same.

C03: Make use of basic universal gates to implement the simple logical functions.

CO4: Analyse the use of diodes in rectifiers, filter circuits and wave shaping.

Course Content:

UNIT-1:

Introduction to Basic Concepts & Single-Phase AC Circuits: A. Basic Concepts: Ohm's Law and Kirchhoff's Laws; Analysis of series, parallel and series-parallel circuits excited independent voltage sources; Power and energy. Electromagnetism*:* Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamicallyinduced EMF; Concepts of self-inductance, mutual inductance and coefficient of coupling; Energy stored in magnetic fields. Introduction to DC Circuits.

Single Phase AC Circuits: Generation of sinusoidal voltage- definition of average value, root mean square value, form factor and peak factor of sinusoidal voltage and current and phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Real power, reactive power, apparent power and power factor, series, parallel and series-parallel circuits.

UNIT-2:

Three Phase AC Circuits and Transformers: A. AC Circuits:; Three Phase A.C. Circuits covering, Necessity and Advantages of three phase systems, Generation of three phase power, definition of Phase sequence, balanced supply and balanced load; Relationship between line and phase values of balanced star and delta connections; Power (Expression for Power in Star and Delta, No numerical)

B. Transformers: Principle of operation and construction of single-phase transformers (core and shell types). EMF equation, losses, efficiency and voltage regulation;

UNIT-3:

Digital Electronics: Introduction, Switching and Logic Levels, Digital Waveform (Sections 9.1 to 9.3). Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary, Converting Hexadecimal to Decimal, Converting Decimal to Hexadecimal, Octal Numbers: Binary to Octal Conversion. Complement of Binary Numbers. Boolean Algebra Theorems, De Morgan's theorem.

Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, NAND Gate, NOR Gate, X-NOR Gate. Algebraic Simplification, NAND and NOR Implementation, NAND Implementation, NOR Implementation. Half adder, Full adder.

UNIT 4:

Semiconductor Diodes and Applications: p-n junction diode, Characteristics and Parameters, Diode approximations, DC load line analysis, Half-wave rectifier, Two-diode Full-wave rectifier, Bridge rectifier, Capacitor filter circuit (only qualitative approach), Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator. Numerical examples as applicable.

Self-Learning Components:
Bipolar Junction Transistors: BJT operation, BJT Voltages and Currents, BJT amplification, Common Base, Common Emitter and Common Collector Characteristics, Electromagnetism: Electromagnetic Induction, Electromagnetic Pulse and Electromagnetic Radiation.

Text books:

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.*

Reference books:

1. *Theodore Wildi, "Electrical Machines, Drives, and Power, 5th Systems", Pearson Edition, 2007.*
2. *Hughes, "Electrical Technology", International Students 9th Edition, Pearson, 2005.*
3. *International Journal of Electrical Power and Energy Systems (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)*
4. *Journal of Electrical Engineering (https://link.springer.com/journal/202)*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	H	M			H		M		H		M			
CO2	M	M			H		M		H		M			
CO3	H	M			M		M		H		M			
CO4	M	M	L		M		M	L	H	L	M			

where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. With different scenarios, identify the ways by which electricity is generated using natural water sources. Describe in detail the working of the same. (Task based)
2. Illustrate in detail, the working of a DC Motor. (Assignment)

List of Experiments: (For integrated course)

Introduction to Simulation tools: PSPICE 9.1 Student Version- Design and simulate analog and digital circuits, Digital Simulator -Digital Simulator has a toolbar of digital circuit elements, including logic gates, flip-flops, switches, and indicators.

SL. NO.	EXPERIMENT	CO	PO
1.	Electrical Safety Training. To Study the importance of Earthing during accidental shorting of line wire and the body of equipment. To study the Importance and mechanism of FUSE.	1	b, g, i
2.	Home Electrical Wiring Demonstration 1. To study the Importance and mechanism of MCB.	1	b, g, i

3.	Home Electrical Wiring Demonstration 2. To study & verify the connection procedure for fluorescent lamp wiring. To study the connection of Fan with switch and regulator.	1	b, a, g, i
4.	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring.	1	b, a, g, i
5.	Behaviour of current and voltage in series and parallel circuits. To study and verify the behaviour of current and voltage in series circuit. To study and verify the behaviour of current and voltage in parallel circuit.	1	b, a, g, i
6.	Polarity test on single phase transformer. To determine the additive polarity of a single-phase transformer. To determine the subtractive polarity of a single-phase transformer.	2	b, a, g, i
7.	Polarity test on single phase transformer. To determine the subtractive polarity of a three-phase transformer.	2	b, a, g, i
8.	Determination of VI characteristics of Zener Diode	4	b, a, g, i
9.	Determination of VI characteristics of Silicon Diode	4	b, a, g, i
10.	Design and Analysis of a Half Wave rectifier using Diode	3,4	b, a, g, i
11.	Characteristics of BJT in Common Emitter Configuration	4	b, a, g, i
12.	Characteristics of JFET in Common Source Configuration	4	b, a, g, i
13.	Half Wave and Full Wave Rectifier Without Filter	4	b, a, g, i
14.	Half Wave and Full Wave Rectifier with Filter	4	b, a, g, i

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT1050	**Environmental Science**	**FC**	**2**	**0**	**0**	**0**	**2**	**2**

Prerequisites:

Basic knowledge of Environmental Science studied at higher secondary & school level.

Course Description:

Environmental Science is a multidisciplinary subject which includes various aspects from physics, chemistry, Ecology, Biology, Earth science & Engineering etc. Environmental Studies includes the introduction to environment, Objectives & guiding principles of Environmental education, environmental ethics, Components of Environment, Impacts of Engineering/human activities on environment, Sustainable development, Role of individual and government in environmental Protection, and various topics related to environmental science imparted through this course.

Course Objectives:

The objectives of this course are to:

1. Describe Foster clear awareness and concern about economic, social, political and ecological interdependence in urban and rural area
2. Demonstrate the new patterns of behaviors of individuals, groups and society as a whole towards the environment
3. Discuss knowledge values, attitudes, commitment and skills needed to protect and improve the environment
4. Explain the evaluation of the environmental measures and education programs.

Course Outcomes:

On successful completion of this course, the student will be able to:

CO1: Outline the environmental conditions and protect it.

CO2: Estimate the role of individual, government and NGO in environmental protection.

CO3: Interpret the new renewable energy resources with high efficiency through active research.

CO4: Analyze the ecological imbalances and protect it.

Course Content:

UNIT-1:

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 protecttion
Role of Government-Assignments of MOEF, Functions of central and state boards, 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. Solid Waste management – Municipal solid waste, Biomedical waste, Industrial solid 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 (Importances, Deforestation-Causes, effects and controlling measures)

UNIT 4:

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 and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

Self-Learning Component: Waste water treatment processes, hydrology and modern methods adopted for mining activities, remote sensing and its applications, disaster management, case studies of Bhopal gas tragedy, Chernobyl nuclear disaster, London smog.

Text books:

1.*R.J. Ranjit Daniels and JagadishKrishnaswamy, Co-authored & Customised by Dr.MS Reddy &Chandrashekar, "Environmental Studies", Wiley India Private Ltd., New Delhi (Authors from REVA University), 2017.*

2. Benny Joseph, "Environmental Studies" -Revised Edition, Tata McGraw – Hill PublishingCompany Limited, 2017.

3. Ashish Shukla, Renu Singh, Anil Kumar, Environmental Science, Revised Edition,IKInternational Publishing House Pvt.Ltd, 2018.

4. Dr.S.M.Prakash, Environmental Studies by Elite Publishers Mangalore, 2017.

5. R.J. Ranjit Daniels and JagadishKrishnaswamy, "Environmental Studies", Wiley India PrivateLtd., New Delhi, 2009.

6. G.Tyler Miller, Scott E.Spoolman, Environmental Sciences, Cengage Learning, 14th Edition, 2015.

Reference books:

1. BharuchaErach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad, India, 2017.

2. RajagopalanR.,"Environmental Studies – from Crisis to cure", Oxford University Press, 2017.

3. Environmental Science by Arvind walia, Kalyani Publications, 2018.

4. Jadhav, H &Bhosale, V.M. Environmental Protection and Laws. Revised Edition, HimalayaPub.House, Delhi, 2018.

5. Sharma B.K., Environmental Chemistry. Goel Publ. House, Meerut, 2018.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO-1				M		M			H					
CO-2						M	L							
CO-3					L			M						
CO-4				M		M								

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Answer to questions uploaded in moodle software.(Assignment)
2. Skill tests based on the topics related to environmental aspects. (Seminar)
3. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.(Field work).
4. Attending the conferences based on Environmental and sustainable Energies.
5. Visiting the Labs and Organisations that maintain environmental protection and safety.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT1060	**Technical English - I**	**FC**	**0**	**0**	**2**	**0**	**2**	**4**

Prerequisites:

Fundamentals in Spoken English.

Course Description:

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:

On successful completion of this course, the student will be able to:

CO1. Interpret audio files and comprehend different spoken discourses/ excerpts in different accents (Listening Skills).

CO2. Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies (Speaking Skills).
CO3. Make use of reading different genres of texts adopting various reading strategies (Reading Skills).
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 (Writing skills).

Course Content:

UNIT-1:

Functional English: Grammar: Prepositions; Modal Auxiliaries, Listening: Listening to audio (verbal sounds), Speaking: Debating Skills, Reading: Skimming a reading passage; Scanning for specific information, Writing: Email communication

UNIT-2:

Interpersonal Skills: Grammar: Tenses; Wh-questions, Listening& Speaking: Listening and responding to video lectures / talks, Reading: Reading Comprehension; Critical Reading; Finding key information in a given text, Writing: Process descriptions (general/specific); Recommendations

UNIT-3:

Multitasking Skills Grammar: Conditional Sentences, Listening & Speaking: Listening to specifictask; focused audio tracks and responding, Reading: Readingand interpreting visual material, Writing: Channel conversion (flowchart into process); Types of paragraph (cause and effect / compare andcontrast / narrative / analytical); Note Taking/ Note Making

UNIT 4:

Communication Skills Grammar: Direct and indirect speech, Listening & Speaking: Watching videos / documentaries and responding to questions based on them; Role plays, Reading: Making inference from the reading passage; predicting the content of a reading passage, Writing: Interpreting visual materials (line graphs, pie charts etc.); Different types of Essay Writing.

Text 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.*

Reference books:

1. *Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.*
2. *Rizvi, M. Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill, 2005.*
3. *Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.*
4. *Sen et al. Communication and Language Skills. Cambridge University Press, 2015*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	E	f	g	H	i	j	k	l	m	n

CO1							H							
CO2							H							
CO3							H							
CO4							H							

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Pick and Speak for two minutes, each student will have different topics to come prepared and speak on their topic

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT1070	**Problem Solving with Programming Lab**	**HC**	**0**	**0**	**2**	**0**	**2**	**2**

Lab Outcomes:

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

CO 1: Identify the constructs of C to be used for a given application.
CO 2: Develop a C program to solve a given problem using structures and unions.
CO3: Design a C program to solve a given problem using pointers and file operations.
CO 4: Demonstrate the use of basic concepts of computer graphics for a given problem using command line arguments.

List of Experiments:

Experiment Nos.	Programs	Course Outcome	Program Outcome
1	Design and develop an algorithm to find the reverse of an integer number NUM and check whether it is PALINDROME or NOT. Implement a C program for the developed algorithm that takes an integer number as input and output the reverse of the same with suitable messages. Ex: Num: 2014, Reverse: 4102, Not a Palindrome.	**1**	**a**
2	Design and develop a flowchart to find the square root of a given number N. Implement a C program for the same and execute for all possible inputs with appropriate messages. Note: Don't use library function sqrt (n).	**1**	**a**
3	Design and develop a C program to read a year as an input and find whether it is leap year or not. Also consider end of the centuries	**1**	**a**
4	Design and develop an algorithm for evaluating the polynomial f(x) = $a^4x^4 + a^3x^3 + {}^{a2x2} + a^1x + a^0$, for a given value of x and its coefficients using Horner's method. Implement a C program for the same and execute the program for different sets of values of coefficients and x.	**1**	**a**
5	Write a Program to calculate and display the volume of a CUBE	**1**	**a**

	having its height (h=10cm), width (w=12cm) and depth (8cm).		
6	a) People frequently need to calculate the area of things likerooms, boxes or plots of land where quadratic equation can be used. Write a program to find the coefficients of a quadratic equation and compute its roots. b) Consider the age of 3 persons in a family, Write a program to identify the eldest person among three of them. c) Consider student's marks in Computer Test. Write a Program display the grade obtain by student in Computer Test based on range.	1,2	a,b
7	a) A student has taken 10 books from the library. Every time he takes the book librarian reads its ISBN Number. Write a program to identify whether book is issued to him or not based on ISBN Number using linear search. b) Suppose students have registered for workshop, and their record is maintained in ascending order based on student id. Write a program to find whether a particular Student has registered for that particular workshop or not using binary search.	1,2	a,b
8	Calculator allows you to easily handle all the calculations necessary for everyday life with a single application. Write a program using switch statement to design a basic calculator that performs the basic operations and you want to give choice to user to perform b. Addition of two numbers c. Subtraction of two numbers d. Multiplication of two numbers. e. Division of two numbers. f. Wrong choice	1,2	a,b,d
9	In a stock market at the end of the day, summation of all the transactions is done. Write a program using array to i) Display transactions IDs from 1 to n. ii) Find the sum of n natural numbers.	2,3	a,b,d
10	a) In computer based applications, matrices play a vital role in the projection of three dimensional image into a two dimensional screen, creating the realistic seeming motions. Write a program using 2-dimensional array to perform matrix Multiplication and check compatibility of matrix.	2,3	b,m,n
11	a) Write a C Program to Store Information and Display it Using Structure. b) Write a C program using union to display the total memory size occupied by the data types.	2,3	m,n
12	In a memory game, you first enter a string wait for a time and again enter second string, Write a program to check both sting are same or not.		
13	In a CCP test you scored less marks compared to your friend, Write a program using pointers to swap your marks with your friend by passing address as a parameter.		
14	Write a C program to create a file called emp.txt and store information about a person, in terms of his name, age and salary and retrieve the contents and display it.	3,4	m,n
15	Write a c program to implement Digital Differential Analyzer line generating algorithm using command line arguments.	3,4	m,n

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/Wk
B19IT1080	**Chemistry Lab**	**HC**	**0**	**0**	**2**	**0**	**2**	**2**

Pre University level of Knowledge in Chemistry, Physics and Mathematics.

Course Description:

This course provides a solid foundation for practical implementation of fundamental concepts and to solve the engineering problems.

Course Outcomes:

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

CO1. Analyse the amount of material by different instrumental methods.

CO2. Evaluate the amount of oxygen demand, alkalinity, and hardness of the different water samples.

CO3. Estimate impurities in water.

CO4. Analyze the ions present in unknown substance/ores using titrimetric and instrumental metals

Lab Experiments:

Name of the Experiment	CO	PO
1. Potentiometric Estimation of Mohrs salt.	1,4	a,b,c
2. Colorimetric estimation of copper.	1,4	a,b,c
3. Conductometric estimation of acid mixture using standard NaOH.	1,4	a,b,c
4. Determination of pKa of given weak acid using pH meter.	1,4	a,b,c
5. Determination of viscosity co-efficient of a given organic Liquid.	1,4	a,b,c
6. Determination of total hardness of the given water sample.	2,3,4	a,b,c
7. Determination of calcium oxide in the given cement sample.	4	a,b,c
8. Determination of COD of the given waste water sample.	3,4	a,b,c
9. Determination of percentage of copper in the given brass sample.	4	a,b,c
10. Determination of iron in the given sample of Haematite ore using Potassium dicromate.	4	a,b,c
11. Estimation of Alkalinity of the given water sample using standard HCl solution	2	a,b,c

12. Flame photometric estimation of sodium in the given water sample.	4	a,b,c
13. Electroplating of Copper and Nickel.	4	a,b,c
14. Determination of Calcium in a milk sample.	4	a,b,c

Simulation based Chemistry Practical Assignments

Note: Student has login into the below mentioned link with their username and password and has to conduct the experiments in the simulator and note down the readings. Later they have to participate in the discussion mentioned below the experiment along with assignment.

List of experiments to be simulated:

1. To determine the absorbance of the sample at different wavelengths and to determine the concentration of the unknown sample.
2. To determine the EMF of the cell and to determine the Gibbs Free Energy change of the
   a. cell reaction.
3. Determination of viscosity of Organic Liquid 01.
4. Determination of viscosity of Organic Liquid 02.
5. To determine the physical parameters such as turbidity, pH and conductance of a water sample.
6. To determine the Hardness of given water sample using EDTA method.
7. To determine the alkalinity of given water sample.
8. To determine the COD of industrial waste water sample.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/Wk
B19IT1090	**Skill Development**	**RULO**	**0**	**0**	**0**	**0**	**1**	**2**

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

SECOND SEMESTER:

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2010	**Probability and Statistics**	**HC**	**4**	**0**	**0**	**0**	**4**	**4**

Prerequisites:

Knowledge of statistics – mean, mode, median, and knowledge of set theory, permutation and combination, basics of probability theory.

Course Description:

This course covers concepts of curve fitting, data interpretation, probability distributions and sampling analysis. This course provides an elementary introduction to probability and statistics with applications with basic combinatorics, random variables, probability distributions, Bayesian inference, hypothesis testing, confidence intervals and linear regression.

Course Objectives:

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 science 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.

Course Outcomes (Cos):

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

CO1. Solve the problems of Curve fitting and regression in various problems in Computer Science & engineering fields.

CO2. Apply the concepts of Probability and statistics in various computer science engineering fields like data mining, classification problems etc.

CO3. Relate the Sampling theory concepts to solve various engineering problems like structured and unstructured data models.

CO4. Develop a stochastic problem as Markov model as a problem solving methods for systematic model buildings.

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, 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 stochastic matrices, Markov chains, higher transition probability-simple problems. Applications in computer science.

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.
Introduction to queuing systems: Single queuing nodes, service disciplines, M/M/1 Queuing system.

Self-learning Components:

Curve fitting for application problems, Regression analysis for a bivariate data, Probability distribution-Geometric, gamma- distributions, Joint probability distributions of continuous random variables, sampling analysis of real time problems.Applications to computer science: Data mining, classification problems etc

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd 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, 19th Reprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition, 2016.
3. V.Sundarapandian, "Probability, Statistics and Queueing 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 edition, 2013.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	H				H			H			H			
CO2	H				M			M			H			
CO3	H				H			M			M			
CO4	H				M			M			H			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

(Implement the following using MATLAB / SciLab/ Octave tool):

1. In a school, 60% of pupils have access to the internet at home. A group of 8 students is chosen at random. Find the probability that

a) exactly 5 have access to the internet.

b) at least 6 students have access to the internet.

2. The grades of a group of 1000 students in an exam are normally distributed with a mean of 70 and a standard deviation of 10. A student from this group is selected randomly.

a) Find the probability that his/her grade is greater than 80.

b) Find the probability that his/her grade is less than 50.

c) Find the probability that his/her grade is between 50 and 80.

d) Approximately, how many students have grades greater than 80?

3. In a group of 40 people, 10 are healthy and every person the of the remaining 30 has either high blood pressure, a high level of cholesterol or both. If 15 have high blood pressure and 25 have high level of cholesterol,

a) how many people have high blood pressure and a high level of cholesterol?

If a person is selected randomly from this group, what is the probability that he/she

b) has high blood pressure (event A)?

c) has high level of cholesterol(event B)?

d) has high blood pressure and high level of cholesterol (event A and B)?

e) has either high blood pressure or high level of cholesterol (event A or B)?

f) Use the above to check the probability formula: P(A or B) = P(A) + P(B) - P(A and B).

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2020	**Physics**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

The fundamental concepts in physics related to atomic physics, electricity and magnetism, mechanics, waves and optics.

Course Description:

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 fibres, Display Technology, superconductors, Quantum computation and Nano materials. The subject has basic laws, expressions and theories which help to increase the scientific knowledge to analyse upcoming technologies.

Course Objectives:

Objectives of this course are to:

1. Impart the knowledge about wave mechanics and its applications
2. Demonstrate the different applications of lasers, and optical fibers
3. Discuss different types of display technologies, superconductors and its applications
4. Explain the importance of quantum computation, nanomaterials , synthesis and applications

Course Outcomes (Cos):

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

CO1: Classify optical fibres and derive expression for NA, number of Modes and attenuation. (Analysis)

CO2: Summarize superconductivity with applications. (Comprehension)

CO3: Demonstrate capacitive and resistive Display Technologies. (Application)

CO4: Analyse synthesis of nonmaterial's and application of quantum computation (Analysis)

Course Content:

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**:** Heisenberg's uncertainty principle, its significance 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- 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, Construction and working of Carbon Dioxide (CO_2) laser &semiconductor laser and their applications. Applications: Holography (recording and reconstruction of images) and its applications.

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- 3

Superconductors: Zero resistance, Critical temperature (Tc), Critical field (Hc), Critical current density (Jc), Perfect diamagnetism, Meissner effect, Type I and Type II superconductors, Isotope effect, BCS theory of superconductivity, Applications-Superconducting magnets and Maglev vehicle. Display technology: Touch screen technologies: Resistive and capacitive touch screen and Displays: CRT, Field emission display, Plasma display, LED display, OLED display, LCD display.

UNIT- 4

Nanomaterials: Introduction to nanoscience, nanomaterials and their applications, Synthesis of nano materials using bottom-up method (arc-discharge method), top-down methods (ball milling method), Carbon Nanotubes: properties and applications. 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.

Self-learning component:

Introduction to haptics. Magnetic storage devices, solid state storage devices, optical storage devices, and characteristics of materials used in manufacture of laptops/desktops (body, internal circuit connection), heat sink cooling, liquid cooling, fan based cooling, laser printer working, accelerometers. Gold nano particles as storage devices

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, 10thedition 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 text book of Engineering Physics, S. Chand and Company, New Delhi, 2014.*

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. *Janglin Chen, Wayne Cranton, Mark Fihn, Handbook of Visual Display Technology, Springer Publication, Second edition 2012.*

Mapping COs with POs (Program outcomes)

						Program Outcomes								
Outcomes	a	b	c	d	e	f	g	h	i	j	k	l	m	N
CO1	L			L										
CO2	L			L						M				
CO3	L			L										
CO4	L			L										

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Discuss the merits and demerits of carbon dioxide laser
2. Discuss the construction and working principle of semiconductor diode laser with its applications
3. Explain the advantages and disadvantages of fibre optic communication
4. Distinguish between Phase velocity and Group velocity and derive the relation between them.
5. Formulate Schrodinger wave equation for a particle in 1 dimension
6. By applying Schrodinger wave equation determine Eigen values and Eigen functions for a particle in a box.
7. Describe the physical components of touch screen.
8. Discuss capacitive touch screen and resistive touch screen technologies.
9. What is quantum computing and distinguish between ‘bit’ and ’qubit’?

Additional assignments questions

Simulate Intensity variation of photocurrent w.r to distance in photodiode using spice Software.

Obtain interference pattern from superposition of waves using Matlab/Mathematics.

Using Matlab/mathematics obtain diffraction pattern for laser.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2030	**Python Programming**	HC	3	0	0	0	3	3

Prerequisites:

Object Oriented Programming, Data Structures.

Course Description:

Python is a high level programming language which works on different platforms (Windows, Mac, Linux, Raspberry Pi, etc). It has a simple syntax similar to the English language and it allows developers to write programs with fewer lines than other programming languages. Python is a 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, exception handling, It can parse the strings using regular expressions. It can be used for implementing the machine learning algorithms effectively.

Course Objectives:

The objectives of this course are to:

1. Explain the fundamentals of python statements like statements, functions, exceptions, errors, scripts, Data Types, Files and Dictionaries
2. Demonstrate the Parsing of regular expressions
3. Illustrate the features of Object oriented programming and files
4. Describe the features of NumPy.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

1. Make Use of fundamentals of python like statements, functions, exceptions, errors, scripts, Data Types, Files and Dictionaries in real world applications.
2. Develop a program to illustrate the parsing of given regular expressions
3. Apply object oriented features and files in real world applications.
4. Design programs using NumPy packages.

Course Content:

UNIT-1:

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, Dictionaries

Comprehensions: Working with Files and Dictionaries, List Comprehensions, Dictionary Comprehensions, Set Comprehensions

UNIT-2:

Strings: Unicode, Diving In, Formatting Strings, Compound Field Names, Format Specifiers, Other Common String Methods, Slicing a String, Strings versus Bytes, Character Encoding of Python Source Code.

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, Verbose Regular Expressions, Case Study : Parsing Phone Numbers.

UNIT-3:

Classes and Iterators: Defining Classes, The init_() Method, Instantiating Classes, Instance Variables, A Fibonacci Iterator.

Advanced Iterators: Finding all occurrences of a Pattern, Finding the Unique items in a sequence, Making Assertions, Generator Expressions, Calculating Permutations, Other Fun stuff in the itertools Module, A new kind of string Manipulation, Evaluating Arbitrary Strings as Python Expressions.

Files: Reading from Text Files, Writing to text files, Binary Files, Streams Objects from Nonfile Sources, Standard Input, Output, and Error.

UNIT-4:

NumPy : Origin of NumPy, Object Essentials: Data type Descriptors, Basic Indexing, memory layout of ndarray, universal functions of arrays, summary of new features, The Array Object: ndarray attributes, ndarray methods, array special methods, array indexing.

Implementation of Machine Learning algorithms: Linear regression, Logistic regression, k-means clustering algorithms.

Self-Learning Components: C4.5**,** k-means, SVM, Apriori, expectation maximum, Page Rank, AdaBoost, Naïve Bayes and CART algorithms.

Text Books:

1. *Mark Pilgrim, Dive into Python 3, Apress special edition, second edition, 2015.*
2. *Travis E. Oliphant,Guide to NumPy, Trelgol publishers,2006.*

Reference books:

1. *Mark Lutz, Learning Python, Oreilly.*
2. *John M. Zelle, PYTHON Programming: An Introduction to Computer Science, Franklin, Beedle& Associates.*
3. *Michael Dawson, Python Programming for the Absolute Beginners, 3rd Edition, CENAGE Learning.*
4. *Wesley J. Chun, Core Python Programming, 2nd Edition, Prentice Hall.*
5. *Steve Holden and David Beazley, Python Web Programming, New Riders.*
6. *Springer, Kent D. Lee, Python Programming Fundamentals, 2nd Edition.*

7. *John V. Guttag, Introduction to Computation and Programming using Python, MIT Press.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1				L	M			M			M	L	M	M
CO2	M		H					L		H	H		H	M
CO3					H						H		M	
CO4	M		H					L		H	H		H	M

Sample Assignments:

1. List the various steps involved in installation of python packages on windows operating system.
2. Write a python script to perform various operations of dictionaries.
3. Write a python script to perform various operations of lists.
4. Write a python script to define and call functions with optional and named arguments.
5. Write a python script to demonstrate the use of str to coerce any arbitrary value into a string representation.
6. Write a python script to demonstrate the use of getattr to get references to functions and other attributes dynamically.
7. Write a python script to demonstrate the use of and−or operations.
8. Write a python script to demonstrate lambda function.
9. Write a python script to demonstrate importing modules using either import *module* or from *module* import.
10. Explain defining and instantiation of classes.
11. Explain __init__methods and other special class methods, and understanding when they are called.
12. List and explain various operators or symbols used in regular expressions.
13. Write a Python script to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
    Sample Dictionary (n = 5) :
    Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
14. Write a Python program to iterate over dictionaries using for loops.

15. Write a Python program to print all unique values in a dictionary.
Sample Data : [{"V":"S001"}, {"V": "S002"}, {"VI": "S001"}, {"VI": "S005"}, {"VII":"S005"}, {"V":"S009"},{"VIII":"S007"}]
Expected Output : Unique Values: {'S005', 'S002', 'S007', 'S001', 'S009'}

16. Write a Python program to create and display all combinations of letters, selecting each letter from a different key in a dictionary.
Sample data : {'1':['a','b'], '2':['c','d']}
Expected Output:
ac
ad
bc
bd

17. Write a Python program to find the index of an item of a tuple.

18. Write a Python program to replace last value of tuples in a list.
Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]
Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)]

19. Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a circle.

20. Write a Python program to reverse a string.
Sample String : "1234abcd"
Expected Output : "dcba4321"

21. Write a Python function to check whether a number is perfect or not. According to Wikipedia : In number theory, a perfect number is a positive integer that is equal to the sum ofits proper positive divisors, that is, the sum of its positive divisors excluding the number itself (also knownas its aliquot sum). Equivalently, a perfect number is a number that is half the sum of all of its positive divisors (including itself).*Example* : The first perfect number is 6, because 1, 2, and 3 are its proper positive divisors, and 1 + 2 + 3 = 6. Equivalently, the number 6 is equal to half the sum of all its positive divisors: (1 + 2 + 3 + 6) / 2 = 6. The next perfect number is 28 = 1 + 2 + 4 + 7 + 14. This is followed by the perfect numbers 496 and 8128.

22. Write a Python function to create and print a list where the values are square of numbers between 1 and 30 (both included).

23. Write a Python program to solve the Fibonacci sequence using recursion.

24. Write a Python program to calculate the geometric sum of n-1.
Note: In mathematics, a geometric series is a series with a constant ratio between successive terms.
Example :

$$\sum_{n=1}^{\infty} \frac{1}{n} = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} - \frac{1}{5} + \cdots.$$

25. Write a Python program to convert a list of numeric value into a one-dimensional NumPy array.
Expected Output:
Original List: [12.23, 13.32, 100, 36.32]
One-dimensional numpy array: [12.23 13.32 100. 36.32]

26. Write a Python program to reverse an array (first element becomes last).
Original array:
[12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37]
Reverse array:
[37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12]

27. Write a program to perform basic mathematical operations. Write a user defined function for each operation. Create a doc string for each function. Display the output of each mathematical operation
28. Create a list with the following elements 1,2,3,4,5. What are the different ways that are available where you can print the entire list(mention alteast 4) and also print the elements of list in reverse order. Give example for each by considering the above list.
29. Observe the following list where li = [“a”, ”b”, ”c”, ”exam”, ”b”, ”d”, ”a”, ”is”]. Write a program by considering the above list to display single occurrence of elements of the list, to display only the repetitive elements of the list, to display the elements whose length of the element is greater than 1.
30. Write the syntax for creating a class and also the instance of a class with example. Construct a

program to create a class called “student”, declare the attributes of class as SRN, name and college. Read and display student information.

31. Write the regular expression by considering the following string
    s=”Karnataka Bank Private Limited”

    a. replace PVT. for Private
    b. Substitute PVT. for Private considering the whole word.

32. Consider the following pattern s= '^M?M?M?(CM|CD|D?C?C?C?)$'

    Write the regular expression and also search the pattern for the following 'MMMCCC', 'MMMCCC'. Justify with output.

33. Write and search the pattern for an empty string. Justify with output. Write the regular expression by considering the following string
    s=”100 BROAD ROAD APT”

    a. replace RD. for ROAD
    b. Substitute RD. for ROAD by considering the whole word.

34. Consider the following pattern s=’^M?M?M?(CM|CD|D?C?C?C?)$’

    a. Write the regular expression and also search the pattern for the following numbers 1300, 1500, 1900. Justify with output.
    b. Write and search the pattern for an empty string. Justify with output.
    Search “MCMC” in the above pattern “s” and justify your output

35. Create a set of all English stopwords and then use it to filter stopwords from a sentence in NLTK with example.

36. Write a program to extract features in a given text

37. Write a program using NUMPY perform operations on matrices such as addition, multiplication, transpose, inverse

38. Write a program to illustrate record arrays.

Course Code	Course Title	Duration (Week)	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2040	**Technical English - II**	**16**	**FC**	**0**	**0**	**2**	**0**	**2**	**4**

Prerequisites:

Fundamentals in Spoken English.

Course Description:

This course aims at utilizing the ability of using language skills effectively in real-life scenarios, to develop the learners’ competence in employability skills, to improve the habit of writing, leading to effective and efficient communication, to prioritize specially on the development of technical reading and speaking skills among the learners.

Course Objectives:

The objectives of this course are to:

1. Enable learners of Engineering and Technology develop their basic communication skills in English
2. Emphasize specially the development of speaking skills amongst learners of Engineering and Technology
3. Ensure that learners use the 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:

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

CO1: Organize their opinions clearly and meaningfully.
CO2: Demonstrate the ability to speak appropriately in social and professional contexts.
CO3: Build inferences from the text.
CO4: Take part in interviews confidently.

CO5: Develop accurate writing skills using different components of academic writing.

Course Content:

UNIT-1:

Language Acquisition: Grammar: Active and passive voice, Listening & Speaking: Listening to informal conversations and interacting, Reading: Developing analytical skills; Deductive and inductive reasoning, Writing: Giving Instructions; Dialogue Writing

UNIT-2:

Persuasive Skills Grammar: Compound words; Phrasal verbs, Listening: Listening to situation baseddialogues. Speaking:Group Discussions, Reading:Reading a short story or an article from newspaper; Critical reading, Writing:Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives)

UNIT-3:

Cognitive Skills Grammar: Homonyms; homophones, Listening: Listening to conversations; Understanding the structure of conversations, Speaking: Presentation Skills, Reading: Extensive reading, Writing: Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions - interpretation of data using charts, PPT); Precis Writing.

UNIT 4:
Employability Skills Grammar: Idioms; Single Word Substitutes, Listening: Listening to atelephone conversation; viewing model interviews (face-to-face, telephonic and video conferencing), Speaking: Interview Skills, Mock Interviews, Reading: Reading job advertisements and the profile of the company concerned, Writing: Applying for a job; Writing a cover letter with résumé / CV.

Text books

1.Thorpe, Edgar and Showick Thorpe. Objective English. Pearson Education, 2013.

2.Dixson, Robert J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd., 1988.

3.Turton, Nigel D. ABC of Common Errors. Mac Millan Publishers, 1995.

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.Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.

4.Kumar, E Suresh, J. Savitri and P Sreehari (ed). Effective English. Pearson Education, 2009.

5.Goodale, Malcolm. Professional Presentation. Cambridge University Press, 2013.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	E	f	g	H	i	j	k	l	m	n
CO1							H							
CO2							H							
CO3							H							
CO4							H							
CO5							H							

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Each student will have to choose different technical paper, prepare a PPT and give a presentation.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2050	**Indian Constitution And Professional Ethics**	**FC**	**2**	**0**	**0**	**0**	**2**	**2**

Prerequisites:

Pre-university level Constitution of India and Professional Ethics.

Course Description:

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:

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

CO1: Outline the Fundamental Rights, Duties and other Rights protected under Indian Constitution.

CO2: Demonstrate the practicality of Constitution perspective and make them face the world as a bonafide citizen.

CO3:Illustrate the professional ethics and human values.

CO4: Summarize ethical standards followed by different companies.

Course Content:

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 &oldage).

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

Self-learning component: Abuse of Technologies: Hacking and other crimes, addiction to mobile phone usage, video games and social networking websites

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.

Reference 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.

3.MGovindarajan, S Natarajan, V S Senthil Kumar, Engineering.

4.Dr. Durga Das Basu, Introduction to constitution of India.

5.M V Pylee, An introduction to constitution of India.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	E	f	g	H	i	j	k	l	m	N
CO1				M								H	M	
CO2				M			H					H		
CO3				H		H	M					M		
CO4				H		H							M	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Each student will have to choose a topic in one of the following areas and give presentation.

- Fundamental Rights and Duties.
- Ethics
- Human Values

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2060	**Computer Aided Engineering Drawing Lab**	**HC**	**0**	**0**	**2**	**0**	**2**	**4**

Lab Outcomes:

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

CO1: Apply various concepts to solve practical problems related to engineering drawing.
CO2: Express component descriptions as per the commonly practiced standards.
CO3: Draw Orthographic projections, development and Isometric views of solids.
CO4: Create computer models of 3D mechanical objects with a variety of Geometric types.

List of Experiments

Sl.No.	NAME OF THE EXPERIMENT	CO	PO	UNIT
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 infront of VP. Draw the projections of the points and state the quadrants in which the points are situated.	1,2	a,g,k,l	01
2.	Draw the projections of the following points on the same XY line, keeping convenient distance between each projectors. Name the Quadrants in whey they lie. E - 30 mm below HP and 25 mm behind VP. F - 35 mm below HP and 30 mm infront of VP. G - on HP and 30 mm infront of VP. H - on HP and 35 mm behind VP.	1,2	a,g,k,l	01
3.	A line has its end A 10 mm above HP and 15 mm infront of VP. The end B is 55 mm above HP and line is inclined at 30º to HP and 35º to VP. The distance between the end projectors is 50 mm. Draw the projections of the line. Determine the true length of the line and its inclination with VP.	1,2	a,g,k,l	01
4.	The front view of a 90 mm long line which is inclined at 45º to the XY line, measures 65 mm. End A is 15 mm above the XY line and is in VP. Draw the projections of the line and find its inclinations with HP and VP.	1,2	a,g,k,l	01
5.	A triangular plane lamina of sides 25 mm is resting on HP with one of its corners touching it, such that the side opposite to the corner on which it rests is 15 mm above HP and makes an angle of 30º with VP. Draw t6he top and front views in this position. Also determine the inclination of the lamina to the reference plane.	1,2	a,g,k,l	01
6.	A pentagonal lamina of edges 25 mm is resting on HP with one of its sides such that the surface makes an angle of 60 º with HP. The edge on which it rests is inclined at 45 º to VP. Draw its projections.	1,2	a,g,k,l	01
7.	A square prism 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and to VP at 30º.	3,4	a,g,k,	02
8.	A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its edges. Draw the projections of the prism when the axis is inclined to HP at 45º and appears to be inclined to VP at 40º.	3,4	a,g,k	02
9.	A pentagonal pyramid 25 mm sides of base sand 50 mm axis length rests on	3,4	a,g,k	03

	HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45º and VP at 30º.			
10.	A hexagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45 º and VP at 30 º.	3,4	a,g,k	03
11.	A regular pentagonal pyramid of side of base 35mm and altitude 65mm has its base on HP with a side of base perpendicular to VP. The pyramid is cut by a section plane which is perpendicular to the VP and inclined at 30^0 to HP. The cutting plane meets the axis of the pyramid at a point 30mm below the vertex. Obtain the development of the remaining part of the pyramid.	3,4	a,g,k	04
12.	A right cone of 55mm diameter of base and 75mm height stands on its base on HP. It is cut to the shape of truncated cone with its truncated surface inclined at 45^0 to the axis lying at a distance of 40mm from the apex of the cone. Obtain the development of the lateral surface of the truncated cone.	3,4	a,g,k	04

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2070	**Python Programming and Applications Lab**	**HC**	**0**	**0**	**2**	**0**	**2**	**2**

Course Outcomes:

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

1. Outline the fundamentals of python statements like statements, functions, exceptions, errors, scripts, Data Types, Files and Dictionaries
2. Develop the programs on Parsing of regular expressions
3. Make use of features of Object oriented programming and files for developing applications.
4. Apply the concepts of NumPy for developing applications.

List of Experiments:

Sl. No.	Name of the Experiment	CO	PO
1 a)	Running instructions in Interactive interpreter and a Python Script.	1	a, b
b)	Write a program to purposefully raise Indentation Error and correct it	1	a, b
2 a)	Write a program to compute distance between two points taking input from the user	1	a, b
b)	Write a program add.py that takes 2 numbers as command line arguments and prints its sum.	1	a, b
3 a)	Write a Program for checking whether the given number is an even number or not.	1	a, b
b)	Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . . . , 1/10	1	a, b

4 a)	Write a program using a for loop that loops over a sequence. What is sequence?	1	a, b
b)	Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.	1	a, b
5 a)	Find the sum of all the primes below two million.	1	a, b
b)	Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ... By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms	1	a, b
6 a)	Write a program to count the numbers of characters in the string and store them in a dictionary data structure	1	a, b
b)	Write a program to use split and join methods in the string and trace a birthday with a dictionary data structure	1	a, b
7 a)	Write a program combine lists that combines these lists into a dictionary.	1	a, b
b)	Write a program to count frequency of characters in a given file. Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file?	3	a, b, d, e
8 a)	Write a program to print each line of a file in reverse order	3	a, b, d, e
b)	Write a program to compute the number of characters, words and lines in a file.	3	a, b, d, e
9 a)	Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding.	2	a, b, d
b	Find mean, median, mode for the given set of numbers in a list.	2	a, b, d
10 a)	Write a function nearly equal to test whether two strings are nearly equal. Two strings a and b are nearly equal when a can be generated by a single mutation on b.	2	a, b, d
b	Write a function dups to find all duplicates in the list.	2	a, b, d
11 a	Write a function cumulative product to compute cumulative product of a list of numbers.	4	a, b, d, e , f
b	Write a function reverse to reverse a list. Without using the reverse function.	4	a, b, d, e , f
12 a	Write a program that defines a matrix and prints	4	a, b, d, e , f
b	Write a program to perform addition of two square matrices	4	a, b, d, e , f
13 a	Write a program to perform multiplication of two square matrices	4	a, b, d, e , f
b	Write a function unique to find all the unique elements of a list. Program: def	4	a, b, d, e , f

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2080	**Physics Lab**	**HC**	**0**	**0**	**2**	**0**	**2**	**2**

Course Outcomes (Cos):

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

CO1: Develop skills to impart practical knowledge in real time solution.
CO2: Apply the knowledge of new technology and comparison of results with theoretical calculations.
CO3: Enumerate observed optical phenomena in nature.
C04: Design new instruments with practical knowledge

List of Experiments

Sl. No.	EXPERIMENT	CO	PO
1	To find the velocity of ultrasonic waves in non-conducting medium by piezo-electricmethod	1	g, h, i
2	To find the band gap of intrinsic semi-conductor using four probe method	1	g, h, i
3	To find the value of Planck's constant by using Light emitting diode	3	g, h, i
4	To study the V-I characteristics of a zener diode	1	g, h, i
5	To find the laser parameters–wavelength and divergence of laser light by Diffraction method	3	g, h, i
6	To study the photo diode characteristics and hence to verify the inverse square law	1,3	g, h, i
7	To determine capacitance anddielectric constant of a capacitor by charging and discharging a capacitor	1	g, h, i
8	Study of attenuation and propagation characteristics of	3	g, h, i

	optical fibre cable		
9	Determination of Particle size using laser	1,3,4	g, h, i
10	Construction and study of IC regulation properties of a given power supply	1	g, h, i
11	Study of electrical characteristics of a solar cell	3	g, h, i
12	Determination of numerical aperture of a given optical fibre	3	g, h, i
13	Determination of electrical resistivity of Germanium crystal and study the variation of resistivity with temperature by four probe method	1,2	g, h, i
14	To Study the characteristics of a given npn transistor and to determine current gain and amplification factor in CE mode	1	g, h, i
15	To determine the resonance frequency and bandwidth of a given LCR circuit (Series and Parallel)	1	g, h, i

Additional Experiments

1. Study forward and reverse characterisitics for a zener diode using the pspice software and find knee voltage and breakdown voltage
2. Study the frequnce response of series and parallel LCR circuits using pspice software
3. Determine current gain, input resistance and output resistance for a transistor by studying its input, output and transfer characteristics using pspice software.

Text Books:

1. *Thiruvadigal, J. D., Ponnusamy S. Sudha D. and Krishnamohan M. "Physics for Technologists", Vibrant Publication, Chennai, 2013*
2. *R.K.Shukla and Anchal Srivastava, Practical Physics, 1st Edition, New Age International (P) Ltd, New Delhi, 2006.*

Reference Books:

1.G.L.Souires, Practical Physics, 4th Edition, Cambridge University, UK, 2001

2.D. Chattopadhyay, P. C. Rakshit and B. Saha, An Advanced Course in Practical Physics, 2nd Edition, Books & Allied Ltd., Calcutta, 1990.

3.B.L. Worshnop and H.T. Flint, Advanced Practical Physics (KPH)

4.S.L.Gupta and V.Kumar, Practical Physics (PragatiPrakashan).

5. Chauhan and Singh, Advanced Practical Physics Vol.I & II (PragatiPrakashan).

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1		L									L			
CO2		L									L			
CO3		L												
CO4														
CO5										L	L			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2090	**Skill Development -2**	**HC**	**0**	**0**	**0**	**0**	**1**	**2**

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT2X10	**Sports / Yoga / Music / Dance / Theatre**	**RULO**	**0**	**0**	**2**	**0**	**2**	**2**

Note: Music, Dance, and Theater courses are offered by the School of Performing Arts, whereas the Sports and Yoga courses are offered by the Department of Physical Education. The students shall choose any **ONE** of these courses.

A. YOGA FOR HEALTH

Course Objectives:

Following are the Course Objectives.

- To prepare the students for the integration of their physical, mental and spiritual faculties;
- To enable the students to maintain good health;
- To practice mental hygiene and to attain higher level of consciousness;
- To possess emotional stability, self control and concentration; and
- To inculcate among students self discipline, moral and ethical values.

Course Outcomes:

On completion of the course learners will be able to:

- Practice yoga for strength, flexibility, and relaxation.
- Learn techniques for increasing concentration and decreasing anxiety
- Become self disciplined and self-controlled
- Improve physical fitness and perform better in studies
- Gain self confidence to face the challenges in the society with commitment to serve the society

Course Content:

UNIT-I:

Yoga: Introduction ; **Surya Namaskara:-** 12 counts

UNIT-II:

Asanas: Sitting- Vajrasana, Dandasana, Padmasana, Matsyasana, Paschimottasana, Shirasasana.

Asanas: Standing- Tadasana, Trikonasana, Parshwa konasana, Veerabadrasana.

UNIT-III:

Asanas: Prone Position- Bhujangasana, Dhanurasana.

Asanas: Supine Position- Sarvangasana, Halasana.

Mudras- Dhyana mudra, , Namaste mudra, Nasika mudra

UNIT-IV:

Pranayams:- Anuloma – Viloma, Basthrika, Bhramari.

Dhyana & its types: Competition format, Rules and their interpretations

B. VOLLEYBALL

Course Objectives:

To learn the rules, fundamental skills, and strategies of volleyball

1. To develop skills in passing, setting, serving, spiking, and blocking.
2. To learn basic offensive and defensive patterns of play.

3. To develop a positive attitude towards volleyball as a lifetime sport and to improve physical fitness through participation in volleyball.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with volleyball.
2. Apply these skills while playing volleyball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

UNIT-I

- Introduction about Volleyball
- Players Stance, Receiving and passing
- The Volley (Overhead pass), The Dig (Underhand pass), Service Reception

UNIT-II

- Service- Under Arm Service, Tennis Service, Side Arm Spin Service, Round Arm Service, High spin service, Asian serve / American serve (floating)
- Setting the ball- Set for attack, Back set, Jump set

UNIT-III

- Smash/Spike- Straight smash, Body turn smash, Wrist outward smash, Wrist inward smash
- Block- Single block, Double block, Three-man block
- Rolls- Overhead pass & back rolling, One hand underhand pass with side rolling, Forward dive

UNIT-IV

- Attack Combination, Defense Systems, Libero play
- Court marking, Rules and their interpretations and Duties of officials

C. BASKETBALL

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of Basketball
2. To develop technical skills in passing, in ball handling, individual offense, individual defense, rebounding, screen, team offense, team defense and fast break.

3. To learn basic offensive and defensive strategies of play.
4. To develop a positive attitude towards Basketball as a lifetime sport and to improve physical fitness through participation in Basketball.
5. To develop positive understanding and appreciation of the basketball game.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with basketball.
2. Apply these skills while playing basketball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

UNIT-I

- Basketball: Introduction
- Grip; Player stance- Triple threat stance and Ball handling exercises
- Passing (Two hand/one hand)- Chest pass, Bounce Pass, Over head pass, Underhand pass, Hook Pass, Behind the back pass, Baseball pass, Side arm pass and passing in running.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

UNIT-II

- Dribbling- How to start dribble, How to stop dribble, High / Low dribble with variations
- Shooting- Layup shot and its variations, One hand set shot, One hand jump shot, Free throw, Hook shot, Tip-in shot.
- Stopping- Stride/Scoot, Pivoting and Faking /Feinting footwork.

UNIT-III

- Rebounding- Defensive rebound, Offensive rebound, Box out, Rebound Organization.
- Individual Defensive- Guarding the man with the ball and without the ball.
- Offensive drills, Fast break drills, Team Defense/Offense, Team Tactics

UNIT-IV

- Court marking, Rules and their interpretations

D. FOOTBALL

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of football.
2. To develop skills in passing, receiving, controlling the ball, dribbling, shielding, shooting, tackling, beating a defender and heading in football.
3. To learn basic offensive and defensive patterns of play
4. To use different parts of the body in utilizing the above skills while playing football
5. To develop a positive attitude towards football as a lifetime sport and to improve physical fitness through participation in football.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with football.
2. Apply these skills while playing football and exhibit improved performance
3. Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.
4. Improve physical fitness and practice positive personal and lifestyle.
5. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

UNIT-I

Football: Introduction

- Kicks- Inside kick, Instep kick, Outer instep kick, Lofted kick, Chipping, Volley, Half Volley
- Trapping- Trapping rolling the ball, Trapping bouncing ball with sole

UNIT-II

- Dribbling- With instep and outer instep of the foot.
- Heading- From standing, running and jumping.
- Feinting- With the lower limb and upper part of the body.

UNIT-III

- Tackling- Simple tackling, Slide tackling.
- Throw-in- Standing and Sliding
- Goal Keeping- Collection of balls, Ball clearance, throwing and deflecting.

UNIT-IV

- Ground marking, Rules and their interpretations

E. ATHLETICS (TRACK AND FIELD)

Course Objectives:

1. To teach students the skilled techniques in sprints, relay running, hurdles, long jump, high jump, and shot put and practice them.
2. To develop competence among students in demonstrating all the techniques covered in the course.
3. To make students understand some of the scientific and empirical principles and their rationale underlying the development of skilled performance.
4. To inculcate among students the habit of team work and cooperative learning and develop competence in detecting / correcting technique errors.
5. To develop a positive attitude towards sports in general and athletics in particular and to improve physical fitness through participation in various athletic games / sports activities.

Course Outcomes:

On completion of the course learners will be able to:

1. Display competencies in executing basic techniques and skills associated with select track and field events.
2. Develop basic skills and techniques to improve one's running posture and take-off position for different jumps.
3. Learn regular practice of select track and field events and improve physical fitness
4. Appreciate track and field events by applying sports science knowledge to explain the execution of the events.

Course Content:

UNIT-I

- Athletics: Introduction
- Track Events - Steeple Chase, Race Walking, Middle and Long distance races
- Race walking - Technique, Faults and Officiating.
- Middle and Long distance races – Technique and Training

UNIT-II

- Jumping Events - High Jump and Triple Jump: Basic Skills and techniques
- High Jump - Straddle Roll & Flop Technique, Approach, Take-off, Technique in the air, Clearance over the bar & Landing
- Triple Jump – Hop, Step and Jump Technique, Approach, Take-off & Landing

UNIT-III

- Throwing Events - Discus Throw and Hammer Throw: Basic Skills and techniques
- Discus Throw - Standing and Rotatory techniques, Grip, Stance, Rotation Technique, Power stance, Release and Reverse (Follow through)
- Hammer Throw - Grip, Swings, Rotation foot work, Release and Follow through

UNIT-IV

- Rules, Officiating and Marking - Ground / Sector Marking, Interpretation of Rules.

Reference Books

1. Arthur E. Ellison (ed) (1994). Athletic Training and Sports Medicine.
2. Ballisteros, J.M. (1998). Hurdles Basic Coaching Manual, IAAF.
3. Bosen K.O. (1993). Teaching Athletics Skills and Technique.
4. Bosen K.O. (1990). Study Material on Hurdles for the Regular Course Students.
5. Doherty K. (1995). Track and Field Omni book.
6. Martin, David E. Peter N. Coe (1991). Training Distance Runner.
7. Howard S. (1981). Science of Track and Field Athletics.
8. Briggs Graeme (1987). “Track and field coaching Manual”, Australian Track and Field Coaches Association. Rothmans Foundation National Sports Division.
9. Carr, Gerry (1999). “Fundamentals of Track and Field. Track Athletics Title G.V. 1060 5.e. 368.
10. I.A.A.F. Level-II (2001). Text Book on Jumping Event.
11. Jarver, Jesse (1987). “The Jumps”, Track and Field Coaching Manual Australia.

F. DRAMATICS

Pre-requisites: Students with background in Theatre Arts/ Keen interest in Dramatics.

Course Objectives:

- To imbibe the acting skills.
- To understand the broader applications of theatre studies in allied arts forms.
- To be able to use body language for better communication.
- Students shall also be able to understand voice modulation and Navarasas.

Course Outcomes:

On successful completion of this course, students should be able to:

- Freely express improvisation in non-verbal communication.
- Shall hone good acting skills and be able to emote better.

- Be able to put up a theatre act and play a key role.
- Be able to differentiate good acting and understand the importance of good lyrics, stage crafting, music, dance, costume and lighting.

Course Content:

UNIT – 1

Working on Body:

Body and its analysis. Understanding physical abilities (Anga, Pratyanga and Upanga). Challenges of the body. Using body as metaphor and language. The class's bodies as a collective, an ensemble, a collaborative team.

UNIT – 2

Sound and Movement:

Awareness of creating sound patterns, voice modulations, rhythm in speech and diaologues. Understanding the rhythm and patterns of movements like walking, framing, shaping, primitive and animal movements.

UNIT – 3

Characterization and Improvisation:

Observation of people around. Getting into the role and living it. Developing a character from establishment (pace and rhythm). Improvisation techniques of body and mind.

UNIT – 4

Group work and Production:

Develop a theme, concept or a play and include all the theatre skills, stage craft, costuming and put up an act. Choosing theme and characters.

Reference Books:

1. All about Theatre – Off stage – Chris Hogget.
2. Rangadalli Anataranga – K V Subbanna
3. The Indian Theatre – Hemendranath Das Gupta.
4. A Practical handbook for an Actor – Milisa Bruder, ee Milchel Cohn, Madeleine Oliek et al, Zigler Publisher.

G. INDIAN CLASSICAL DANCE FORMS (Bharatanatyam, Kuchipudi ,Mohiniyattam)

Prerequisites: Background of classical dance training or any other dance forms.

Note: Non-classical dancers can also join.

Course Objectives:

- To develop an understanding about the Indian classical dance forms and its universal application.

- To be able to understand the fine nuances of Classical dance.
- To understand the importance of health through Indian classical dance, strengthen the body capacity.
- To understand mythology and its characters in Indian classical dance form through lessons of Abhinaya.

Course Outcomes:

- To be able to identify and appreciate the classical dance forms.
- To be able to execute basics of Adavus with finesse.
- To be able to express through abhinaya.
- To be able to perform to perform the fundamentals in the chosen dance form.

Course Content:

UNIT – 1

An introduction to Indian classical dance forms

Bharatanatyam, Kuchipudi, Mohiniyattam

UNIT - 2

Learning of Fundamentals

Exercises and Adavus- I (Bharathanatyam, Kuchipudi, Mohiniyattam)

UNIT - 3

Adavus –II (Bharathanatyam, Kuchipudi, Mohiniyattam)

UNIT - 4

Learn a basic composition in the chosen dance form.

Reference Books:

1. Indian classical dance forms –U S Krishna Rao,U K Chandrabhaga Devi
2. Classical Dances –Sonal Mansingh, Avinash Parischa
3. Kuchipudi – Sunil Kothari
4. Bharatanatyam An in depth study- Saroja vydyanathan
5. Mohiniyattam – Bharathi Shivaji

H. PERCUSSION INSTRUMENT (TABLA AND MRIDANGAM)

Pre-requisites: Students with background in Percussion instruments and knowledge of Rhythm/ Keen interest in studying Mridagam / Tabala.

Course Objectives:

•To understand the Rhythmology.

•To understand the importance of Laya, Taala.

•To be able to understand the fine finger techniques of playing the instrument.

Course Outcomes:

On successful completion of this course, students should be able to:

• To be able to set instrument to Sruthi.

• To be able to play the fundamentals on instrument.

• To be able to learn and perform a particular taala.

Course Content:

UNIT - 1

1. Introduction to Musical Instruments; 2. Percussion Instruments; 3. Mridangam and its History

UNIT - 2

1. Introduction to Tala System; 2. Definitions of five jaathis and their recitation; 3. Adi Talam and its various forms; 4. Definitions and recitation of different gathis

UNIT - 3

1. Tisra Jaathi; 2. Khanda Jaathi; 3. Misra Jaathi; 4. Sankeerna Jaathi

UNIT - 4

1. Learning of Jathi Formation; 2. Basic jathis; 3. Jathis for Dance forms ; 4. Some Basic Definitions of Korvai, Teermanam etc.

Reference Books:

1. Mridangam- An Indian Classical Percussion Drum – Shreejayanthi Gopal
2. Theory and practice of Tabala – Sadanand Naimpally.
3. Theory and practice of Mridangam – Dharmala Rama Murthy
4. The Art of the Indian Tabala – Srdjan Beronja.

THIRD SEMESTER:

Course Code	Course Title	Course Type	Credit Pattern & Credit Value					Hrs/ Wk
			L	T	P	J	C	
B19IT3010	Digital Logic Design	HC	3	0	1	0	4	5

Prerequisites:

Knowledge of Basic Electrical and Electronics Engineering [B19IT1040]

Course Description:

This course covers basic concepts and techniques of combinational and sequential digital logic circuits, notably basic building blocks such as different types of latches, flip flops, registers, synchronous and asynchronous counters.

Course Description:

This course covers basic concepts and techniques of combinational and sequential digital logic circuits, notably basic building blocks such as different types of latches, flip flops, registers, synchronous and asynchronous counters.

Course Objectives:

The objectives of this course are to:

1. Explain the construction of K-maps to simplify Boolean expressions.

2. Demonstrate the working of combinational and sequential circuits based on the input conditions.

3.Describe characteristic equations of various types of Flip-Flops and types of shift registers.

4. Illustrate circuit implementation using flip flop based approach and ROM based approach.

Course Outcomes:

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

CO1. Construct the K-map from a Boolean expression and to find the minimal SOP/POS forms;
CO2. Design combinational and sequential digital logic circuits;
CO3. Make use of the operations of basic building blocks, such as different types of latches, flip-flops, registers and counters;
CO4. Implement various types of flip-flops in creating sequential circuits and their uses in synchronous and asynchronous counters.

Course Content:

UNIT-1:

Principle and Minimization Techniques of combinational Circuits: Introduction to combinational logic; Minimization Techniques: Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS); 3 and 4 Variable Karnaugh map; Quine-McCluskey method. Application study1**:** Logical Function UNIT

UNIT-2:

Analysis and Design of Combinational Circuits: Half adder; full Adder; half subtractor; full subtractor; Serial Adder/Subtractor; Carry Look Ahead adder; BCD adder; encoder and decoder; multiplexers and demultiplexers; cascading of Mux; Boolean function implementation using Mux and decoders.Application study2:Calculator

UNIT-3:

Introduction to Sequential circuits: The S R Latch; edge and level triggering, flip-flops: SR, JK, D, T, and Master-Slave; Characteristic tables and equations; registers, shift register, universal shift register
Application sudy3: Digital combinational lock

UNIT 4:

Sequential Design: Counters: Analysis of Binary ripple Up/Down counter, Analysis and design of synchronous and asynchronous mod-*n* counter using flip-flop, state machine notation, Introduction to Mealy and Moore model, Sequence detector. Application study: Vending machine

Self-learning component:
Memory devices (ROM, RAM), Elevator, Digital clock.

Text books:

1. *D P Leach, A P Malvino, and GouthamSaha, "Digital Principles and Applications", Tata McGraw-Hill, 7th edition, 2006.*
2. *Moshe Morris Mano, "Digital Design", Prentice Hall, 3rd edition, 2004.*

Reference books:

1. *Samuel C Lee, "Digital Circuits and Logic Design", PHI Course Pvt. Ltd., 2008.*
2. *Charles H Roth Jr., "Fundamentals of Logic Design", Cengage Course, 5th edition, 2014.*
3. *John M Yarbrough, "Digital Logic Applications and Design", Thomson Course, 2001.*
4. *Donald D Givone, "Digital Principles and Design", Tata McGraw-Hill 2002.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	E	f	g	H	i	j	k	l	m	N
CO1	H							H					H	
CO2			M	M								M		
CO3			H	H										
CO4	H							H					H	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Obtain NOT, NAND, AND, OR, X-OR and X-NOR gates using only NOR gates.
2. Design 4-to-1 multiplexer using basic gates.
3. Design a 32-to-1 multiplexer using two 16-to-1 multiplexer and one 2-to-1 multiplexer
4. Find out characteristic equations of J-K flip-flop and D flip-flop.
5. List the application of flip-flops.
6. Draw the shift sequence of a ring/Johnson counter to shift 1001 in the register
7. Convert JK flip-flop into T and D-flip-flop.
8. Design a MOD-8 synchronous counter and realize using MSJK flip-flop.
9. Design a sequence detector to detect the sequence 101 using Moore model.
10. Draw the ASM chart for the vending machine problem.
11. Design of Digital Circuits using EDA tools.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3020	**Computer Organization and Architecture**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Pre-requisites:

Basic Electrical and Electronics Engineering (B19IT1040)

Course description:

The course provides students with an understanding of the design of fundamental blocks used for building a computer system and interfacing techniques of these blocks to achieve different configurations of an “entire computer system”. The course also gives introduction to Multi-core architecture and parallel programming

Course Objectives:

The objectives of this course are to:

1. Explain the concepts such as microprocessor, microcontroller and microcomputer, ARM processor.

2. Demonstrate the use of instruction set of ARM processor in developing real world application.
3. Describe different addressing modes used in developing applications.
4. Discuss Memory architecture and Advanced Computer architecture concepts

Course Outcomes:

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

1. Define microprocessor, microcontroller and microcomputer and ARM processor.
2. Write simple programming assignments using instruction set of ARM processor
3. Make use of different addressing modes for developing real world applications.
4. Apply the concepts of Advanced Computer architecture for solving real world problems.

Course Content:

UNIT- 1

Introduction: Microprocessor, Microcontroller, Micocomputer, IOT, ARM Processor

Introduction to architecture and features of Microprocessor, Microcontroller, Microcomputer, and IOT (block diagram based). History of microprocessors and microcontrollers. IOT based boards.

Introduction to ARM, ARM architecture, Instruction set of ARM Processor, Addressing modes, programs for data movement, logic operations, and loop operations.

UNIT -2

Basics: Computer Arithmetic
Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder, multiplication - shift-and-add, Booth multiplier, carry save multiplier, etc. Division - restoring and non-restoring techniques, floating point arithmetic.

Addressing Modes, Instruction Set
Instruction set architecture of a CPU - registers,

UNIT- 3

Instruction Execution Flow

Instruction execution cycle, RTL interpretation of instructions, addressing modes;

Hardware and Micro-program based control UNIT Design
CPU control UNIT design: hardwired and micro-programmed design approaches: ARM pipelines

UNIT- 4

Memory Architecture, Peripherals and Input-Output
Memory system design: semiconductor memory technologies, memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions.

Peripheral devices and their characteristics: Input-output subsystems, I/O transfers - program controlled, interrupt driven and DMA

ARM cortex memory

Advanced Computer architecture concepts

Parallelism, SIMD architectures, MIMD architectures , Processor interconnection ,

Multicore systems - structure, performance, complexity, power consumption, memory utilization, software development issues for multicore systems

Self-learning component:

More Recent Applications: Data-level parallelism - motivation, challenges, applications

Text books:

1. *Carl Hamacher, Zvonko Vranesic and Safwat Zaky. "Computer Organization", McGraw Hill, 2011.*
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 " Available online: http://www.rigwit.co.uk/ARMBook/ARMBook.pdf*

Reference books:

1. *Heuring, V. P. & Jordan, H. F., Computer Systems Design and Architecture, Pearson Education, 2008*
2. *Shen, J. P. & Lipasti, M. H., Modern Processor Design: Fundamentals of Superscalar Processors, Tata McGraw-Hill, 2013*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes												
	a	b	c	d	e	f	g	h	i	j	k	l	m	N
CO1	M	L						L		L				
CO2	M	L						L		L				
CO3	M	L						L		L				
CO4	M	L						L		L				

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. The digital computer is a fast electronic calculating machine that accepts digitized input information and processes it and produces the resulting output information. Explain the various functional UNITs involved in this process.
2. Assume that the processor has Load, Store, Multiply and add instruction and that all values fit in the accumulator. Write a sequence of instructions that can fit in a single accumulator processor for an expression. i. E X F +G X H
3. Give a short sequence of machine instructions for the task: "Add the contents of memory location A to those of Location B and place the answer in location C". Use different instruction types available

in the computer.
4. Assuming the length of the Register R0 as 8 bit and the content of R0 as 16 bit . Discuss the following operations. Rotate R #2, R0 Rotate LC #2, R0 LshiftR #2, R0
5. Represent the decimal values 5,-2,14,-10,26,-19 as Signed ,7 bit numbers in the following binary formats: a) 1's-Complement b)2's -Complement
6. Registers R1 and R2 of a computer contain the decimal values 1200 and 4600. What is the effective address of the memory operand in each of the following instructions? a. Load 20(R1),R5 b. Move #300, R5 c. Add –(R2),R5 iv) Sub (R1)+,R5
7. The program execution time T is to be computed for a certain high level language program. The program can be run on a computer. The number of instruction executions of a program is15 and average number of basic steps needed is 25 and the Clock Rate of computer is 6 Cycles per Second.
8. Consider a computer that has byte addressable memory organized in 32-bit words according to the big-endian scheme and little-endian scheme. A program reads ASCII characters entered at a keyboard and stores them in successive byte locations, starting at location 1000. Show the contents of the two memory words at locations 1000 and 1004 after the name "Computer" has been entered.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./Wk.
B19IT3030	**Object Oriented Programming with Java**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Problem Solving with Programming (B19IT1030)

Course Description:

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 Objectives:

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

Course Outcomes (Cos):

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

CO1: Develop simple programs using Java language concepts such as variables, conditional and iterative execution methods.

CO2: Apply OOP principles and proper program structuring to develop programs.

CO3: Design an application using inheritance concept exception handling.

CO4: Build applications using Java generic types, generic operations and java collections.

Course Content:

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 Superclass; 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; Rethrowing 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

Self-learning component:

The Eclipse IDE; Streams; Processing Input and Output; Concurrent Programming; Swing and JavaFX; Networking; JDBC Database Access

Text books:

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

Reference books:

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

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	N
CO1							L			H	H		H	
CO2	H	L	H		H		L			H	H		M	

CO3	H				H		L						M	
CO4	H	L	H		H		L			H	H		M	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Use Java Programming Language to complete the assignment.

Assignment	Description	Concepts
SCIENTIFIC COMPUTING		
Global Sequence Alignment	Compute the similarity between two DNA sequences.	dynamic programming, strings
Particle Collision Simulation	Simulate the motion of N colliding particles according to the laws of elastic collision.	priority queue, event-driven simulation
Root Finding	Compute square roots using Newton's method.	loops, numerical computation
Cracking the Genetic Codes	Find the genetic encoding of amino acids, given a protein and a genetic sequence known to contain that protein.	strings, file input
COMBINATORIAL OPTIMIZATION		
Traveling Salesperson Problem	Find the shortest route connecting 13,509 Indian cities.	linked list, heuristics
TEXT PROCESSING		
Word Searching	Search for words horizontally, vertically and diagonally in a 2D character array	Tries
Redundancy Detector	Find the longest repeated sequence in a given text.	suffix sorting, strings
Text Indexing	Build an inverted index of a text corpus and find the position of query strings in the text.	suffix sorting or binary search tree
COMMUNICATION		
Prefix Free Codes	Decode a message compressed using Huffman codes.	binary trees, data compression
Burrows-Wheeler	Implement a novel text compression scheme that out-compresses PKZIP.	suffix sorting, arrays, data compression
RSA Cryptosystem	Implement the RSA cryptosystem.	big integers, repeated squaring, analysis of algorithms

DISCRETE MATH		
Linked List Sort	Shellsort a linked list.	linked list, shellsort
Factoring	Factor large integers using Pollard's rho method.	big integers, Euclid's algorithm
Deques and Randomized Queues	Create deque and randomized queue ADTs.	abstract data types, generics
Stock Market	Predict the performance of a stock using Dilbert's rule.	Loops

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3040	**Data Structures**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Programming for Problem Solving (B19IT1030)

Course Description:

This course covers basic data structures techniques and their implementation in Java. Familiarize the concept of Abstract Data Types (ADT), stacks, Queues and Trees. The course also introduces applications of these data structures in solving problems. Students are expected to use these data structure concepts to write simple programs.

Course Objectives:

1. Discuss the basic Concepts of java and Data Structures
2. Illustrate the creation and use of singly and doubly Linked list in Java.
3. Demonstrate the use of Stacks and Queues in real world applications.
4. Discuss the concept and applications of Binary trees.

Course Outcomes (Cos):

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

CO1: Make use of Java Arrays for generation of random numbers.

CO2: Develop a java program for implementing the process scheduling algorithms using linked list.

CO3: Design a program in Java to use stacks/queues for a given application.

CO4: Implement Trees for storing files on disk.

Course Content:

UNIT 1

Introduction to JAVA: base types, “hello universe” java program, classes and objects, Strings, Wrappers, Arrays and Enum types, type conversion

Fundamental Data Structure: Arrays – definition, sorting an array- insertion sort, java methods for array operations, random number generation

UNIT 2

Linked list: Singly linked list definition, illustration- insert and deleting at beginning and end of list, implementation in java. Circular linked list – implementation in java; Doubly linked list- illustration of insertions and deletions.

Application : Round robin scheduling using linked list.

UNIT 3

Stacks: definition, stack ADT, Array implementation of stack, linked list implementation, implementation of stack class in java.

Application: java implementation for reversing an array using stack; illustration of infix to post fix conversion, evaluation of postfix expression.

Queue: definition, Queue ADT, array implementation, linked list implementation

Application: printer job assigning using circular queue

UNIT 4

Trees : general trees- definitions and properties; Binary Tree ADT, Binary Tree properties, Binary Tree interface in java, Abstract BinaryTree base class in java, linked list representation of Binary Tree, Java implementation of linked binary tree structure.

Application: Tree traversal – illustration of preorder, postorder traversal.

Text books:

1. *Michael T. Goodrich, Roberto Tamassia, Michael H.Goldwasser, Data Structures and Algorithms in JAVA , Wiley, 6th Edition, 2014*
2. *Herbert Schildt, The Complete reference Java, 7th edition , 2007*

Reference books:

1. *Richard Gilberg, BehrouzForouzan, “Data Structures: A Pseudo code Approach with C”, Cengage Learning, 2004.*

2. *DebasisSamanta, “Classic Data Structures”, second edition, PHI Learning Private Limited, 2011.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes												
	a	b	c	d	e	f	g	h	i	j	k	l	m	N
CO1	M	H					H					L		
CO2	H	H		M						M				
CO3	H										M		M	M
CO4	H	H		M						M	M			

Sample Assignments:

1. Write a java program to search for a protein sequence in the DNA string sequence.(CO1,CO2)
2. Write a program to perform check the performance of linear search and binary search on sorted ‘n’ randomly generated number. (CO2)
3. Select and implement a suitable data structure for demonstrating printing jobs assigned for a printer(CO3,CO4)
4. Write a java program to read infix arithmetic expressions as input, evaluates all of the expressions, and writes the resulting answers to the standard output. (CO4)
5. Design an algorithm which takes a preorder and inorder expression and produces the binary tree.(CO3).
6. Write a java program to implement variable length array.(CO1)
7. Write a program to check for balanced parenthesis by using stacks.(CO3)
8. Write a program to solve Tower of Hanoi problem using Stacks(CO3)
9. Write a program to convert from decimal number to binary number using stacks(CO3)
10. Write a program to add two large numbers using linked list.(CO2).

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3050	**Discrete Mathematics and Graph Theory**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Course Description:

The main objective of this course is to provide an understanding of the concepts and application of set theory, logic, relations and functions, principles of counting and to know the algebraic structure with one binary operation and two binary operations.

The main objective of this course is to provide an understanding of the concepts and application of graph theory.

Course Objectives:

The objectives of this course are to:

1. Explain mathematical arguments using logical connectives and quantifiers
2. Illustrate the operations on discrete structures such as sets, relations and functions.
3. Describe the theory and applications 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 systems.

Course Outcomes (COs):

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

CO1: Construct mathematical arguments using logical connectives and quantifiers.

CO2: Apply the operations like union and intersection on discrete structures such as sets, relations and functions.

CO3: Make use of graphs and fundamental theorems in real world application.

CO4: Develop a model using advanced concepts of graphs for the given real world application.

Course Content:

UNIT- 1 Set Theory and Logic

Fundamentals of sets, Sub sets, Venn diagrams, Operations on sets, Laws of set theory, Countable and uncountable sets, Addition- principle, Extended Addition Principle. Propositions, Logical connectives and truth tables (illustrative example), Logical equivalence , Laws of logic, Duality, NAND and NOR connective(Circuits), Converse ,Inverse and Contra positive, Rules of inference , Open statements, Quantifiers, 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 example), Matrices and Digraphs of relations, Operations on relations, Properties of relations, Equivalence relations, Partial ordered relations, Posets, Hasse diagrams, External elements in posets. Types of Functions, Properties of Functions, The pigeon hole principle, Composite functions, Invertible functions, Floor and ceiling function, Sterling numbers of second kind.

UNIT- 3 Introduction to Graph Theory

Konigsberge's Bridge problem, Utilities problem, Seating Problems, graphs, Representation of graphs, Directed graphs, incidence, adjacency, degree, In degree , out degree, regular graphs, complete graphs, Null graphs, Bipartite graphs, Isomorphism, Directed graphs, Sub graphs, Walk, Trail, Path, Cycle, Connected and Disconnected graphs, Weakly Connected and Strongly Connected, Components, Complement of Graph, Partition , Decomposition.

UNIT- 4 Eulerian and Hamiltonian Graph and Graph colouring

Operation on graphs, Definition of Euler Trail, Euler graph, Standard theorems on Euler graphs Hamiltonian Path, Hamiltonian Cycle and Hamiltonian Graph, Standard theorems on Hamiltonian Graph, Planar graph, Detection of Planarity, Geometric dual, Euler formula, Graph colouring, Chromatic polynomial, Map colouring, Four colour theorem, Five Colour theorem, Matching, Network flow and its applications, Cut set, Cut vertex, Chord, Properties of Cut set, Max flow Min cut theorem.

Text books:

1. *Ralph P Grimaldi, Discrete and Combinatorial Mathematics,Pearson Education, 5th Edition, 2014*
2. *NarsinghDeo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall, 2014.*
3. *Ralph P Grimaldi, Discreteand Combinatorial mathematics, Pearson Education, 5th edition, 2014.*

Reference books:

1. *Kenneth H. Rosen, Discrete Mathematics and its Applications, 5thedition,Tata McGraw-Hill, 2014.*
2. *C. L. Liu, Elements of Discrete Mathematics, 4th edition, Tata McGraw-Hill, 2014.*
3. *ThomasKoshy, Discrete Mathematics with Applications, Elsevier, 2012.*
4. *Ralph P. Grimaldi, Discrete and Combinatorial Mathematics, Pearson Education, Asia,2015.*
5. *Frank Harary, "Graph Theory", Narosa, 2013.*
6. *J.A Bondy and U.S.R Murthy, Graph Theory with applications, Macmillan, 2013*
7. *GeirAgnarsson and Raymond Geenlaw ; Graph Theory modeling, Applications and algorithms, Pearson Education, 2007.*
8. *Douglas B, "Introduction to Graph Theory", Prentice Hall of India, 2nd edition, 2015.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes												
	a	b	c	d	e	f	g	h	i	j	k	l	m	N
CO1									H					
CO2	H													
CO3										H				
CO4	H													

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Discuss the applications of Graph theory in the following:

A. Computer Networks
B. Structure of websites
C. Electronic chip design
D. Language processing
E. Semantic Search Engine
F. Modern Coding theory

G. Register allocation methods in compilers
H. Model molecule structures
I. In analysis of Biological networks –
    a. Protein – protein interaction networks
    b. Regulatory networks (GRNs)
    c. Signal transduction networks
    d. Metabolic and biochemical networks
J. Network flow in operation research

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3060	**Software Engineering**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Any Programming language

Course Description:

The course provides students with a knowledge on the basic principles of software development life cycle, activities involved in software requirements engineering, software development, testing, evolution and maintenance. It introduces concepts such as software processes and agile methods, and essential software development activities

Course Objectives:

1. Discuss the importance of the software development process.
2. Explain the workflow of Automating process.
3. Illustrate with case study, the importance of DevOps.
4. Describe the software life cycle using a case study.

Course Outcomes (Cos):

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

CO1. Outline the importance of the software development process.

CO2. Design the workflow of Automating process.

CO3. Make use of DevOps.

CO4. Develop an application using software life cycle.

Course Content:

UNIT- 1

Introduction

Defining the Software Development Process: Goals of Defining the Software Development Process , Why Is Defining the Software Development Process Important? , Where Do I Start?, Explaining the Software Development Lifecycle , Systems versus Software Development Lifecycle, Defining Requirements, Managing Complexity and Change, Validity of Requirements, Testing Requirements ,Functional Requirements, Nonfunctional Requirements, Epics and Stories, Planning for Changing Requirements , Workflow for Defining Requirements ,Test-Driven Development , Designing Systems ,Software Development ,Testing , Testing the Application ,Testing the Process Itself , Continuous Integration , Continuous Delivery and Deployment , Defining Phases of the Lifecycle ,Documentation Required , DevOps , Communicating with All Stakeholders, Production Support ,Maintenance and Bugfixes, Lifecycle in the Beginning ,Maintenance of the Lifecycle ,Creating the Knowledge Base.

UNIT- 2

Agile Application Lifecycle Management: Goals of Agile Application Lifecycle Management, Why Is Agile ALM Important? Where Do I Start? Understanding the Paradigm Shift, Rapid Iterative Development, Remember RAD? , Focus on 12 Agile Principles, Agile Manifesto, Fixed Timebox Sprints, Customer Collaboration, Requirements, and Documentation.

UNIT- 3

Automating the Agile ALM: Goals of Automating the Agile ALM, Why Automating the ALM Is Important, Where Do I Start? Tools, Do Tools Matter? Process over Tools, Understanding Tools in the Scope of ALM, Staying Tools Agnostic, Commercial versus Open Source, What Do I Do Today? ,Automating the Workflow , Process Modeling Automation ,Managing the Lifecycle with ALM, Broad Scope of ALM Tools ,Achieving Seamless Integration ,Managing Requirements of the ALM, Creating Epics and Stories, Systems and +Driven Development ,Environment Management ,Gold Copies ,Supporting the CMDB, Driving DevOps ,Supporting Operations ,Help Desk ,Service Desk ,Incident Management , Problem Escalation ,Project Management, Planning the PMO ,Planning for Implementation, Evaluating and Selecting the Right Tools ,Defining the Use Case ,Training Is Essential, Vendor Relationships, Keeping Tools Current.

UNIT- 4

DevOps: Goals of DevOps, Why Is DevOps Important? Where Do I Start? How Do I Implement DevOps? Developers and Operations Conflicts, Developers and Operations Collaboration, Need for Rapid Change, Knowledge Management, the Cross-Functional Team, Is DevOps Agile? The DevOps Ecosystem, Moving the Process Upstream, Left-Shift, Right-Shift, DevOps in Dev, DevOps as Development, Deployment Pipeline, Dependency Control, Configuration Control, Configuration Audits, QA and DevOps, Information Security, Infrastructure as Code, Taming Complexity, Automate Everything, Disaster Recovery and Business Continuity, Continuous Process Improvement.

Self-learning component:

Case study on Critical system; Case study on ATM using agile method;

Text books:

1. *Bob Aiello and Leslie Sachs, "Agile Application Lifecycle Management Using DevOps to Drive Process Improvement", Addison Wesly, First printing, June 2016.*

Reference books:

1. *Roger S, "Software Engineering – A Practitioner's Approach", seventh edition, Pressman, 2010.*
2. *Roger Pressman, Ian sommerville, "Software Engineering", 9th edition, 2010.*
3. *Hans Van Vliet, "Software Engineering: Principles and Practices", 2008.*
4. *Richard Fairley, "Software Engineering Concepts", 2008.*
5. *ACM Transactions on Software Engineering and Methodology (TOSEM).*
6. *IEEE Transactions on Software Engineering.*

Mapping COs with POs (Program Outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	N
CO1	M			L		H								
CO2	M			L		L					H			
CO3	M		M	L				L			L			
CO4	L		H							L	H			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Consider a scenario where you need to develop software for defense management system. Collect all functional and non-functional requirements and document a detailed report for the same.
2. Design test cases for validity and non-validity data, in a student management system for a university.
3. Consider a census System in India, illustrate the Planning done for Implementation, Evaluating and Selecting the Right Tools for Implementation.
4. Discuss and compare git pull and git fetch.
5. Describe the branching strategies used in devops

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3070	**Data Structures Lab**	**14**	**HC**	**0**	**0**	**2**	**0**	**2**	**2**

Lab Outcomes:

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

CO1: Implement complex array operations on given data. (PO:a,b,m)

CO2: Choose appropriate data-structures for specific problems. (PO:a,b,c,m)

CO3: Develop applications based on different data structures for sorting, searching and computing. (PO:a,e,b,k)

Sl.No.	List of experiments	COs	Pos
1.	Write a Java program using the data structure arrays to multiply two given matrices of same order.	CO1	a,b,m
2.	Develop a program in java to read a **sparse matrix**of integer values in the 2D array format and convert the sparse matrix to <*row, column, value*> format and search for an element specified by the user. Print the result of the search appropriately.	CO1	a,b,m
3.	Write Java programs to implement the STACK ADT using an array.	CO1	a,b,m
4.	Write Java programs to implement the QUEUE ADT using an array.	CO1	a,b,m
5.	The compilers always convert infix expression into postfix to perform further operations like parsing, lexical analysis etc. Select an appropriate data structure and develop a program to convert an infix expression into postfix using **stack.**	CO2	a,b,c,m
6.	Write Java programs to implement the STACK ADT using a singly linked list.	CO2	a,b,c,m
7.	Evaluation of postfix expressions is done by compilers during the compilation process. Design and Develop a program to evaluate a postfix expression using **stack**.	CO3	a,e,b,k
8.	Write Java programs to implement the QUEUE ADT using a singly linked list.	CO3	a,e,b,k
9.	Write a java program that determines whether parenthetic symbols ( ), { } and [ ] are nested correctly in a string of characters (use stack ADT).	CO3	a,e,b,k
10.	Write a java program that uses both stack and queue to test whether the given string is a palindrome (Use Java Utility).	CO2	a,b,c,m
11.	Files are stored in memory in tree structure directory. Design and develop a program to create a directory having files with unique file-id in the hard disk and display the files in all three traversal orders using Binary Search Tree (BST).	CO2	a,b,c,m
12.	Consider a class having 100 students where, the details of each student like name, roll number and marks of 3 subjects is to be stored. Design and develop a program to construct a singly linked list to enter records of different students in list, display the list and calculate the percentage of each student. Also count the number of students passed (scored >40 in all the subjects).	CO3	a,e,b,k

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3080	**Object Oriented Programming with Java Lab**	**HC**	**0**	**0**	**2**	**0**	**2**	**2**

Lab Outcomes:

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

CO1: Select basic Java language constructs to build Java programs. (PO: g,j,k,m)

CO2:Apply OOP principles and proper program structuring to develop programs. (PO: a,b,c,e,g,j,k,m)

CO3:Demonstrate the concepts of inheritance and exception handling. (PO: a,e,g,m)

CO4: Build applications using Java generic types and collections. (PO: a,b,c,e,g,j,k,m)

Lab Experiments:

<table>
<tr><th>SNo.</th><th>Experiment Problem Statement</th><th>CO</th><th>PO</th></tr>
<tr><td>1</td><td>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 smaller than or equal to n.</td><td>1</td><td>g,j,k,m</td></tr>
<tr><td>2</td><td>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 JAVA program to solve a given set of linear equations.</td><td>1</td><td>g,j,k,m</td></tr>
<tr><td>3</td><td>To compute a square root of any positive number a, start with an initial guess $x = x_1$ for $\sqrt{a}$; we then calculate successive approximations $x_2, x_3 \dots, \sqrt{a}$ using the formula:
$$x_i = \frac{x_{i-1} + (a/x_{i-1})}{2}, i = 2, 3, \dots$$
Develop a JAVA application that implements the above $SQRT$ function to compute the square root of any positive number</td><td>1</td><td>g,j,k,m</td></tr>
<tr><td>4</td><td>Model a lamp as a Java object. Make a Lamp class. This will contain at least 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:
• create a lamp object;
• turn it on and off;
• print the the lamp's on/off status to the console.</td><td>2</td><td>a,b,c,e,g,j,k,m</td></tr>
</table>

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 addition, subtraction, multiplication and division operations.
		2	**a,b,c,e,g,j,k,m**

6	The String class in JAVA has a static method compareToIgnoreCase, 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 Arraysclass to sort the strings by passing the compareToIgnoreCase function as a parameter to the sort function using method reference. Print the sorted array.	**2**	**a,b,c,e,g,j,k,m**
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 givenof the following criteria: - Manager 10% of the basic salary, and Technicians 15% of basic. Develop the payroll for XYZ. Implement a class hierarchy using inheritance, where $Employee$ is an abstract class and $Manager\ and$ $Tec\square nician$ are derived from $Employee$. Demonstrate a polymorphic behavior for giving the annual increments.	**3**	**a,e,g,m**
8	Define a new Exception class named OddException. Create a new class named EvenOdd. Write a method called halfOf(), which takes an int as parameter and throws an OddException 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 try/catch blocks, and prints either the output of halfOf() or the caught OddException.	**3**	**a,e,g,m**
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 and also handle divide by zero using java exception handling mechanism.	**3**	**a,e,g,m**
10	Create a class Student that has instance variables as Name, Age, Address and accessor and mutator 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 the details before andafter reversing the collection.	**4**	**a,b,c,e,g,j,k,m**
11	Use generics to build a class Sort. Implement the bubble sort algorithm to sort an array of any type.	**4**	**a,b,c,e,g,j,k,m**
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).	**4**	**a,b,c,e,g,j,k,m**

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3090	**Skill Development-3**	**HC**	**0**	**0**	**0**	**1**	**1**	**2**

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT3X10	**Soft Skills – 1**	**RULO**	**0**	**0**	**2**	**0**	**2**	**2**

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

FOURTH SEMESTER:

Course Code	Course Title	Course Type	L	T	P	J	C	Weekly Contact Hours
B19IT4010	**Design and Analysis of Algorithms**	HC	3	0	0	0	3	3

Prerequisites:

Problem Solving with Programming [B19IT1030], Object Oriented Programming with JAVA [B19IT3030], Data Structures [B19IT3040]

Course Description:

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 are done.

Course Description:

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 are done.

Course Objectives

The objectives of this course are to:

1. Describe basics of algorithms in various domains.
2. Explain design of algorithms using the dynamic programming; greedy method, Backtracking, Branch and Bound strategy, and recite algorithms that employ this strategy;
3. Illustrate the use of appropriate algorithmic design techniques for a given problem;
4. Discuss various design approaches based on time and space efficiency.

Course Outcomes (Cos):

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

CO 1: Explain the mathematical foundation for the analysis of algorithms.

CO 2: Formulate the solution for any computational problem using the appropriate algorithm design technique.

CO 3: Analyze the efficiency of algorithms.

CO 4: Compare the various algorithm design approaches based on time and space efficiency for any given computational problem.

Course Content:

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

Self-learning component:
Decrease-and-Conquer: Algorithms for Generating Combinatorial Objects, Divide-and-Conquer: Strassen's Matrix Multiplication, Space and Time Trade-Offs: Hashing, Greedy Technique: Knapsack Problem, Huffman Trees and Codes, Coping with the Limitations of Algorithm Power: Hamiltonian Circuit Problem, Knapsack Problem

Text books:

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

Reference books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, Introduction to Algorithms, PHI, 3rd Edition.
2. The design and analysis of computer algorithms, 4th Edition Addison-Wesley
3. ACM Transactions on Algorithms.
4. ACM Journal of Algorithms and Computational Technology.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	H		L		M					L	M			
CO2			L					L						
CO3					M									
CO4	H	H						L		L				

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Lab Experiments:

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 and Prim's algorithms. Differentiate the methods.
4. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijikstra's algorithm
5. Design and Implement 0/1 Knapsack problem using Dynamic Programming.
6. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm
7. Obtain the DFS ordering of vertices in a given digraph.
8. Implement Horspool's algorithm for String Matching and find the number of key comparisons in successful search and unsuccessful search
9. Sort a given set of elements in ascending order which has duplicate entries. Use the sorting by counting algorithm
10. Implement N Queen's problem using Back Tracking.
11. Write a program to find network of people of same location in Linkedin social network.
12. Write a program to sort all transactions of Big Mall by quantity of sales.

Sample Assignments:

1. Old World puzzle: A peasant finds himself on a river bank with a wolf, a goat, and a head of cabbage. He needs to transport all three to the other side of the river in his boat. However, the boat has room for only the peasant himself and one other item (either the wolf, the goat, or the cabbage). In his absence, the wolf would eat the goat, and the goat would eat the cabbage. Solve this problem for the peasant or prove it has nosolution. (Note: The peasant is a vegetarian but does not like cabbage and hence can eat neither the goat northe cabbage to help him solve the problem. And it goes without saying that the wolf is a protected species.)

2. Huffman coding is a lossless data compression algorithm. The idea is to assign variable-length codes to input characters; lengths of the assigned codes are based on the frequencies of corresponding characters. The most frequent character gets the smallest code and the least frequent character gets the largest code. Give a brief report on the Huffman coding algorithm and name the design paradigm it follows.

3. Kosort the nigsberg bridges The Konigsberg Bridge puzzle is universally accepted as the problem that gave birth to graph theory. It was solved by the great Swiss-born mathematician Leonhard Euler (1707–1783). The problem asked whether one could, in a single stroll, cross all seven bridges of the city of Konigsberg exactly once and returns to a starting point. a. State the problem as a graph problem. b. Does this problem have a solution? If you believe it does, draw such a stroll; if you believe it does not, explain why and indicate the smallest number of new bridges that would be required to make such a stroll possible.
4. Design and Develop program to search documents based on text query (Use string matching algorithm).
5. Build Google map application for REVA that finds the shortest route between source and destination

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4020	**Information and Communication Theory**	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Probability and Statistics (B19IT2010), Discrete Mathematics and Graph Theory (B19IT3050)

Course Description:

This course covers basic concepts of Information theory is the mathematical theory that deals with the fundamental aspects of communication systems. The purpose of this course is to develop the fundamental ideas of information theory and to indicate where and how the theory can be applied.

Course Objectives:

The objectives of this course are to:

1. Explain the concepts of information source and entropy.
2. Demonstrate the working of various Encoding Techniques.
3. Discuss various source encoding algorithms.
4. Illustrate the use of Cyclic and convolution codes.

Course Outcomes (Cos):

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

CO1: Summarize the basic concepts of information source and measure of information.

CO2: Implement different Encoding Schemes for given applications

CO3: Develop the different Source Encoding Algorithm for given applications.

CO4: Make use of Cyclic and convolution codes in real world applications.

Course Content:

UNIT- 1

INFORMATION THEORY: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Markoff Sources.

UNIT -2

COMMUNICATION THEORY: A Data Communication Model, Concepts of Frequency, Spectrum and Bandwidth, Analog and Digital data, Analog and Digital Signals, Channel capacity- Nyquist Bandwidth, Shannon capacity formula, the expression E_b/N_o, Digital Data, Analog Signals Encoding Techniques- Amplitude Shift Keying(ASK), Frequency Shift Keying(FSK), Phase Shift Keying(PSK).

UNIT- 3

SOURCE CODING: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI. Encoding of the Source Output, Shannon's Encoding Algorithm. Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm.

UNIT- 4

BINARY CYCLIC CODES: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction.
Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm.

Self-Learning Concepts:

Methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting hamming Codes, Table lookup decoding using Standard Array.

Text books:

1. *Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.*
2. *Digital and analog communication systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 2005.*
3. *Data and Computer Communications, William Stallings, PEARSON Ed Inc, 9th edition, 2011*
4. *Information Theory and Coding, Muralidhar Kulkarni, K.S. Shivaprakasha, Wiley India Pvt. Ltd, 2015.*

Reference books:

1. *ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007.*
2. *Principles of digital communication, J. Das, S. K. Mullick, P. K. Chatterjee, Wiley, 1986 - Technology & Engineering*

3. *Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016.*
4. *Information Theory and Coding, K.N.Haribhat, D.Ganesh Rao, Cengage Learning, 2017.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	A	B	c	d	e	F	g	h	i	j	k	l	m	n
CO1									H					
CO2	H								M					
CO3					H		M							
CO4								H						

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. A Binary Source produces symbols 0 and 1 with probability P and 1-P. Determine Entropy of the source. Sketch the variation of Entropy with P and comment on the result.

2. In a Facsimile picture transmission of pictures, there is about 3.25 M-pixels per frame. For a good reproduction, 15 brightness leve1s are necessary. Assuming that all the levels are equallylikely to occur, lind the rate of transmission if one picture istransmited in every 3 minutes.

3. Apply Shannon encoding algorithm and generate binary codes for the set of symbols given in table below. Also find efficiency.

Sym	A	B	C	D	E	F	G
P	9/32	9/32	3/32	3/32	3/32	3/32	2/32

4. Derive an expression for the Data Transmission Rate of Binary Erasure Channel.

5. An analog source has a bandwidth of 4KHz. The signal is sampled at 2.5 times the Nyquist Rate and each sample is quantized into 256 equally like1y levels. Assume that the successive samples are statistically independent. Find the information rate of the source. Can the output of this source be transmitted without error over an analog channel of Bandwidth 50Khz and S/N = 20db. If the output of the source is to be transmitted without error over an analog channel having S/N = 10, compute the bandwidth required.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4030	**Database Management System**	**HC**	**3**	**0**	**1**	**0**	**4**	**5**

Prerequisites:

Basics of Database Systems

Course Description:

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 Objectives:

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):

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

CO1: Design database schemas for the different Database applications.

CO2: Make use Relational model and Relational algebra in a given real world application.

CO3: Develop an application for using different SQL commands for managing the database.

CO4: Implement Normalization for database applications.

Course Content:

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.

Self –Learning Component:

Sequences, synonyms, Triggers and Procedures and Introduction to Transaction Management Systems.

Text books:

1. *Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education, 5th Edition, 2007.*
2. *Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill, 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*
6. *ACM Transactions on Database Systems*

Mapping Cos with POs (Program outcomes)

Course Outcomes							**Program Outcomes**							
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	M	H	H										M	

CO2	H	H	M	M	H						M	M	H
CO3	H		H	M	H				H	M		H	
CO4	H		M	H	H	M			H	M		M	M

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

List of Lab Experiments:

1. Product - Order System

In recent years, most of the grocery items are available online; hence people are doing online transactions for purchase. There are lot of discounts and benefits through the online orders. Since everyone in the life is busy with one or other works, such applications will save their time.
These online transaction based applications require many databases to be built for storage and transaction management. Design a product-order database which can store the details of customers, agents and the products. All the details of sold products along with commission from different agents across different cities will get stored in this database and utilized for transactions.

Customer (<u>cid</u>, cname, city, discount)
Agent (<u>aid</u>, aname, city, commission)
Product (<u>pid</u>, pname, city, quantity, price)
Orders (<u>ordno</u>, month, cid, aid, pid, qty, amount)

Queries

a. Retrieve the customer ids of any product which has been ordered by agent "a06".
b. Retrieve cities in which customers or agents located.
c. List product ids which have been ordered by agents from the cities “Dargeling” or “Srinagar”.
d. Retrieve customer ids whose discounts are less than the maximum discount.
e. Retrieve product ids ordered by at least two customers.
f. For each (aid, pid) pair get the sum of the orders aid has placed for pid.
g. Retrieve product ids and total quantity ordered for each product when the total exceeds 1000.
h. List the names of the customers and agent who placed an order through that agent.
i. Retrieve order numbers placed by customers in "Dargeling" through agents in "New Delhi".
j. Retrieve names of the customers who have the same discount as that of any (one) of the customers in "Dargeling" or "Bangalore".
k. Retrieve customer idswith smaller discounts than every customer from " Srinagar”
l. Retrieve names of the customers who have placed an order through agent "a05". (using exists)
m. Retrieve names of the customers who do not place orders through agent "a05". (using not exists)
n. Retrieve customer ids whose orders placed through all the agents in "New Delhi".
o. Retrieve agent ids either from "New Delhi" or "Srinagar" who place orders for ALL products priced over one dollar.

p. Retrieve names and ids of the customers and agents along with total dollar sales for that pair. Order the result from largest to smallest total sales. Also retain only those pairs for which total dollar sales is at least 9000.00.
q. Increase the percent commission by 50% for all agents in "New York".
r. Retrieve the total quantity that has been placed for each product.

2. Employee Database System

The storage of digital data is increasing day by day. Every big / small organization started storing their Employee details like name, salary, address, Department under which they are working in their own database. Design a company database which can store the details of Departments, projects, their Employee and his / her dependent details of a particular organization

Employee (ssn, name, salary, sex, super_ssn, address, dno)
Department (dname, dnumber,mgr_ssn)
Dept_Loc (dnumber, dloc)
Project (pname, pnumber, plocation, dnum)
Works_On (essn, pno, hours)
Dependent (essn, depen_name, address, relationship, sex)

Queries

a. Retrieve the names of the Employees who works on all the projects controlled by dept no 3.
b. Retrieve the names of the Employees who gets second highest salary.
c. Retrieve the names of the Employees who have no dependents in alphabetical order.
d. List the names of all Employees with at least two dependents.
e. Retrieve the number of Employees and their average salary working in each Department.
f. Retrieve the highest salary paid in each Department in descending order.
g. Retrieve the SSN of all Employees who work on atleast one of the project numbers 1, 2, 3.
h. Retrieve the number of dependents for an Employee named RAM.
i. Retrieve the names of the managers working in location named xyz who has no female dependents.
j. Retrieve the names of the Employees who works in the same Department as that of RAM.
k. Retrieve the names of the Employees whose salary is greater than the salary of all the Employees working in Department no 3.
l. Retrieve the names of the Employees who work for dept no 3 and have a daughter as dependent.
m. Retrieve the names of the Employees who paid highest salary from each Department.
n. Retrieve the names of the Employees who are paid the same salary as that of Anil.
o. Retrieve the total the number of Employees in the ‘Research’ Department.
p. For each project, retrieve the project number, the project name, and the number of Employees who work on that project.

3. Car rental agency database systems

The application that can be used for booking a vehicle online from his / her place is very much needed in mobile devices. The main aim of this system is to illustrate a database application for booking vehicles online. Design a car rental agency database which can store customer details, vehicle details like vehicle id, size, transmission and reservation details like who had booked from one date to other.

Customers(cid, firstname, lastname, address)
Vehicle(vid, mileage, location, vsize, transmission)
Reservations(cid,vid, start_date, end_date)

Note :
->Vehicle.transmission can have two values ‘manual’ and ‘automatic’.
->Vehicle.vsize can have following values. ‘compact’, ‘mid-size’, ‘full-size’, ‘premium’ and ‘luxury’. The default size is compact.

Queries

a. Display both the first name and last name in uppercase as “Name of the customer “ as column name.
b. Display vehicles size which is having maximum mileage.

c. Find location and total mileage of all vehicles specific to each respective location.
d. Find average mileage of vehicles for each location, which has at least five vehicles.
e. Display the customer names whose reservation start date is before Feb 18^{th} 2016.
f. Display the vehicles which has been reserved between the dates Nov 5^{th} 2015 and Jan 16^{th} 2016.
g. Display the names of the customers whose lastname starts with 'D' and who has reserved more vehicles than the customer with cid as '101'.
h. Retrieve the customers who have reserved vehicles from all the locations.
i. Retrieve the locations that have at least one vehicle with manual transmission that has lower mileage than any luxury vehicle at that location.
j. Delete all the reservations for customer whose last name starts with 'S'.

Sample Assignments:

1. Design and draw the ER Diagram for any of the two following database application with minimum 4/ 5 entities and also specify the proper key and structural constraints:

2. Design a college library management project that manages and stores books information electronically according to students needs. The system helps both students and library manager to keep a constant track of all the books available in the library. It allows both the admin and the student to search for the desired book.

3. Develop a Hostel Management system for the computerization of the Hostel. The common transactions of the hostel includes the maintenance of mess bills, information about students in the hostel, enrolling of new students and their payments and dues etc are stored into the databases and reports are generated according to the user requirements

4. Develop a Hospital Management system that includes registration of patients, storing their details into the system, and also computerized billing in the pharmacy, and labs. The software should have the facility to give a unique id for every patient and stores the details of every patient and the staff automatically.

5. Bank Management creation of a secure Internet banking system. This will be accessible to all customers who have a valid User Id and Password. This is an approach to provide an community to the customers to have some important transactions to be done from where they are at present without moving to bank

6. Super Market Information Management automation .This software should help salespersons in managing the various types of Records pertaining to his/her customer. The product should help the user to work in a highly effective and efficient environment.
7. Insurance Management a complete solution for organization which needs to manage different type of insurance. Organization can track insurance, premium and policies with this application.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4040	Operating Systems	HC	3	0	1	0	4	5

Prerequisites:

Problem Solving with Programming [B19IT1030], Computer Organization and Architecture [B19IT3020]

Course Description:

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.

Emphasis is given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping) and file systems.

Course Objectives:

The objectives of this course are to:

1. Discuss the history, basics and structure of Operating System.
2. Demonstrate the process and threading concepts.
3. Illustrate the different scheduling and deadlock techniques
4. Explain the physical, virtual memory management techniques and file structure of UNIX operating system

Course Outcomes (Cos):

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

CO1: Develop applications that use files data source with suitable system calls.

CO2: Implement process management and scheduling schemes.

CO3: Apply synchronization and deadlock techniques in real time applications.

CO4: Design memory management techniques for a given machine architecture.

Course Content:

UNIT – 1:

Operating System Principles: Evolution of Operating Systems, Structural overview, Types of Operating System and operations, 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. Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, Scheduling algorithms, Multiple Processor scheduling, thread scheduling.

UNIT-3:

Synchronization and Deadlock Synchronization: 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; Monitors.

Deadlock: Definition, Deadlock characteristics, Deadlock Prevention, Deadlock Avoidance: banker's algorithm, Deadlock detection and Recovery.

UNIT – IV:

Memory Management: Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.
File System: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection.

Self-learning component:
Virtual machines and Introduction to Linux Operating System, Introduction to Distributed computing, Parallel computing, grid computing, cloud computing.

Text books

1. *Abraham Silberschatz, Peter Bear Galvin, Greg Gagne, Operating System Principles, Wiley Asia Student Edition, 2009.*
2. *William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition, 2011.*
3. *D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill, Third edition 2012.*

Reference books

1. *Frederic Magoules, Jie Pan, Kiat-An Tan, Abhinit Kumar, Introduction to Grid Computing, CRC Press, Second Edition, 2014*
2. *Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation. Prentice-Hall, Third edition, 2014.*
3. *Charles Crowley; Operating System: A Design-oriented Approach; Tata McGraw-Hill, First edition 2017.*
4. *Gary J. Nutt; Operating Systems: A Modern Perspective; Addison-Wesley, Second edition 2011.*
5. *Harvey M. Deitel, An introduction to operating systems. Addison-Wesley, Third edition, 2010.*
6. *Springer, Springer transaction for advance in Distributed computing and middleware.*
7. *IEEE transaction for Real time operating system.*

8. *ACM transaction for embedded operating system.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	A	b	c	D	e	F	g	h	i	j	k	l	m	n
CO1	H									H				
CO2		H	M	M	H					H				
CO3										H	H			
CO4			H	H	M					M	M			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Lab Experiments: (Implement following using C-language on Unix/Linux)

Sl. NO.	Experiments	CO	PO
1	A child process in computing is a process created by another process (the parent process). This technique pertains to multitasking operating system and sometimes called a sub-process or subtask. Now, use C language to create a child process to read commands from the standard input and execute them.	1	a, j
2	Fibonacci series is one of the optimal searching techniques. Multi-threaded program is used to execute multiple process or threads concurrently by the central processing UNIT. Now, run a Multi-threaded program in C to generate and print the Fibonacci series in such a way that one thread has to generate the numbers up to the limit specified by the user and another thread to print them.	1	a, j
3	In multiprogramming environment, several processes execute at the same time sharing the processor time. It is required to understand the performance of the policies FCFS and SJF in proper utilization of CPU time. Therefore write program to compare their performance metrics in terms of average waiting time and average turnaround time.	1	a, j
4	To design and develop operating system, it is necessary to develop variousmodules like, Process Manager, Memory Manager, Input-Output Manager and Network Manager and many more. The process manager is one of the important modules of OS. It deals with creation and execution of multiple processes sharingthe processor time. The process manager uses various scheduling policies. Hence,there is a need to understand the various scheduling policies. Hence, given the listof processes and their CPU burst times, display/print the Gantt chart for Priority. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.	2	b, c, d ,e, j
5	Given the list of processes and their CPU burst times, display/print the Gantt chart	2	b, c, d ,e, j

	for Round Robin Algorithm. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.		
6	Producer-Consumer Problem also known as bounded-buffer problem is an example of multi-process synchronization problem. This problem arises when the producer and consumer share a common, fixed size buffer. The solution can be obtained by means of inter–process communication typically using Semaphores. Now, implement a process with a produces thread and a consumer thread which makes use of bounded buffer. Use any suitable synchronization construct. (Implement producer-consumer problem using semaphores).	3	J, k
7	Banker's Algorithm is used for Deadlock Avoiding purpose. It is suitable to resource allocation system with multiple instances of each resource type. Implement Banker's Algorithm which finds whether the state is safe or not.	4	c, d, e, j, k
8	The operating system manages the computer's memory. The OS allocates required memory for the task and deallocates memory after execution of task. There are many allocation strategies. Write a C program to simulate the Multi Programming with Variable number of Task (MVT) memory strategy.	4	c, d, e, j, k
9	The operating system replaces the page of a old process whenever a new process page has to be loaded in memory. To select the page for replacement there are many methods. Write a C program to implement LRU page replacement algorithm.	4	c, d, e, j, k
10	The operating system manages storage of information by creating and storing information in the file. There are many methods of creating file. Write a C program to implement any one of the file allocation techniques (Linked, Indexed or Contiguous).	4	c, d, e, j, k
	Take Home assignments		
1	Implement shared memory and semaphore concepts for inter process communication	1	a, j
2	Implement file organization strategies a) single level b) Two level c) Hierarchical	1	a, j
3	Write a C program to simulate the concept of Dining-Philosophers problem.	1	a, j
4	Write programs using the following system calls of UNIX operating system: exec, getpid, exit, wait, close, stat, opendir, readdir	2	b, c, d ,e, j
5	Write a C program to simulate the following contiguous memory allocation techniques a) Worst-fit b) Best-fit	4	c, d, e, j, k
6	Implement Memory management Scheme-II a) Segmentation Concept	4	c, d, e, j, k
7	Write a C program to simulate the First fit contiguous memory allocation technique.	4	c, d, e, j, k
8	Write a C program to simulate disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN	4	c, d, e, j, k
9	Design and develop a data recording system that receives data from LAN and records it in a file .Use threading and buffering & Synchronization Mechanisms.	4	c, d, e, j, k
10	Write a program that demonstrates the usage of the shared resources using semaphores	4	c, d, e, j, k

Sample Assignments:

1. Implement a process with a producer thread and a consumer thread which make use of a bounded buffer (size can be prefixed at a suitable value) for communication. Use any suitable synchronization construct. (Project)
2. List differences among short-term, medium-term, and long term scheduling. (Assignment)
3. Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 115 KB, 500 KB, 358 KB, 200 KB, and 375 KB (in order)? Rank the algorithms in terms of how efficiently they use memory. (Assignment).
4. Write note on various scheduling algorithms (Assignment)
5. Develop a graphical package useful for teaching students to demonstrate how SJF scheduling algorithm works.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4051	**Digital Communication**	**SC-1**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Multivariable Calculus and Linear Algebra [B19IT1010], Probability and Statistics [B19IT2010]

Course Description:

Communication systems are at the heart of today's information driven economy and support our modern-day lifestyles and even our very existence. From the familiar telephone that was invented over a century ago, to modern day cell phones, wireless networks, and Internet, as well as radio, television, cable and satellite systems, we now rely on electrical communication systems in almost all aspects of our lives. The course focuses on the technologies underlying these systems, which constitute the field of digital communications. Topics include digital transmission and reception, signal space representations, spectral analysis of digitally modulated waveforms, design considerations for band limited channels, introductory concepts of information theory, and error correction coding. The course is intended for graduate/senior undergraduate level students. While the course is intended to serve as a introduction to digital communications, the pre-requisites/co-requisites listed are absolutely necessary.

Course Objectives

The objectives of this course is to:

CO1: Discuss the limitations of analog communications resources bandwidth and power to appreciate the effective use of such Resources

CO2: Illustrate the flow and processing of information from the source to various UNITs atthe transmitter side.

CO3: Explain the inverse operations at the receiver to facilitate the retrieval of transmitted information.

CO4: Describe various processing UNITs of a digital communication system.

Course Outcomes (COs):

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

CO1: Demonstrate the limitations of analog communications resources bandwidth and power to appreciate the effective use of such Resources

CO2: Analyze the flow and processing of information from the source to various UNITs atthe transmitter side.

CO3: Explain the inverse operations at the receiver to facilitate the retrieval of transmitted information.

CO4: Design various processing UNITs of a digital communication system.

Course Content:

UNIT- 1

Information Theory: Information and entropy, conditional entropy and redundancy, Shannon Fano coding, Mutual Information, Information loss due to noise, source codings - Huffman Code, variable length coding, Source coding to Increase average Information per bit, Lossy source coding.

UNIT -2

Digital Modulation Techniques: Introduction, ASK,ASK Modulator, Coherent ASK Detector, Non-Coherent ASK Detector, FSK, Bandwidth and Frequency Spectrum of FSK. Non coherent FSK Detector, Coherent FSK Detector, FSK Detection Using PLL, BPSK, Coherent PSK Detection, QPSK, Differential PSK.

UNIT- 3

Spread Spectrum Modulation Techniques: Use of Spread Spectrum, Direct Sequence Spread Spectrum (DSSS), Code Division Multiple Access, and Ranging using DSSS. Frequency Hopping Spread Spectrum, PN - sequences: Generation and Characteristics. Synchronization in Spread Spectrum Systems

UNIT- 4

Channel coding: Waveform Coding, Types of Error control, Structured Sequences, Matrix description of Linear Block Codes, Error detection and error Correction capabilities of linear block codes, Cyclic Codes, Algebraic structure, encoding.

Self-Learning Component:

Power spectra of digitally modulated signals, Performance comparison of digital modulation schemes, Signal space theory and various modulation schemes.

Text Books:

1. *Bernard Sklar, "Digital Communications - Fundamentals and Applications", Pearson Education (Asia) Pvt. Ltd, 2nd Edition, 2014.*
2. *Herbert Taub. Donald L Schiling, Goutam Sana, Principles of communication systems, 3rd Edition, McGraw-Hill, 2008.*
3. *Sam Shanmugam, Digital and Analog Communicator Systems, John Wiley, 2005.*

Reference Books:

1. *John G. Proakis . Masoud Salehi, Digital Communications, 5th Edition, McGraw-Hill, 2008.*
2. *Simon Haykin, Digital Communication, John Wiley, 2005.*
3. *Ian A. Glover, Peter M. Grant, Digital Communications, Edition, Pearson Edu., 2008.*
4. *B.P. Lathi, Communication Systems, BS Publication, 2006.*
5. *Elsevier Journal Digital Communications and Networks.*
6. *IEEE Transactions on Communications.*
7. Journal of Analog and Digital Communications.

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	c	d	e	F	g	h	i	j	k	l	m	n
CO1	H							M						
CO2	H		M	M								M		
CO3			H			H			H		H			
CO4	H			M										

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments: (Implement following using Mat lab)

1. A binary PSK signal is applied to a correlator filter supplied with a phase reference that differs from the exact carrier phase by pi radians. Determine the effects of phase error on the average probability of symbol error of the system.

2. An FSK system transmits binary data at the rate of 2.5*10^6 bites/sec. During the
    a. course of transmission a white Gaussian of zero mean and power spectral density 10^- 20 W/Hz is added to the signal in the absence of noise the amplitude of sinusoidal wave for digit 1 or 0 is 1 m/v. determine the average probability of symbol error assuming coherent detection .

3. In a coherent FSK system ,the signal S1(t) and S2(t) representing symbols 1 and 0
    a. respectively are defined by S1(t),S2(t)= Ac cos[2pi(fc+_del(f)/2)t} 0<_t(del F), show that the correlation co efficient of the signal S1(T) and S2(t) is approximately given by
        i. What is the minimum value of frequency shift del (F) for which the signal S1
        ii. (t) and S2(t) are Orthogonal?
        iii. Find the value of del (f) that minimizes the average probability of symbol error?
        iv. For the value of del(f) obtained in part(c), determine the increase in Eb/N0

        required so that this coherent FSK system has the noise performance as a coherent binding PSK system.

4. Binary data are transmitted over a microwave link at the rate of 10^6 b/s,and the power spectral density of noise at the receiver input is 10^-10W/HZ.Find the carrier power required to maintain an average Probability i.e.,Pe>=10^-14 for coherent binary FSK.What is the required channel value?

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4052	**UNIX System Programming**	**SC-1**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Problem solving with Programming (B19IT1030)

Course Description:

This course provides an introductory overview of UNIX operating systems and system programming, mainly focusing on system-level programming based on UNIX OS services and other APIs. Topics include system calls, file I/O, files and directories, memory management, process control, inter-process communication (IPC), socket-based network programming, remote procedure call (RPC) programming, and basic security mechanisms.

Course Objectives:

Objectives of this course are to:

1. Discuss the **UNIX, ANSI Standards** and POSIX API'S for files.
2. Illustrate the use of API's for implementing process control.
3. Demonstraate the use of Signals and Daemon process in UNIX.
4. Explain different API's and IPC methods.

Course Outcomes:

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

CO1: Outline POSIX API'S for files and to know the different UNIX standards.

CO2: Apply the API's for implementing UNIX commands, process control and process management.

CO3: Make use of Signals and Daemon process in UNIX.

CO4: Develop solutions for problems using appropriate API's, IPC methods and Sockets.

Course Content:

UNIT 1

UNIX and ANSI Standards: ANSI C standard, ANSI/ISO C++ standards, Difference between ANSI C and C++, POSIX standards, POSIX.1 FIPS standard, X/Open standards. UNIX and POSIX APIs: POSIX APIs, Unix and POSIX development Environment, API common characteristics

Files: File types, Unix and POSIX file system, Unix and POSIX file attributes, INODES in Unix System V, Application program interface to files, Unix kernel support for files, Relationship of C stream pointers and file descriptors, Directory Files, Hard and Symbolic links.

UNIX File APIs: General File APIs, File and Record locking, Directory File APIs, Device file APIs, FIFO file APIs, Symbolic Link File APIs.

UNIT 2

UNIX Processes: Environment of UNIX process: Introduction to main function, Process Termination, Command Line Argument, Environment list.

Process Control: Introduction, Process identifiers, fork, vfork, exit, wait, waitpid, wait3, wait4 functions, Race conditions, exec functions, changing Users IDs and Group IDs, Interpreter files, System function, Process accounting, User identification, Process times, I/O Redirection.

Process Relationship: Introduction, Terminal login, Network login, process groups, sessions, job control, Shell execution of programs, Orphaned process groups.

UNIT 3

Signals: Unix Kernel support for signals, signal, Signal mask, Sigaction, SIGCHLD signal and waitpid function, sigsetjmp and siglongjmp functions, Kill, Alarm, Interval Times, POSIX.lb timers,

Daemon processes: Introduction, Daemon characteristics, Coding Rules, Error logging, Client server model.

UNIT 4

Inter Process Communication: Overview of IPC methods, Pipes, Popen, Pclose functions, Co-processes, FIFOs system V IPC, Message Queues, Semaphores, Shared Memory, Client server properties, Stream pipes, Passing File descriptors, An open server version 1 and Client server connections functions. **Network IPC and**

Sockets: Introduction, Socket descriptors, Addressing, Connection establishment, Data Transfer Socket Options, Out of band data, Non- blocking, Asynchronous I/O.

Text books

1. Unix System Programming Using C++, by Terrence Chan - Prentice Hall India, 2011.
2. Advanced Programming in the UNIX Environment, by Stephen A. Rago, W. Richard Stevens, third edition,

Pearson Education / PHI, 2013.

Reference books

1. UNIX Systems Programming: Communication, Concurrency, and Threads by Kay A. Robbins and Steven Robbins, Prentice Hall; 2 edition, December 2015
2. UNIX Network Programming, Interprocess Communications (Paperback) (2nd Edition) by W. Richard Stevens, Addison-Wesley.

Mapping COs with POs (Program outcomes)

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Consider the last 100 bytes as a region. Write a C/C++ program to check whether the region is locked or not. If the region is locked, print pid of the process which has locked. Ifthe region is not locked, lock the region with an exclusive lock, read the last 50 bytes and unlock the region.
2. Write a C/C++ POSIX compliant program that prints the POSIX defined configuration options supported on any given system using feature test macros.
3. To Write a C/C++ POSIX compliant program to check the following limits:
(i) No. of clock ticks
(ii) Max. no. of child processes
(iii) Max. path length
(iv) Max. no. of characters in a file name
(v) Max. no. of open files/ process
4. Write a C/C++ program which demonstrates interprocess communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.
5. Write a C/C++ program thgat output the contents of its Environment list and Write a C / C++ program to emulate the unix ln command.
6. Write a C/C++ program to illustrate the race condition.
7. Write a C/C++ program that creates a zombie and then calls system to execute the ps command to verify that the process is zombie.
8. Write a C/C++ program to avoid zombie process by forking twice.
9. Write a C/C++ program to implement the system function.
10. Write a C/C++ program to set up a real-time clock interval timer using the alarm API.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./ Wk.
B19IT4053	**System Software**	**SC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Object Oriented Programming with Java [B19IT3030] , Data Structures [B19IT3040].

Course Description:

The course provides the architecture of SIC and SIC/XE machine to build the concepts of System Software, function of various system software: assemblers; loaders and linkers, and macro processors.

Course Objectives:

The objectives of the course are to;

1. Explain basics of system software and differentiate between system software and application software.
2. Describe assemblers design (pass1 and pass2) for the SIC and SIC/XE machine architecture.
3. Illustrate the working of the pass1 and pass2 algorithms of linkers and loaders.
4. Discuss functions and algorithms of macro-processor.

Course Outcomes (Cos):

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

CO1: Outline the system software and architecture of SIC and SIC/XE machines.

CO2: Apply suitable data structures to design and develop various system softwares.

CO3: Implement the 2 pass assembler for SIC & SIC/XE machine architectures and also design new algorithms for various machine architectures.

CO4: Develop loaders for absolute and re-locatable object programs for SIC/XE.

Course Content:

UNIT- 1:

Architecture of SIC; SIC\XE: Introduction: system software and machine architecture; Simplified Instructional Computer (SIC) – SIC; SIC/XE machine architecture; SIC and SIC/XE programming examples

UNIT- 2:
Assemblers: Basic assembler function; a simple SIC assembler; assembler algorithm and data structures; machine dependent assembler features - instruction formats; machine independent assembler features – literals symbol definition statements; expression; program blocks; control sections and programming linking

UNIT- 3:

Loaders and Linkers: Basic loader functions; design of an absolute loader; a simple bootstrap loader; machine-dependent loader features –relocation; program linking; algorithm and data structures for a linking loader; machine-independent loader features - automatic library search; loader options

UNIT- 4:

Macro Processor: Basic macro processor functions; macro definitions and expansion; macro processor algorithm and data structures; machine- independent macro processor features - concatenation of macro parameters; generation of unique labels; conditional macro expansion; keyword macro parameters

Self Learning Components:
Design of a micro preprocessor, Peep hole optimizer and Compile and GO loader.

Text books

1. Leland L Beck, System Software, 3rd Edition, Pearson Education, 2002.
2. Alfred V. Aho, Compilers: Principles, Techniques and Tools, Pearson, 2nd Edition, 2013.

Reference books

1. H. Dave, Compilers: Principles and Practice, Pearson, 1st Edition, 2012
2. Elsevier Journal of Systems and Software.
3. IEEE Transactions on Software Engineering

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**												
	a	b	C	d	e	f	g	i	j	k	l	m	n
CO1	H							H					
CO2			M	M								M	
CO3			H			H			H		H		
CO4			H	H									
CO5				H				H		M			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignment questions:

1. Suppose that ALPHA is an array of 100 words. Write a sequence of instructions for SIC/XE to set all 100 elements of the array to 0. Use immediate addressing and register –to-register instructions to make the process as efficient as possible.
2. Write a sequence of for SIC machine architecture to set ALPHA equal to 4*BETA-9. Assume that ALPHA & BETA has integers constants stored. Use immediate addressing for the constants.
3. Write SIC instructions to swap the values of ALPHA and BETA.

4. Generate the object program for the source program given below.

SUM	START	4000
FIRST	LDX	ZERO
LDA	ZERO	
LOOP	ADD	TABLE,X
TIX	COUNT	
JLT	LOOP	
STA	TOTAL	
RSUB		
TABLE	RESW	2000
COUNT	RESW	1
ZERO	WORD	0
TOTAL	RESW	1
END	FIRST	

Given that: LDX=04, LDA=00, ADD=18, TIX=2C, JLT=38, STA=0C, RSUB=4C.

5. Assembler is a system program that generates object program for an assembly language program in multiple pass to avoid forward reference problem. Develop a C program for the implementation of pass one of a two pass assembler.

6. Assembler, using in-built OPTAB & SYMTAB with contents entered during pass-1 generates object program of the given assembly program in pass-2. Develop a C program for the implementation of pass two of a two pass assembler

7. Develop C program for the implementation of an Absolute loader, which does not perform the functions as linking & program relocation and all functions are performed in a single pass.

8. Develop C program for the implementation of an Absolute loader, which is the first program to be loaded when the system is turned on and does the job of loading the operating system.
9. Loader that modifies the object program so that it can be loaded at an address different from the location originally specified is relocatable loader. Design a program to implement the functionality of such a loader.
10. Suggest appropriate ways of organizing and accessing the tables DEFTAB and NAMTAB.
11. With an example program, define macro definition, macro invocation and macro expansion.
12. List out the differences between macros and subroutines.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4054	**Advanced IoT Programming**	**SC-1**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Basic Electrical and Electronics Engineering [B19IT 1040], Digital Logic Design [B19IT 3010]

Course Description:

This course introduces the basics of building IoT applications and second section follows a project-based approach. At the end of each chapter a working prototype of an IoT application is being discussed. The various chapter covers programming based on Arduino board.

Course Objectives:

The objective of this course are to:

1. Explain how to use Arduino hardware, the Arduino IDE to write, upload, and execute basic Arduino programs.
2. Demonstrate the attachment of Ethernet and WiFi shield to Arduino and how to write the programs for connectivity.
3. Illustrate the basics of the HTTP protocol and Send an HTTP request to the server.
4. Discuss the basics of the MQTT protocol then Publish and subscribe to an MQTT broker.

Course Outcomes (COs):

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

CO1: Make use of Arduino hardware, the Arduino IDE to write, upload, and execute basic Arduino programs

CO2: Develop an Ethernet connectivity code using Ethernet shield and WiFi shield.

CO3: Design an application using HTTP protocol.

CO4: Apply the basics of the MQTT protocol for a real world application.

Course Content:

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 (WiFi), 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

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, 2015, apress.*

Reference books

1. *Agus Kurniawan, Smart Internet of Things Projects, 2016, Packt.*
2. *www.apress.com/source-code/*
3. *2.https://www.xively.com/*
4. *https://www.arduino.cc*
5. *https://nodered.org/*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1									H					
CO2	H													
CO3										H				
CO4	H													

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Set up Arduino Yún to connect to WiFi
2. Build a smart temperature controller for your room
3. Build your own decision system based-IoT
4. Build a tracking vision system for moving objects
5. Build a your own car robot based on GPS
6. Make your IoT board speak
7. Make IoT application with data science-based cloud.
8. Explore architecture and programming of Raspberri Pi
9. Explore ESP8266 NodeMcu WiFi Development Board
10. Discuss decision system based on Bayesian
11. Discuss decision system based on fuzzy logic
12. Explore OpenCV library
13. Explore DIY robot platform, aluminium mobile smart robot car platform
14. Explore GPS module for navigation
15. Explore EasyVR shield3, voice recognition shield for Arduino boards
16. Explore Zapier for app integration

<table>
<tr><th rowspan="1">Course Code</th><th>Course Title</th><th>Course Type</th><th colspan="5">Credit Pattern & Credit Value</th><th>HWrs/k</th></tr>
<tr><td rowspan="2">B19IT4060</td><td rowspan="2">Unix Programming Lab</td><td rowspan="2">HC</td><td>L</td><td>P</td><td>T</td><td>J</td><td>C</td><td rowspan="2">2</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
</table>

Prerequisites:

Problem solving with Programming [B19IT1030]

Course Outcomes:

CO1: Implement fundamental concepts of UNIX Operating system and the working of various commands in the operating system.

CO2: Formulate various filters to solve variety of applications and Develop and use of regular expression with pattern matching utilities like grep

CO3: Develop, Debug and execute SHELL scripts effectively.

CO4: Make use of AWK script.

Lab Exercise:

Question Number	Question
Part – A	
1	Write a shell script to generate a multiplication table: The program should accept an integer *n* given by the user and should print the multiplication table of *n*.
2	Write a shell script that copies multiple files to directory. Interactive version / Command line arguments version
3	Write a shell script which counts the number of lines and number of words present in a given file. Interactive version / Command Line arguments version
4	Write a shell script to print all the prime numbers within the given valid range.
5	Write a shell script which receives two file names as arguments. It should check whether the two file contents are same or not. If they are same then second file should be deleted.
6	Write a awk script to find the number of characters, words and lines in a file?
Part – B	
1	Write a C Program that makes a copy of a file using standard I/O and system calls.
2	Using an appropriate system calls Implement in C the following Unix commands using system calls “cat” and “mv”.
3	a. An ls command in Unix is used to display the files present in the directory. Emulate this command using system calls in C programming language. b. Write a C program to list for every file in a directory, its inode number and file name.
4	a. Write a C program to create a child process and allow the parent to display “parent” and the child to display “child” on the screen? b. Write a C program to create a Zombie process?
5	Write a program in C that illustrates how to execute two commands concurrently with a command pipe?

6	Write a C program to list for every file in a directory,its inode number and file name.?

Text books

1. *UNIX – Concepts and Applications, Sumitabha Das, Tata McGraw Hill, 2017.*

Reference books

1. *UNIX and Shell Programming, Behrouz A. Forouzan and Richard F.Gilberg, Thomson, 2005.*
2. *Meeta Gandhi, Tilak Shetty, Rajiv Shah, —"The 'C'Odyssey Unix – the open boundless C", BPB.*
3. *Mike Joy, Stephen Jarvis, Michael Luck, —"Introducing UNIX and Linux", Palgrave Macmillan.*
4. *UNIX & Shell Programming, M.G. Venkateshmurthy, Pearson Education, 2005.*
5. *STM Journals, "Journal of Advances in Shell Programming (JoASP)"*
6. *Elsevier, System An International Journal of Educational Technology and Applied Linguistics.*
7. *Inderscience, "International Journal of Services and Standards"*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
CO1	H	H			L		L			M	M	H		
CO2	H						L					H	M	
CO3	H						L					H		
CO4	H	H			M		L			L	M	H	H	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Lab Assignment Questions	
1	Develop an interactive shell script and awk that asks for a word and a file name and then tells how many lines present in it.
2	Write a shell script that takes a command –line argument and reports on whether it is directory, a file, or something else.
3	Write a shell script that accepts one or more file name as arguments and converts all of them to uppercase, provided they exist in the current directory.
4	Write a shell script that determines the period for which a specified user is working on the system
5	Write a shell script that accepts a file name starting and ending line numbers as arguments and displays all the lines between the given line numbers.
6	Write a shell script that computes the gross salary of a employee according to the following rules: i)If basic salary is < 1500 then HRA =10% of the basic and DA =90% of the basic. ii)If basic salary is >=1500 then HRA =Rs500 and DA=98% of the basic The basic salary is entered interactively through the key board.
7	Write a shell script that accepts two integers as its arguments and computes the value of first number raised to the power of the second number.

8	a) Write an interactive file-handling shell program. Let it offer the user the choice of copying, removing, renaming, or linking files. Once the user has made a choice, have the program ask the user for the necessary information, such as the file name, new name and so on. b)Write shell script that takes a login name as command –line argument and reports when that person logs in
9	Develop an interactive script that ask for a word and a file name and then tells how many times that word occurred in the file.
10	Write a shell script to perform the following string operations: i)To extract a sub-string from a given string. ii)To find the length of a given string.
11	Write a shell script that deletes all lines containing a specified word in one or more files supplied as arguments to it.
12	Write a shell script that accept a file name starting and ending line numbers as arguments and display all the lines between given line no:
13	Write a shell script that delete all lines containing a specified word.
14	Write a C program that illustrates how an orphan is created.
15	Implement Unix wc command using C programming language.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4070	IOT Lab	HC	0	0	2	0	2	2

Course Outcomes

On successful completion of this course, student will be able to:

CO1: Design assembly language programs for the ARM microcontroller
CO2: Interface various environmental and human interfaces with ARM microcontrollers
CO3: Use modern system development tools in the design of a microcontroller-based system
CO4: Develop microcontroller-based embedded systems for real-world control applications

List of Experiments:

Sl. No.	List of experiments	COs	POs
1	Interface 8-bit LED and a Switch to an ARM microcontroller and demonstrate the ON/OFF status of LEDs depending on switch positions.	CO2	a,j,k,m
2	Design an interface for connecting a stepper motor to the microcontroller and rotate it clockwise/anti-clockwise.	CO2	a,c,e,j,k,m
3	Interface a 4X4 Matrix Keyboard and identify the key pressed	CO2	a,e,j,k,m
4	Develop and demonstrate a time delay program using built – in Timer / Counters.	CO2	a,e,j,k,m

5	Write a program to display a message in a 2 line x 16 characters LCD display.	CO2	a,e,j,k,m
6	Design an program to display data on 7-segment display using l2c interface.	CO3	a,c,e,j,k,m
7	Design and construct a module to build a RFID based Access Control System or an RFID based Door Lock using Arduino and display lock status on LCD.	CO3	a,c,e,k,m
8	Design a module to control an LED from Webserver using NodeMcu or Esp8266 programming with Arduino IDE.	CO4	c, e,k,m
9	Design a module for non-contact object detection using Arduino and proximity sensor (Car proximity alert).	CO4	c, e,k,m
10	Design an intelligent Garden Computer with Arduino and soil moisture sensor that lights an LED to alert the user when it is time to water a potted plant.	CO4	a,e,j,k,m

Additional Experiments:

1. *Demonstrate the working of ADC and Temperature sensor interfacing with the ARM.*
2. *Design and construct a module to drive DC motor clockwise and anti-clockwise using L293D with Arduino board.*

Recommended Learning Resources:

1. *https://www.arduino.cc*

2. *Peter J Knaggs, "ARM Assembly Language Programming", 2016. (Available online at http://www.rigwit.co.uk/ARMBook/ARMBook.pdf)*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	c	D	e	f	g	h	I	j	k	l	m	n
CO1	M	H												
CO2		H			M									
CO3										M	H			
CO4				M				H						

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4080	**Skill Development – 4**	**RULO**	**0**	**0**	**0**	**1**	**1**	**2**

Note: The Skill Development profram is conducted by the School in association with Skill Development Centre

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT4090	**Soft Skills – 2**	**RULO**	**0**	**0**	**2**	**0**	**2**	**2**

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

FIFTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./ Wk.
B19IT5010	**Computer Networks**	HC	3	0	0	0	3	3

Prerequisites:

Computer Organization and Architecture [B19IT3020]

Course Description:

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 Objectives:

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.

Course Outcomes:

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

CO1. Outline the protocol stacks (OSI and TCP/IP) used for data communication.

CO2. Apply error detection & correction strategies for data transmission.

CO3. Analyze the connection establishment of network computing devices.

CO4. Compare TCP, UDP protocols and explain Domain Name System.

Course Content:

UNIT – 1:

Introduction to Data Communication and Networking: Internet history and Internet today, DataCommunications, 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, shanon 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, andTransmission Media. **Error Detection and Correction**: Introduction, cyclic Codes: Cyclic redundancy code generation forchecksum. 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-Wifi, 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 GoBack-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, DNSMessage Format.

Self Learning Component:

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

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.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	c	d	e	f	g	H	i	j	k	l	m	n
CO1		L	L		L				L				M	
CO2		L	L		M				L	L	L			
CO3			M		M				M	L	M			
CO4			M		M			L		L	M		M	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Sample Assignments:

1. Write a Program in NS3 to implement star topology.
2. Write a Program in NS3 to implement a bus topology.
3. Write a Program in NS3 for connecting multiple routers and nodes and building a hybrid topology.
4. Write a Program in NS3 to implement FTP using TCP bulk transfer.
5. Write a Program in NS3 for connecting multiple routers and nodes and building a hybrid topology and then calculating network performance.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5020	**Cloud Computing and Big Data**	HC	3	0	0	0	3	3

Prerequisites:

Computer Networks [B19IT5010]

Course Description:

This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). It gives insight into various cloud infrastructure and management mechanisms. The introduction to Azure App Service and Web Apps is given.

Course Objectives:

The objectives of this course are to:

1. Discuss the various Cloud computing service models like Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
2. Explain the working of cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology and service technology.
3. Illustrate the use of various cloud computing mechanisms like load balancer, automated scaled listener, failover system and more in real world applications.
4. Describe development of web service and its hosting on Microsoft Azure

Course Outcomes (COs):

On successful completion of this course; the student will be able to:
CO1: Compare the cloud computing service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
CO2: Make use of the cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology and service technology.
CO3: Interpret various cloud computing mechanisms like load balancer, automated scaled listener, failover system and more.
CO4: Develop applications using Bigdata concepts.

Course Content:

UNIT 1:
Introduction to Cloud Computing: Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges.
Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models and Cloud Deployment Models.

UNIT 2:

Cloud Enabling Technologies: Broadband Networks and Internet Architecture, Data Center Technology; Virtualization Technology; Web Technology; Multitenant Technology; Service Technology. Cloud Infrastructure Mechanisms: Logical Network Perimeter; Virtual Server; Cloud Storage Device; Cloud Usage Monitor; Resource Replication; Ready-made environment

UNIT 3:

Specialized Cloud Mechanisms: Automated Scaling Listener; Load Balancer; SLA Monitor;
Pay-per-use Monitor; Audit Monitor; Failover System; Hypervisor; Resource cluster; Multi-device Broker; State Management Database
Cloud Management Mechanisms: Remote Administration System; Resource Management System; SLA Management System; Billing Management System.

UNIT 4:

Big Data: The Data Explosion, Why is big data special?, Storing Big Data, Big Data Analytics, Big data and medicine, big data & big business, big data security and big data & society.

Self-Learning Components:
Implementation of different Cloud Service Delivery and Deployment Models.

(Recommended Learning Resources)Text books:

1. *Thomas Erl , Ricardo Puttini , Zaigham Mahmood Cloud Computing: Concepts, Technology & Architecture PHI, 2013.*
2. *Dawn. E. Holmes, "Big Data- A short Introduction", Oxford University Press, 2017.*

(Recommended Learning Resources)Reference books:

1. *Dan C. Marinescu, Cloud Computing: Theory and Practice, MK*
2. *RajkumarBuyya, JamesBroberg, Andrzej Goscinski, Cloud Computing- Principles and Pradigms, Wiley.*
3. *Gautam Shroff, Enterprise Cloud Computing- Technology, Architecture, Applications, CAMBRIDGE.*
4. *Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, Distributed and Cloud Computing,MK,2012*
5. *Michael Collier, Robin Shahan, Fundamentals of Azure-Microsoft Azure Essentials, Microsoft Press, 2nd Edition,2016.*
6. *Neil Peterson, Get started guide for Azure IT operators, Microsoft,2016.*
7. *Roberto Brunetti, Windows Azure-Step by Step, Oreilly Media,2011.*
8. *Journal of Cloud Computing -Advances, Systems and Applications, Springer Open.*
9. *International Journal of Cloud Computing, INDERSCIENCE Publishers.*
10. *IEEE Cloud Computing*
11. *International Journal of Cloud Applications and Computing (IJCAC), IGI Global.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	C	d	e	f	g	h	i	j	k	l	m	n
CO1	M	H												
CO2		H									M			
CO3	H	M												
CO4								M	H					

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Creating a private cloud using Open Stack.
2. Give a report on benefit of Cloud on Health Industry.
3. Give a report on benefit of Cloud on Farmers.
4. Execute some of the azure based projects available in github.
5. Write a note on azure virtual machines.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5030	Web Application Development	**HC**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Object Oriented Programming with Java (B19IT3030) and Basics of Database Management System (B19IT4030).

Course Description:

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, Perl and PHP.

Course Objectives:

1. Explain the basic concepts of HTML code.
2. Illustrate the use of Cascading Style Sheets in web pages.
3. Demonstrate the use of Angular JS, Java Scripts and XML in real world applications.
4. Describe the principles of object oriented development using Perl and PHP.

Course Outcomes (Cos):

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

CO1: Build web pages using HTML syntax and semantics.

CO 2: Make use of Cascading Style Sheets in developing web applications.
CO 3: Develop Web based applications using Angular JS, Java Scripts and XML concepts.
CO 4: Apply the principles of object oriented development using Perl and PHP

Course Content:

UNIT- 1

Introduction to HTML, HTML Syntax, Semantic Markup, Structure of HTML Documents, HTML Elements, HTML Semantic Structure Elements, HTML Web Storage. HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Micro formats

UNIT -2

Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, CSS Text Styling. Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

UNIT- 3

Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, Caching, JavaScript and jQuery, Angular JS, JavaScript Pseudo-Classes, XML Processing and Web Services, XML Processing, Overview of Web Services.

UNIT- 4

Introduction to Perl and PHP. Arrays and Superglobals, Arrays, GET and POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting, PHP Error and Exception Handling.

Self-learning component:

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

Text books

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 1st Edition, 2016
2. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 1st Edition, 2006.
3. Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 4th Edition, 2007.

Reference books

1. Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", O'Reilly Publications, 4th Edition, 2015.
2. Luke Welling, Laura Thomson, "PHP and MySQL Web Development", Pearson Education, 5th Edition 2016.

3. Nicholas C Zakas, *"Professional JavaScript for Web Developers", Wrox/Wiley India, 3rd Edition 2012.*
4. *David Sawyer Mcfarland, "JavaScript & jQuery: The Missing Manual", O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 1st Edition, 2014*
5. *Zak Ruvalcaba Anne Boehm, "Murach's HTML5 and CSS3", Murachs/Shroff Publishers & Distributors Pvt Ltd, 3rd Edition, 2016.*
6. *Gerardus Blokdyk, "Representational State Transfer: Practical Integration", CreateSpace Independent Publishing Platform, 1st Edition, 2018*
7. *Michael Fitzgerald, 'Learning Ruby", O'Reilly, 1st Edition, 2007*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	B	c	d	E	F	g	H	i	J	k	l	M	N
CO1	H							H			H			
CO2			M									M		
CO3			H			H			H		H			
CO4			H				H							

Where L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Create a static REVA University web page using HTML tags
2. Create a web page that will have separate links to show map of India and World. When user will open a map of India, create links to display the information of each state i.e. highlighted in the map in a separate window/document. (The information should be brief i.e. not more than 3-4 sentences.) When user will open a world map, show the list of countries on clicking the image in a new window.
3. Write an HTML page to display information of three products. The name of three products should be displayed at the top. The hyperlink should be provided to move to the details of the product like its features, size, price etc .alongwith its image. The link should be internal link.
4. Explain the following tags with the attributes that often required. Write suitable example for each. 1) SELECT 2) TEXTAREA
5. What is CSS and List out the properties of CSS.
6. Differentiate between java and JavaScript.
7. Explain with sample program perl.
8. Explain with sample program php.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B19IT5040	**Machine Learning**	HC	3	0	0	3	3

Prerequisites:

Students must have studied Data Structure, Algorithms and Mathematics

Course Objectives:

The objectives of the course are to:

1. Discuss the basic theory underlying machine learning.
2. Explain machine learning algorithms to solve problems of moderate complexity for data analysis.
3. Illustrate the concept of Genetic Programming and Artificial Neural Network.
4. Discuss the implementation of Machine learning algorithms and modules.

Course Outcomes:

On successful completion of this course, the student shall be able to:
CO1: Explain the basics of machine learning concepts.
CO2: Understand machine learning algorithms for intelligent applications.
CO3: Apprehend how to perform evaluation of learning algorithms and model selection.
CO4: Implement machine learning applications.

Course Content:

UNIT-1:

Introduction: Well-Posed Learning Problems, Designing a Learning System, Perspectives and Issues tin Machine Learning Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, and Reinforcement Learning. Supervised Learning. Concept Learning and the General-to-Specific Ordering: A Concept Learning Task, Concept Learning as Search, FIND-S.

UNIT-2:

Dimensionality Reduction: Subset Selection, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis. Classification.

UNIT-3:

Clustering: Introduction**,** kmeans, nearest neighbor, expectation maximization algorithm, Supervised learning after clustering, hierarchical clustering, choosing the number of clusters. Decision Tree Learning.

UNIT-4:

Artificial Neural Networks: Introduction, Perceptrons, Multilayer Networks and the Back propagation Algorithm.

Reinforcement Learning: Introduction, Learning task, Q-learning.

Design and Analysis of Machine Learning Algorithms and experiments using WEKA//Rapid Miner Tool

Recommended Learning Resources:

1. *Tom Mitchell: Introduction to Machine Learning Chapters 1, 2, 3, 4, 6, 8, 9.1 to 9.4, 13 2. 2.*
2. *EthemAlpaydin: Second edition MIT press McGraw-Hill Chapters 1, 2, 6, 7, 19*
3. *William W Hsieh Machine Learning Methods in the Environmental Sciences, Neural Networks, Cambridge University Press.*

Reference Books:

1. *EthemAlpaydin: Introduction to Machine Learning, Second edition MIT press, 2010. Chapters 1, 2, 6, 7, 19.*
2. *YoshuaBengio and Aaron Courville,Deep Learning -Ian Good fellow, , MIT Press book,2016*

3. *Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001*
4. *Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995*

The laboratory exercises will include use of various machine learning algorithm for data classification, data regression, clustering using WEKA Tools.

The list of experiments are:

The Weka tool should be taught to the students

1) Introduction to WEKA, installation of WEKA Tool and demonstration.
2) Perform data preprocessing.
3) Perform classification to the dataset.
4) Perform Clustering using k-means for the contact lens dataset.
5) Perform Logic Regression for Iris data set.
6) To Visualize the results usingthe Tool.
7) To Analyze the results using the Tool.
8) Apply ID3 decision tree algorithm to House database.
9) Apply CART decision tree algorithm To IRIS database.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT5051	**Mobile Application Development**	SC	**3**	**0**	**0**	**3**	**3**

Prerequisites:

Object Oriented Programming with Java [B19IT3030]

Course Description:

This course introduces programming technologies, design and development tools related to mobile applications. Topics include accessing device capabilities, industry standards, operating systems, and programming for mobile applications using OS Software Development Kit (SDK).

Course Objectives:

1.Discuss mobile application models/architectures and patterns for development of a mobile software application

2 Demonstrate the installation of software and tools required for development of android applications.

3. Illustrate the use of fundamentals of android with graphics and animation APIs.

4. Describe an application with multimedia concepts of audio, video with entertainment services.

Course Outcomes:

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

CO1: Apply mobile application models/architectures and patterns for development of a mobile software application

CO2: Make us of different tools required for development of android applications.

CO3: Develop the programs using fundamentals of android with graphics and animation APIs.

CO4: Implement multimedia concepts of audio, video with entertainment services.

Course Content:

UNIT-1:

Introduction to mobile communication and computing: Introduction to mobile computing, Novelapplications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security, Smart phone operating systems and smart phones applications.

UNIT-2:

Fundamentals of Android Application Development: Introduction to Android., The Android 4.1Jelly Bean SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator.

UNIT-3:

Layouts, Menus and Graphics in Android: Menus:Options menu and app bar,Context menu andcontextual action mode,Popup menu, Defining a Menu in XML, Creating an Options Menu, Changing menu items at runtime, Creating Contextual Menus, Creating Menu Groups, Adding Menu Items Based on an Intent, Activity, Service, BroadcastReceiver and Content Provider. Building Blocks for Android Application Design, Laying Out Controls in Containers. Graphics and Animation: Drawing graphics in Android, Creating Animation with Android's Graphics API.

UNIT 4:

Creating the Activity, Working with views: Exploring common views, using a list view, creatingcustom views, understanding layout. Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments. Multimedia: Playing Audio, Playing Video and Capturing Media. Advanced Android Programming: Internet, Entertainment, and Services.

Self-learning component:

More Recent Applications: Multimedia;2D graphics ; networking support in Android, Introduction to IoS, App. Development.

Text books

1. *Bill Phillips, Chris Stewart, and Kristin Marsican, Android Programming: The Big Nerd Ranch Guide pearson technology group,3rd Edition,2015*
2. *Barry Burd, Android Application Development All-in-One For Dummies ,wiley publisher,2nd Edition, 2012.*
3. *ZigurdMednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura,Programming Android: Java Programming for the New Generation of Mobile Devices,oiley,2nd Edition,2012.*

Reference books

1. *Greg Nudelman, Android Design Patterns: Interaction Design Solutions for Developer, wiley, 2013.*
2. *Jason Tyler, App Inventor for Android: Build Your Own Apps No Experience Required!, wiley,2011.*
3. *J.F.Dimarzio, Android programming with Android studio,wrox,4th edition ,2017*
4. *Maurice Sharp Erica Sadun Rod Strougo, Learning iOS Development-A Hands-on Guide to the Fundamentals of iOS Programming, Addison Wesley by Pearson Education, Inc.2014.*
5. *Wei-Meng Lee, Beginning Swift Programming, Wiley India Pvt. Ltd.,2018.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	C	d	E	f	g	H	i	j	k	l	m	n
CO1										H	M		M	
CO2		H	M		L						H	H		H
CO3		M	H								M	M		H
CO4		M	H									M	L	H

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. 1.Introduction to Android platform. Introduction to the tools used in the Android emulator. Create a simple application.
2. Create an Android UI with one text field, centered at the top of the screen, and one button. The text field display the text "**You tapped 0 times**" .For every user ‘s tap the button, will increment a counter and update the text field accordingly.
3. Program a **"<username>DemoSuite**" app that allows a user to retrieve and display an internet resource (an xkcd cartoon), trigger a simple custom animation, play video, convert text to speech, and enter text via speech.The main structure that developer must follow is that of a "TabLayout + ViewPager " skeleton, and five different fragments that are started from tabs in the TabLayout. The five fragments will implement the abovementioned functionalities, and they can be tested individually, and need not interact with each other, other than being started from the same framework.
4. The Developer can use skeleton code to get started with the development. Unzip the file and rename the "BoilerPlateHW3" folder to **"<username>DemoSuite**", which can then import to Android Studio. Refactor this code to rename the package name to your usual package name, and theapp name to **"<username>DemoSuite**" (as shown in class). The skeleton code displays a package name in the Activity's **onCreate method**. Include the code if app is created from scratch. The TAs

will rely on this Toast while grading.Fragments are added, using AndroidStudio menu actions. The app must handle orientation switches from Portrait to Landscape and back. State should be saved in all cases. The video player should have a special landscape layout. When the app is opened for the first time it should display a view of the first tab (the xkcd viewer), with an empty page and a text field to enter a number and a send button.

Sample Mini projects:

1. CHILD MONITORING SYSTEM APPLICATION PROJECT

The application uses two main services that is GPS and telephonic services. For location services is GPS and telephony services is SMS, call logs and contacts. Android is a widely used OS used by a lot of masses globally. Internet is used for communicating between children and parent side. The System can be designed in a simple way. The application developed to make user-friendly approach on both sides. The parents and children both should have GPS Based smart phones. The application is used to track the Child’s location as well as call logs, messages and contact from their smartphone. Reason for choosing android OS is that to target more users.

2. CLASSROOM AUTOMATION USING ANDROID APP PROJECT

In this Classroom Automation project, we are using an android app by which the user can select the classroom or group multiple classrooms to announce script, with this system human effort and time is reduced. Announcement from control room is captured with mic and feeded into the amplified box, from thatamplifier box sound signal is sent into relay switching box, from relay switching box sound is switched intothe respective classroom based on user inputs from android app.

3. TIME TABLE ANDRIOD APPLICATION PROJECT

Class time table project main objective is to develop an android app which can help institutions, schools or colleges faculty members to plan and schedule classes and batches using their Smartphone. By using this app they can enter details of the batches and timings of the batches from starting and ending date with the scheduling the class. Whenever faculty wants to know about class timings he/she can find them using this android app. This is very simple and suitable app with all basic features for Time Table related information in the colleges and schools.

4. AGRICULTURE UPDATES PROJECT

Our Agriculture Updates project discuss everything about providing the SMS updates on various agriculture products as per the user requirements on his GSM or GPRS mobile phone.The updates may vary from pricing, availability, stocks and need of various products on the market. Basically this will be expected to be helpful for farmers around the state. Since it works everywhere with the mobile signal it does not require internet.We are also providing pricing details to the customers. This Agriculture Updates app is mainly concerned about the specific group of customers which is farmers. It updates status on various products as per the user choice on daily or weekly basis.

5. ANDROID MULTI LAYER PATTERN LOCKING PROJECT

Most of the smart phone users use pattern locking application in order to lock the application which contains important information. But these pattern locking applications allows the user to open the mobile application only when the user enters the pattern at one go, user won't be able to open the application if he overlaps the pattern. So in our system user must specify the pattern while registering. He must specify the locking pattern twice for the confirmation. When the user registered successfully, he can use the pattern to open the application by specifying the registered pattern. This application allows the user to overlap the pattern. If the pattern matches with the registered pattern user will be allowed to access the application. If the user fails to match the pattern with the one registered within 5 attempts system will display an error message. Whenever user specifies the pattern each time pattern color will be changed. Multiple users can use this application

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5052	**Object Oriented Analysis and Design**	SC-2	3	0	0	0	3	3

Prerequisites:

Programming for Problem Solving [B19IT1030]

Course Description:

This course introduces object models and designs from system requirements; use the modelling concepts provided by UML; identify use cases and expand them into full behavioral designs; expand the analysis into a design ready for implementation and construct designs that are reliable. The course begins with an overview of the object oriented analysis and design.

Course Objectives:

The objective of this course is to:

1. Explain the object oriented models for developing large applications
2. Describe the classes and objects.
3. Demonstrate the use of various UML diagrams in real world applications.
4. Discuss different case studies that make use of OOAD concepts.

Course Outcomes (Cos):

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

CO1: Apply object oriented models for developing larger applications.

CO2: Identify classes and objects for a given problem.

CO3: Implement use-case and sequence diagrams for a given real world application.

CO4: Summarize the case studies that require Object oriented approach.

Course Content:

UNIT- **1**

Complexity: The Structure of Complex Systems, Inherent Complexity of Software, five Attributes of a Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos On Designing Complex Systems.

The Object Model: The Evolution of the Object Model, Foundations of the Object Model, Elements of the Object Model, Applying the Object Model.

UNIT -**2**

Classes and Objects: The Nature of an Object, Relationships among Objects, The Nature of a Class, Relationships among Classes, The Interplay of Classes and Objects, On Building Quality Classes and Objects. Classification: The Importance of Proper Classification, Identifying Classes and Objects, Key Abstractions and Mechanisms.

UNIT- **3**

Notation: The Unified Modelling Language, Package Diagrams, Component Diagrams, Deployment Diagrams, Use Case Diagrams, Activity Diagrams, Class Diagrams, Sequence

Diagrams, Interaction Overview Diagrams, Composite Structure Diagrams, State Machine Diagrams, Timing Diagrams, Object Diagrams, Communication Diagrams. Process: First Principles, The Macro Process: The Software Development Lifecycle, The Micro Process: The Analysis and Design Process.

UNIT- **4**

Case Study: Web Application: Vacation Tracking System: Inception, Elaboration, Construction, Transition and Post-Transition.

Self-learning components:

System Usability and Measuring User Satisfaction: Usability Testing, User Satisfaction Test, Analyzing User Satisfaction by Satisfaction Test Template, Developing Usability Test Plans and Test Cases.

Text books

1.Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen and Kelli A. Houston, Object-Oriented Analysis and Design with Applications, Third Edition, Addison Wesley, 2009.

Reference books

1. *Brett McLaughlin, Gary Pollice, David West, Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D, Oreilly Media Inc, 2007.*
2. *Brahma Dathan, Sarnath Ramnath, Object-Oriented Analysis, Design and Implementation: An Integrated Approach, Springer Universities Press, 2015.*
3. *James J. Odell, Advanced Object-Oriented Analysis and Design Using UML, SIGS Books and Mutimedia, 1998.*
4. *Elsevier Journal of systems and software.*
5. *Springer Journal of Object-Oriented Programming.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	H						M							
CO2			M		H									
CO3					H									
CO4					M			H						

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Develop the system architecture for the hypothetical Satellite Navigation System (SNS) by logically partitioning the required functionality.
2. Develop the system architecture for the Train Traffic Management System (TTMS).
3. Design a solution to the cryptanalysis problem using the blackboard framework.
4. Design a data acquisition system for weather monitoring station.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5053	**Embedded Systems Design**	SC-1	3	0	0	0	3	3

Prerequisites:

Digital Logic Design [B19IT3010]

Course Description:

Embedded systems have become the next inevitable wave of technology, finding application in diverse fields of engineering. Microprocessors, together with sensors and actuators, have become embeddable in almost everything. The purpose of the course is to provide the students with the basic information about embedded systems which can be defined as a control system or computer system designed to perform a specific task.

Course Objectives:

The Objectives of this course is to:

1. Demonstrate the optimal composition and characteristics of an embedded system.
2. Exaplin A/D conversion process.
2. Demonstrate the protocols and software tools employed in embedded system design.
3. Discuss Hardware/Software co□design techniques for microcontroller-based embedded systems.

Course Outcomes (Cos):

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

CO1: Outline the optimal composition and characteristics of an embedded system.

CO2: Develop an application using A/D conversion process.

CO3: Summarize the protocols and software tools employed in embedded system design.

CO4: Make use of Hardware/Software co□design techniques for microcontroller-based embedded systems.

Course Content:

UNIT- 1

Introduction to Embedded Systems: Application Domain of Embedded Systems; Desirable Featuresand General Characteristics of Embedded Systems; Model of an Embedded System; Microprocessor vs Microcontroller; Example of a Simple Embedded System; Figures of Merit for an Embedded System; Classification of MCUs: 4/8/16/32 Bits.

Embedded Systems – The Hardware Point of View:

Microcontroller UNIT (MCU); A Popular 8-bit MCU; Memory for Embedded Systems; Low Power Design; Pullup and Pulldown Resistors.

UNIT -2

Sensors, ADCs and Actuators: Sensors; Analog to Digital Converters; Actuators. Examples ofEmbedded Systems:Mobile Phone; Automotive Electronics; Radio Frequency Identification (RIFD); Wireless Sensor Networks (WISENET); Robotics; Biomedical Applications; Brain Machine Interface

UNIT- 3

Buses and Protocols: Defining Buses and Protocols; On-board Buses for Embedded Systems;External Buses; Automotive Buses; Wireless Communication Protocols.

Software Development Tools: Embedded Program Development; Downloading the Hex File to the Non-volatile Memory; Hardware Simulator.

UNIT- 4

Real-time Operating Systems: Real-time Tasks; Real-time Systems; Types of Real-time Systems;Real-time Operating Systems (RTOS); Real-time Scheduling Algorithms; Rate Monotonic Algorithm; The Earliest Deadline First Algorithm; Qualities of a Good RTOS.

Hardware Software Co-design and Embedded Product Development Lifecycle Management: Hardware Software Co-design; Modelling of Systems; Embedded Product Development Lifecycle Management; Lifecycle Models.

Self-learning component:

Programming in Embedded C; ARM (Part 1: Architecture and Assembly Language Programming; Part 2: Peripheral Programming of ARM MCU Using C); PSoC-SoC for Embedded Applications; DSP Processors.

Text books

1. *Lyla B. Das, Embedded System: An Integrated Approach, Pearson, 2013*
2. *KVKK Prasad, Embedded / Real Time Systems, Dreamtech Press, 2005.*
3. *Peter M, Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and Internet of Things, Springer, 3rd Edition, 2018*
4. *Rob Toulson, Fast and Effective Systems Design, Newnes Publisher, 2nd Edition, 2016*

Reference books

1. *Frank Vahid, Tony D. Givargis, Embedded System Design – A Unified Hardware/Software Introduction, John Wiley, 2002.*
2. *Jonathan W. Valvano, Embedded Microcomputer Systems, 3rd. edition, Cengage Learning, 2011.*
3. *David E. Simon, An Embedded Software Primer, Pearson Ed., 2005.*
4. *Raj Kamal, Introduction to Embedded Systems, TMH, 2002.*
5. *Sri Ram V Iyer, Pankaj Gupta, Embedded Real Time Systems Programming, TMH, 2004.*
6. *Michael Barr, Programming Embedded Systems in C and C++, O'Reilly, 1999.*
7. *International Journal of Embedded Systems-InderScience Publishers.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	C	d	e	f	g	h	i	j	k	l	m	N
CO1							L			L	M		H	
CO2	M		L				L				H			

CO3	M						L			M	H		H	
CO4	M	M			H		L			H	M		H	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Note: Assignments based on following topics can be carried out on Keil µVision Simulator or any other Simulator for ARM Cortex M3 microcontroller.

1. Basic C and FreeRTOS programming.
2. Peripheral Interface Programming.
3. Interrupt System Programming.
4. ADC/DAC programming.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ wk
B19IT5054	Operations Research	SC - 2	3	0	0	0	3	3

Prerequisites:

Basic Mathematics, Linear Algebra, Calculus

Course Description:

This course teaches a student the science of modelling and optimization. It provides tools and theories to solve these real-world problems by finding the optimal solutions to the models subject to constraints of time, labour, resource, material, and business rules. With Operations Research, people make intelligent decisions to develop and manage their processes and businesses.

The objectives of this course are to:

1. Explain basic concepts of Operation Research
2. Illustrate a real world problem as a linear programing problem
3. Discuss applications of dynamic programming and integer programming to solve an optimization problem
4. Develop mathematical models based on game theory

Course Outcomes (Cos):

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

CO1: Outline the basic concepts of Operation Research
CO2: Develop a real world application using linear programing technique.
CO3: Apply Dynamic programming and integer programming to solve an optimization problem
CO4: Formulate a problem based on game theory

Course Content:

UNIT-1

Introduction to Operations Research: Overview of Operations Research Modelling Approach,origin of operations research, nature of operations research, impact of operations research, defining a problem and gathering data, formulating a mathematical model, deriving solution from model, testing models, preparing to apply model, implementation, Introduction to optimisation , Engineering Applications of Optimization, Statement of Optimization Problem.

UNIT-2

Linear and Non Linear Programming: Linear Programming - Applications of linear programming,standard form of linear programming problem, solution of a system of linear simultaneous equations simplex algorithm, two phases of simplex method. Transportation problem, assignment problem

Non-Linear Programming - Unimodal function, unrestricted search – search with fixed step size, search with accelerated step size, Exhaustive search, random walk methods, Gradient of a function-evaluation of gradient, rate of change of a function along a direction, Transportation problem, assignment problem.

UNIT-3

Dynamic and Integer Programming: Dynamic Programming-Multistage decision process-definitionand examples, Concept of sub-optimisation and principle of optimality, computation procedure in dynamic programming, example illustrating calculus methods of solution, example illustrating tabular method of solution.

Integer Programming – Graphical representation, Gomory's cutting plane method-concept of a cutting plane, Gomory's method for integer programming problems, branch and bound methods.

UNIT-4

Game Theory and Metaheuristics: Basic terminology – Player, Strategy, Optimal strategy, Payoff,Saddle point, Value of the game The formulation of two person, zero sum games, solving simple games- a prototype example, Pure Strategies (Minimax and Maximin Criterion)games with mixed strategies, graphical solution procedure, solving by linear programming.

Self-learning component:

Stochastic modelling and simulation, Metaheuristics

Text books

1. *Frederick S Hillier, Gerals J Lieberman, Bodhibrata Nag, PreetamBasu, Introduction to Operations Research, , 9th Edition, McGraw Hill Education, Special Indian Edition, 2012*

2. *Singiresu S Rao, Engineering Optimization Theory and Practice, 3rd Edition, New Age International, 3rd reprint, 2018*

3. *K.V.Mittal, C.Mohan, Optimization Methods in Operations research and System Analysis, , 3rd Edition New Age International Publishers, 1996*

Reference books

1. *Frank Tillman, A Professional's guide to problem solving with decision science, Pioneering Partnership, 2nd Edition, 2018*

2. *A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2016*

3. *Hamdy A. Taha, Operations Research An Introduction, , 8th Edition, Pearson Education, 2007*

4. *IEEE Transactions on Evolutionary Computation*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	H	H	H		H		M			M			M	
CO2	H	H	H		H		M			M	H	M	M	
CO3	H	H	H		H		M			M	H	M	M	
CO4	H	H	H		H		M			M	H	M	M	M
CO5	H	H	H		H		M			M	H	M	M	M

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Describe in details the OR approach of problem solving. What are the limitations of the Operations Research?

A company makes two products, called X and Y, from a mix of chemicals. The mix is made up of three raw materials identified by the letters A, B, and C. At least 45% of the mix must be raw material A and no more than 30% of the mix may be raw material C. After processing the mix, the products are withdrawn in the proportions: 40% is X, 20% is Y, and 40% is a waste product that must be discarded.

Up to 1000 pounds of X can be sold for $12 per pound. Product Y is sold for $18 per pound for any amount up to 2000 pounds. No more than 1000 pounds of X or 2000 pounds of Y may be produced. The processing cost of the mix is $1.50 per pound. Material A costs $6 per pound for any amount. Material B costs $3 per pound up to 2500 pounds. Raw material C is free for up to 1500 pounds. No more than 2500 and 1500 pounds of raw materials B and C are available respectively.

a. Solve this problem with a linear programming model. Describe the optimum mix of raw materials and production levels for the products. How much profit does the business make?

b. What restrictions in the problem are limiting the profit?

c. Change the model so that the simple upper bounds are specified as explicit constraints. (If you previously specified these using the simple upper bound option, change the bound to a higher value 999999.)

$X \leq 1000, Y \leq 2000, B \leq 2500, C \leq 1500$

Note that it is necessary to use explicit constraints to get sensitivity information.

Solve the problem again and determine which of these simple upper bounds you would like to change.

Should the change be up or down? Predict the profit of the new solution.

d. How much can you increase the cost of raw material B increase before the solution changes? (Do all this without solving the problem again.)

e. How much can you increase the limit on product X before the variables in the basic solution change? (Do all this without solving the problem again.)

f. Add the restriction that the mix must be at least 60% raw material B. Solve the problem again and tell what happens to the solution with this constraint?

g. Delete the constraint added in part f. Change the model to remove the limitations on the sales of X and Y. What happens to the solution?

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5055	**Microcontroller and Interfacing**	SC-2	3	0	0	0	3	3

Prerequisites:

Number System; Binary Arithmetic; C programming

Course Description:

Microcontroller course is suitable for candidates who are interested in embedded systems and robotics. 8051 is one of the first microcontrollers used in embedded system design. This course will give an understanding about:

- Embedded programming using 8051 microcontroller
- Architecture of 8051
- Interfacing to peripheral devices

Course Objectives:

The objective of this course are to:

1. Explain systematic and comprehensive treatment of microcontroller architecture, programming, and interfacing.
2. Discuss the implementation of system-level features using hardware and software components of a microcontroller.
3. Demonstrate the understanding of hardware and software aspects of integrating digital peripheral devices.
4. Illustrate the design, implementation, and debugging of microcontroller-based systems.

Course Outcomes (Cos):

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

1. Outline concepts of based embedded systems.
2. Develop applications to implement human interfaces with microcontrollers;
3. Evaluate assembly language programs for the 8051 microcontroller;
4. Make use of modern system development tools in the design of a microcontroller-based system.

Course Content:

UNIT-1

8051 microcontroller architecture: Preliminaries of micro-computing, Microcontroller architecture, registers flags, memory organization, stack, special-function registers, serial and parallel ports, counters and timers, serial input/output, interrupts.

UNIT – 2

8051 microcontroller programming: Addressing modes, complete instruction set, assembly language programming.

UNIT --3

8051 microcontroller-based system design: External memory interface, reset and clock circuits, testing the design, software and hardware timing, look-up table access, serial data transfer in various modes.

UNIT – 4

8051 Microcontroller applications: Interfacing keyboards, displays, measuring frequency and time, interfacing analog to digital and digital to analog converters.

Self-learning component:

Text books

1. *Kenneth J. Ayala, 8051 Microcontroller: Architecture, Programming, and Applications (2nd ed.), Delmar Thomson Course, 1999*

Reference books

1. *Muhammed Ali Mazidi and Janice GillispieMazidi, The 8051 Microcontroller and Embedded Systems (1st ed.), Prentice Hall PTR, Upper Saddle River, NJ, USA, 1999.*
2. *David Calcutt, Frederick Cowan and Hassan Parchizadeh, 8051 Microcontroller: An Applications Based Introduction, Elsevier, 2004.*
3. *Scott MacKenzie, The 8051 Microcontroller (3rd ed.), Prentice Hall PTR, Upper Saddle River, NJ, USA, 1998.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	C	d	e	f	g	h	i	j	k	l	m	n
CO1									H					
CO2	H													
CO3										H				
CO4	H													

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Group-1

1. Draw and explain the internal structure of 8051.
2. Explain PSW register of 8051 indication functionality of its bits.
3. Estimate the time required for the following instructions to execute.
   a) MOV A, R3 requiring 1M/C cycle and running on 6MHz clock.
   b) MUL AB requiring 4M/C cycle and running on 6MHz clock

4. Explain the RAM structure of 8051 with a neat memory map.
5. Explain how Port0 pins can be used as I/P and O/P ports. Is the port pin multiplexed? IF so explain how multiplexed function can be performed by the port.
6. 8051 is operating with a clock of 16MHz. Find the minimum period for its fetch operation. What is the minimum period during which a simple instruction can get executed?
7. What is addressing mode? Explain immediate and direct addressing modes with examples.
8. Identifying the addressing modes used in the following instructions. How do each one of them execute?
   a) MOV R0, #42H
   b) MOV R3, 72H
   c) MOV A, @R0
   d) MOV R1, A
   e) MOV 03H, 01
9. Explain register and indirect addressing modes with examples.
10. Develop an ALP for block transfer of 10 data starting from memory locations 30h-39h to 2050h-2059h.
11. Check whether the following instructions are valid or not. If valid, give working of instruction and if invalid, give reason.
    a) ADD A, @B
    b) MULT R0, R1
    c) DAA A
    d) DIV B, A
    e) DJNZ R7, #0Ah, LABEL
    f) AND B, #FCh
12. Explain the special function TMOD register bits configuration.

Group-2

1. Elaborate on the 8051 features with the help of block diagram.
2. How Port 0 pins of 8051 can serve as input and output?
3. Show the contents of PSW register after addition of 0BFh and 1Bh in the following instructions.

   MOV A, #0BFh
   ADD A, #1Bh
4. Calculate in an 8051 system, driven by 11.0592MHz clock the time taken for an instruction which takes 4 machine cycles.
5. How is internal RAM of 8051 organized?
6. Elaborate on the Timer/Counter logic and discuss Auto-reload mode and 13 bit timer mode of operation.
7. Are the addressing modes in the following instructions valid? If not valid, state Why? If valid, how do they execute?
   a) MOV A, @R4
   b) MOV R0, #1258h
   c) MOV DPTR, 2374h
   d) MOV A, @DPTR
   e) MOV 07h, 03h
8. Discuss the immediate addressing mode with example instructions.
9. Discuss how program counter or Date pointer register in conjunction with Accumulator can be used to access code memory.
10. Identify the addressing mode and give the operation of each instruction
    a) MOV @R0, #35h

b) MOV 6, 3
c) MOV 3Ch, #3Ch
d) MOVX A, @R0
e) MOVC A, @A+DPTR
f) MOV A, 4Eh

11. Write an ALP to find the largest element in a given string n=6 bytes at location 4000h, store the result at the location 4060h.
12. Figure out the functions of the following 8051 instructions giving correct syntax of each:
    a) SWAP   b) CJNE

Group-3

1. Illustrate block diagram of 8051 and explain its functionality in detail?
2. Explain the importance of PSW register bits.
3. Explain the special function TCON register bits configuration.
4. Explain the special function IE register bits configuration.
5. Illustrate the diagram of programming model of 8051 and explain them in detail.
6. Detail indirect addressing mode of 8051 with example instructions.
7. Develop an ALP to find sum and average of 5 hexadecimal numbers stored in memory locations 40h onwards, store the sum in memory location 50h and average in 51h.
8. Outline the status of overflow flag and check when the result is correct after the execution of
   a) MOV A, #+66
      MOV R4, #+69
      ADD A, R4
   b) MOV A, #-30
      MOV R0, #+24
      ADD A, R0
9. Figure out the functions of the following 8051 instructions giving correct syntax of each:
   a) DAA   b) JBC
10. Explain immediate, direct and register indirect addressing modes of 8051 with example for each.
11. Explain the working of the following instructions with examples:
    a) MOV dst, src
    b) PUSH addr
    c) ADD dst, src
    d) ORL dst, src
    e) MUL AB
12. Write an ALP to demonstrate the serial and parallel data transfer to the I/O ports. To read the data parallel from P1 and write the same data to P0.0 serially.

Group–4

1. Illustrate the structure of Program Status Word.
2. Draw the block diagram of 8051 controller and summarize literally its components in brief.
3. Show the operation of the Port0 pins drawing the correct circuits diagram in regard to 8051 microcontroller.
4. Draw the oscillator circuit and represent on timing diagram the Pulse, State and Machine cycle in context of the 8051 microcontroller.
5. Make use of diagram to indicate and explain the internal Ram organization of 8051 microcontroller.
6. Assume that 5 BCD data items are stored in RAM locations starting at 40h; create an ALP to find sum of all numbers.
7. Explain addressing modes of 8051 with examples.

8. Write an ALP to an to sort an array of n=6 bytes of data in descending order stored from location 9000h.(Use bubble sort algorithm)
9. Explain the conditional jump instructions of 8051 microcontroller with example.
10. Explain the following instructions with examples
    a) DAA
    b) ANL
    c) ACALL
    d) SWAP
11. Explain the working of the following instructions with examples:
    a) SUBB dst, src
    b) XRL dst, src
    c) RLC A
    d) CPL C
    e) JZ rel
12. Write an ALP to check whether the given number is ODD or EVEN. If odd, store 'O' else store 'E' in memory location 80h.

Questions for Assignment-2

Group- 1

1. Examine how to interface 8255 programmable interface with 8051 microcontroller to expand its I/O capability.
2. Develop an assembly language program the tests to ensure that the microcontroller can fetch and execute program from the EPROM.
3. Develop an assembly level program to illustrate pure software time delay used in applications.
4. Write an ALP to demonstrate how DPTR can be used for lookup tables in applications.
5. Evaluate the various keyboard configurations using their schematic diagrams.
6. Build an ALP to measure the width of pulses fed to pin3.2(INT0); that are known to vary from 400 to 900µSec. Utilize timer T0, to enable count on the first pulse edge and count when the pulse is high and stop on the second edge. Output the width at internal memory location 100h(MSB) and 101h(LSB).
7. Outline how analog signal is converted into digital using A/D converter with the help of circuit diagram.
8. Indicate the pin function of an intelligent LCD by explaining each of them.

Group- 2

1. Develop an ALP to demonstrate how PC can be used for lookup tables in building applications.
2. Enumerate the importance of RAM and ROM in a microcontroller? With illustration explain how the capacity of RAM and ROM can be extended.
3. Develop an ALP to illustrate hardware time delay used in microcontroller applications.
4. Develop an ALP to demonstrate how DPTR can be used for lookup tables in building applications.
5. Evaluate the various keyboard configurations using their schematic diagrams.
6. Design the circuit for LCD interfacing with 8051. The display is of two lines, 20 characters per line. Port 1 is used to furnish the command or data byte, and ports 3.2 to 3.4 furnish register select and read/write levels.
7. Summarize how timers can be used to measure the frequency in industrial and commercial control applications.
8. Outline how digital signal is converted into analog using D/A converter with the help of a circuit diagram.

Group- 3

1. List all the key board configurations. Sketch and detail one of them.
2. A 4X4 key pad is interfaced with the controller. It is required to display the key press information on a seven segment display. Develop an algorithm, flow chart, program for the above task.
3. Develop an algorithm, flow chart, program the helps 8051 in measuring the width of the unknown pulse appearing on INT1.
4. Sketch the interrupt register (IP) and detail each of its bits that are designed to setup interrupt priority.
5. Elaborate on the expansion of input/output ports of 8051.
6. Briefly discuss the program test that ensures that the microcontroller can fetch and execute programs from the ROM.
7. Develop a program to demonstrate the PC usage for lookup tables, which are essential part of many applications.
8. Summarize how timers can be used to measure the frequency in industrial and commercial control applications.

Group – 4

1. A DAC interfaced with the controller has the following specifications. Maximum O/P voltage is 5Vand Minimum voltage is 0V. Develop a program that generates a sine wave having valid specification along with flow chart.
2. An 8-bit ADC is interfaced with controller. It is required to sample that I/P every 50µSec, 500time. Each sample has to be stored in external RAM. Develop an algorithm, flow chart, program that performs the given task.
3. Detail the controls of the 2-line 20 characters LCD display interfaced with the controller.
4. Develop an algorithm, flow chart, program to display “GOOD LUCK” on the LCD display. Assume that display. Assume that display commands are embedded in the array.
5. Develop an algorithm, flow chart, program to display 00 to 55 on the seven segment display interfaced with the controller.
6. Illustrate how the capacity of RAM and ROM of 8051 can be extended?
7. Briefly discuss the program to perform RAM test in 8051.
8. Label the SCON register contents and give the importance of each bit.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT5061	**Digital Signal Processing with SCILAB**	**SC-3**	**3**	**0**	**0**	**0**	**3**

Prerequisites:

Linear algebra, Calculus and Multivariable calculus and Trigonometry [B19IT1010], Complex number

Course Description:

This course provides insight into fundamentals of Continuous and Discrete-time signals and systems, their properties and representations, understanding of signal representation in Frequency domain, discrete Fourier transform and its properties. It introduces fast Fourier transform and finite impulse response filter designing. It analyses infinite impulse response filter designing.

Course Objectives:

1. Explain the Discrete Fourier Transform (DFT) properties

2. Describe algorithms to compute DFT & IDFT, FFT MATLAB commands.
3. Enumerate various characteristics of commonly used analog filters

4. Discuss various Designs of FIR Filters and Digital Filter Structures.

Course Outcomes:

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

CO1: Implement discrete Fourier transform to represent signal in frequency domain

CO2: Analyse and solve signal representation problems using DFT properties and fast Fourier transforms using radix-2 form.

CO3: Apply DFT to perform linear filtering.

CO4: Design IIR filters from analog domain and linear phase FIR filters using windows.

Course Content:

UNIT-1:

Discrete Fourier Transforms&its properties: The Discrete Fourier Transform (DFT)-Definition & Concept, and Properties of DFT: Periodicity, Linearity, and Symmetry Properties, Circular Convolution, Additional DFT Properties. Problems. DFT SCILAB commands

UNIT-2:

Fast Fourier Transform Algorithms:A linear filtering approach based on DFT, Filtering of long data sequences using overlap - add method, direct computation of the DFT, efficient computation of the DFT, FFT algorithms: Radix–2 DIT- FFT, DIF-FFT algorithms to compute DFT & IDFT, FFT SCILAB commands.

UNIT-3:

Design of IIR Filters: Characteristics of commonly used analog filters, design of Butterworth and Chebyshev analog filters. Frequency transformations in the analog domain, design of digital IIR Butterworth. IIRMATLAB commands.

UNIT-4:

Design of FIR Filters and Digital Filter Structures: Introduction to Linear-phase FIR filters, Symmetric and Anti-symmetric FIR Filters, Design of Linear phase FIR filters using windowing technique: Rectangular, Hamming & Kaiser windows. Design of Linear phase FIR filters by frequency sampling method. Implementation of FIR digital filters: Frequency sampling structures, direct form-I Linear phase structures, Implementation of IIR digital filters: Direct form-I & Direct form-II structures, filter SCILAB commands.

Self-learning component:
Implement the above using Scilab and Octave instead of Matlab.

Text books

1. *Proakis&Monalakis, "Digital signal processing – Principles Algorithms & Applications", PHI, 4th Edition, New Delhi, 2007.*
2. *Sanjit K Mitra, "Digital signal Laboratory using MATLAB", MGH Ed.2000.*
3. *Ashok Ambardar, "Digital signal processing: A modern Introduction", Cengage Learning, 2009.*

Reference books

1. *Oppenheim & Schaffer, "Discrete Time Signal Processing", PHI, 2003.*
2. *S.K.Mitra, "Digital Signal Processing", Tata Mc-Graw Hill, 2nd Edition, 2004.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**												
	a	b	C	d	e	f	g	i	j	k	l	m	n
CO1	H	H			H								
CO2	H	H											
CO3	H	H	H		H	H							
CO4	M	M				M							
CO5	H	H	H		H	H							

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Using a rectangular window technique, design a low pass filter with pass band gain of UNITy cut off frequency of 1000Hz and working at a sampling frequency of5kHz. the length of the impulse response should be 7.
2. Design an FIR low pass digital filter using the frequency sampling method for the following specifications:
   Cut off frequency = 1500Hz
   Sampling frequency = 15000Hz

Order of the filter N = 10

Filter Length required L = N+1 = 1

3. (i) Realize the following FIR system using minimum number of multipliers 1.

   $H(Z) = 1 + 2Z^{-1} + 0.5Z^{-2} - 0.5Z^{-3} - 0.5Z^{-4}$ 2.

   $H(Z) = 1 + 2Z^{-1} + 3Z^{-2} + 4Z^{-3} + 3Z^{-4} + 2Z^{-5}$

   (ii) Using a rectangular window technique, design a low pass filter with pass band gain of UNITy cut off frequency of 1000Hz and working at a sampling frequency of 5 kHz. The length of the impulse response should be 5.

Lab Experiments: (Implement following using SCILAB)

1. Perform the Linear convolution of any two given sequences in time domain.
2. Computation of N point DFT of a given sequence using the definition of DFT and plot magnitude and phase spectrum, and verify using built in function (using FFT).
3. Perform the Circular convolution of two given sequences in time domain.
4. Perform Circular convolution of any two given sequences in frequency domain by using DFT and IDFT.
5. Obtain the Auto correlation and cross correlation of a given sequence and verify its properties.
6. Verification of sampling theorem.
7. Design of digital Low-pass and High-pass Butterworth IIR filter to meet the given specifications using bilinear transformations.
8. Design of digital Low-pass and High-pass Chebyshev IIR filter to meet the given specifications using bilinear transformations.
9. Design of digital Low-pass FIR filter to meet the given specifications using windowing technique.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5062	**Parallel Processing and Algorithms**	**SC**	**3**	**0**	**0**	**0**	**3**	**4**

Prerequisites:

Computer organization and Architecture (**B19IT3020**), Problem Solving with Programming (**B19IT1030**), Design and Analysis of Algorithm (**B19IT4010**).

Course Description:

In a parallel computation, multiple processors work together to solve a given problem. These are exciting times in parallel computing. The largest parallel machine has over a hundred thousand processors, and it is believed that machines with over ten thousand processors will be commonly available by the end of the decade. Furthermore, with most chip manufacturers moving toward multicore processors, most machines will soon be parallel ones. It is, therefore, essential to learn to use parallel machines effectively.

Course Objectives:

1. Explain the concepts of parallelism.
2. Demonstrate the use of OpenMP for implementing shared memory concepts.
3. Discuss the computational bottlenecks of basic computational problems.
4. Illustrate the use of graph algorithms for solving problems.

Course Outcomes (Cos):

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

CO1: Outline the concepts of parallelism.

CO2: Develop parallel programs using OpenMP and pthreads.

CO3: Analyze computational bottlenecks of basic computational problems.

CO4: Make use of graph algorithms for solving problems.

Course Content:

UNIT- 1

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing. **Parallel Programming Platforms**: Implicit Parallelism-Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms. **Principles of Parallel Algorithm Design:** Decomposition Techniques, Characteristics of Tasks and Interactions, Parallel Algorithm Models.

UNIT -2

Programming Shared Address Space Platforms: Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs, OpenMP: a Standard for Directive Based Parallel Programming.

UNIT- 3

Dense Matrix Algorithms: Matrix-Matrix Multiplication. **Sorting:** Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Quicksort. **Graph Algorithms:** Definitions and Representation, Minimum Spanning Tree: Prim's Algorithm.

UNIT- 4

Graph Algorithms continued: Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths and Transitive Closure. **Search Algorithms for Discrete Optimization Problems:** Definitions and Examples, Sequential Search Algorithms, Search Overhead Factor, Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms.

Self-learning component:
Algorithms merging and sorting, Lower Bounds Lock Free synchronization, load stealing, lock free synchronization.

Recommended Learning Resources (Text books):

1. *Introduction to Parallel Computing (2nd Edition). Ananth Grama , George Karypis, Vipin Kumar, Anshul Gupta - Addison Wesley Publications, ISBN : 0-201-64865-2,2003.*

Recommended Learning Resources (Reference books):

1. *Parallel Programming in C with MPI and OpenMP by M.J. Quinn, McGraw-Hill Science/Engineering/Math, 1st edition, ISBN: 0072822562,2003.*

2. *OpenMP: www.openmp.org/*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	D	e	f	g	h	i	j	k	l	m	n
CO1	L			L										
CO2	M		L		M					L				
CO3	M		L		M			M		L	M			
CO4	M		L		M			M		L	M			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1 Implement a multi-access threaded queue with multiple threads inserting and multiplethreads extracting from the queue. Use mutex-locks to synchronize access to the queue.Document the time for 1000 insertions and 1000 extractions each by 64 insertion threads(producers) and 64 extraction threads (consumers).

2 Develop a threaded program for computing the Sieve of Eratosthenes. Think throughthe threading strategy carefully before implementing it. It is important to realize, forinstance, that you cannot eliminate multiples of 6 from the sieve until you have eliminatedmultiples of 3 (at which point you would realize that you did not need to eliminatemultiples of 6 in the first place). A pipelined (assembly line) strategy with the currentsmallest element forming the next station in the assembly line is one way to think aboutthe problem.

3 Device a sorting algorithm that sort the elements of an array by partitioning it and also parallelize such an algorithm.

4 convert the following sequentially executing programs into parallel using OpenMP

a)Matrix Multiplication b) Matrix Addition c.) Addition of two arrays d) Searching

e) Sorting

5. Show how Dijkstra's single-source algorithm and its parallel formulation need to be modified in order to output the shortest paths instead of the cost. Analyze the run time of your sequential and parallel formulations.

6. Compute the total amount of memory required by the different parallel formulations of the all-pairs shortest paths problem.

7. Discuss and illustrate the speed up gain due to pipelining.

8. Demonstrate Super-Scalar execution with the help of an example

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5063	Object Oriented Programming with C++	HC	3	0	0	0	3	3

Prerequisites:

Problem Solving with programming [B19IT1030]

Course Description:

This course introduces the basic concepts of object oriented programming. Familiarizes with object creation and accessing members of object. OOP concepts such as data abstraction, information hiding (Encapsulation), overloading operations, inheritance mechanisms, virtual functions, friend functions and are discussed. File I/O operations, Templates and exception handling mechanisms are also introduced.

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

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

CO1: Apply the basic concepts of objects and classes for a real world application.

CO2: Make use of operator overloading/function overloading for given applications.

CO3: Develop programs using Inheritance feature of OOP.

CO4: Design programs using I/O streams and Templates and Exception Handling.

Course Content:

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 toobjects, 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 ofException handling, handling derived class exceptions.

Self –Learning Components:

I/O System Basics, File I/O: C++ stream classes, Formatted I/O, <fstream> and File classes.

Recommended Learning Resources (Text books):

1. *HerbertSchildt: The Complete Reference C++, 4th Edition, Tata McGraw Hill, 2003.*
2. *SanleyB.Lippmann, JoseeLajore: C++ Primer, 4th Edition, Pearson Education, 2005.*

Recommended Learning Resources (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, 1999.*
3. *ACM, ACM Transactions on Programming Languages and Systems (TOPLAS).*
4. *ACM Journal on Object-Oriented Programming.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	C	d	e	f	g	h	i	j	k	l	m	n
CO1				L	M			M			M	L	M	M
CO2	M		H					L		H	H		H	M
CO3					H						H		M	
CO4	M		H					L		H	H		H	M

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Write a C++ program to implement library information system of C & IT of REVA University.
2. Develop an object motion tracking system in C++.
3. Implement Auto Time-Table generation system for Academics in engineering education.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5064	**Principles of Programming languages**	SC	3	0	0	0	3	4

Prerequisites:

Problem Solving with Programming [B19IT1030]

Course Description:

The course is aimed at introducing the student with the general concepts common to all programming languages so as to make him learn new languages. The course describes syntax and semantics, lexical and syntax analysis, Expressions and Assignment Statements, Statement-Level Control Structures, Subprograms, Concurrency and Exception Handling and Event Handling.

Course Objectives

The objectives of this course are to:

1. Explain the fundamentals of programming languages design and implementation.

2. Describe Names, Scopes, and Bindings of objects, variables.

3. Discuss various machine architectures and issues in language design.

4. Illustrate the use of Composite Types, Records (Structures), Arrays, Strings, Sets, Pointers and Recursive Types, Lists, Files and Input/Output structures, data abstraction.

Course Outcomes

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

1. Outline the fundamentals of programming languages design and implementation.

2. Compare various Scopes, and Bindings of objects and variables

3. Make use of Regression techniques for data analysis.

4. Develop applications using Composite Types, Records (Structures), Arrays, Strings, Sets, Pointers and Recursive Types, Lists, Files and Input/Output structures, data abstraction.

Course Content:

UNIT -1:

Preliminaries: Reasons for Studying Concepts of Programming Languages, Programming Domains,Language Evaluation Criteria, Influences on Language Design, Language Categories, Language Design, Trade-Offs, Implementation Methods and Programming Environments.

Describing Syntax and Semantics: Introduction, The General Problem of Describing Syntax, Formal

Methods of Describing Syntax, Attribute Grammars, Describing the Meanings of Programs: Dynamic Semantics.

UNIT -2:

Lexical and Syntax Analysis: Introduction, Lexical Analysis, The Parsing Problem, Recursive-Descent Parsing, and Bottom-Up Parsing. Names, Bindings, and Scopes: Introduction, Names, Variables, The Concept of Binding, Scope, Scope and Lifetime, Referencing Environments, Named Constants.

Data Types: Introduction, Primitive Data Types, Character String Types, User-Defined Ordinal Types, Array Types, Associative Arrays, Record Types, Tuple Types, List Types, Union Types, Pointer and Reference Types, Type Checking, Strong Typing, Type Equivalence and Theory and Data Types.

UNIT-3:

Expressions and Assignment Statements: Introduction, Arithmetic Expressions, Overloaded Operators, Type Conversions, Relational and Boolean Expressions, Short-Circuit Evaluation Assignment Statements and Mixed-Mode Assignment.

Statement-Level Control Structures: Introduction, Selection Statements, Iterative Statements, Unconditional Branching, Guarded Commands and Conclusions.

Subprograms: Introduction, Fundamentals of Subprograms, Design Issues for Subprograms, Local Referencing Environments, Parameter-Passing Methods, Parameters That Are Subprograms, Calling Subprograms Indirectly, Overloaded Subprograms, Generic Subprograms, Design Issues for Functions, User-Defined Overloaded Operators, Closures and Coroutines.

UNIT-4:

Implementing Subprograms: The General Semantics of Calls and Returns, Implementing “Simple”Subprograms, Implementing Subprograms with Stack-Dynamic Local Variables, Nested Subprograms, Blocks and Implementing Dynamic Scoping.

Concurrency: Introduction, Introduction to Subprogram-Level Concurrency, Semaphores, Monitors, Message Passing, Ada Support for Concurrency, Java Threads, C# Threads, Concurrency in Functional Languages and Statement-Level Concurrency.

Exception Handling and Event Handling: Introduction to Exception Handling, Exception Handling in Ada, Exception Handling in C++, Exception Handling in Java, Introduction to Event Handling, Event Handling with Java and Event Handling in C#.

Self-learning Component:

Abstract Data Types and Encapsulation Constructs, Support for Object-Oriented Programming and Functional Programming Languages.

Recommended Learning Resources (Text books):

1. Robert .W. Sebesta, "Concepts of Programming Languages", 10/e, Pearson Education.

Recommended Learning Resources (Reference books):

1. *A. B. Tucker, R. E. Noonan, "Programming languages", 2e, TMH.*
2. *K. C. Louden, "Programming Languages", 2e, 2003.*
3. *Patric Henry Winston and Paul Horn," LISP", Pearson Education.*
4. *W. F. Clocksin, C. S. Melish, "Programming in Prolog", 5e, Springer.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	a	b	C	d	e	f	g	h	i	j	k	l	m	n
CO1	M	H												
CO2	H				M									
CO3					M				H					
CO4	H	M												
CO5	H				M									

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Perform the comparsion of the PL/I and Ada programming languages, considering both completeness and flexibility.

2. Write EBNF descriptions for the following:

   a. A Java class definition header statement
   b. A Java method call statement
   c. A C switch statement
   d. A C union definition
   e. C float literals
   f. Write features of concurrency of different programming language.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT5070	Web Application Development Lab	HC	0	0	2	0	2	3

Course Outcomes (Cos):

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

CO1: Build web pages using HTML syntax and semantics.

CO 2: Make use of Cascading Style Sheets in developing web applications.

CO 3: Develop Web based applications using Angular JS, Java Scripts and XML concepts.

CO 4: Apply the principles of object oriented development using Perl and PHP

Lab Experiments:

Sl. No.	Name of the experiment	CO	PO
1	In today's digital world, information dissemination through printed documents consume 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 a static web pagesfor an online Book store. The pages should resemble like www.amazon.comThewebsite should consist of. Home page, Registration & Login, User profile page, Books catalog, Shopping cart, Payment by credit card, and order confirmation.	1	a,b
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 forvalidity or correctness of the input data by writing a JavaScript to validate these fields.	1	a,c

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 pageby 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.	2	a,e ,f
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 composedin response to users' requests. Advanced web technologies play a vital role in storage, processing and retrieval of dynamic web content from web servers. Hence itis 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.	2	a , c
5	Information technology has become part and parcel of humanity to such an extent that people can shop anything online, from anywhere, at anytime 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 3 XSLT. Design a document using CSS and XSLT to create a catalog of items for an online electronic shopping	1, 2	a , e
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.	4	a g
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	3	a.c

	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	*PHP* is a server scripting language, and a powerful tool for making dynamic and interactive Web pages. 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.	4	i,k
9	*PHP* (recursive acronym for *PHP*: Hypertext Preprocessor) is a widely-used open source general-purpose scripting language that is especially suited for web development and can be embedded into HTML. Write a PHP program to store page views count in SESSION, to increment the count on each refresh, and to show the count on web page.	4	i,k
10	Databases are the storage systems used by most of the business an 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.	2,3	f,g

First Name	Last Name	Age	Address	Pincode
Ram	Kumar	21	REVA University	560064
Anil	Vinay	30	REVA University	560064

SIXTH SEMESTER

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT6010	**Artificial Intelligence**	HC	**4**	**0**	**0**	**4**	**4**

Prerequisites:

Data structures (B19IT3040), Design and Analysis of Algorithms (B19IT4010)

Course Description:

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 Objectives

The objectives of this course is to:

1. Discuss the basics of Artificial Intelligence (AI).
2. Illustrate knowledge representation issues and methods
3. Explain planning methods/algorithms in problem solving
4. Demonstrate various learning methods for constructing knowledge.

Course Outcomes (Cos):

At the end of the course, the students shall be able to:

CO1: Outline basics of Artificial Intelligence and AI search strategies.
C02: Represent knowledge using logic and apply reasoning methods
CO3: Construct plans using agent technology for solving problems.
C04: Employ learning and reasoning methods in programs for constructing the Knowledge.

Course Content:

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:

Learning: Learning from observations; Inductive learning; A general model of learning agents; Learning decision trees; Using information Theory, Learning general logical descriptions; Computational learning theory, Reinforcement learning; Passive learning in a known environment, passive learning in Unknown environment; Examples: Connection to server, creating database, selecting a database; Active learning in an unknown environment; Neural Networks; Applications of Neural Networks

Self-Learning Components:

PEAS (Performance, Environment, Actuators and Sensors) for Agents ,Genetic Algorithm,Distributed Agents,Wumpus World game (Understanding the game and applying planning and learning rules),Bioinformatics.

Text books

1. *Russell & Norvig: Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2010.*
2. *Elaine Rich, Kevin Knight: Artificial Intelligence, 3rd edition, TataMcgraw Hill, 2009.*
3. *Timothy J. Ross: Fuzzy Logic with Engineering applications: Third Edition, 2010*

Reference books

1. *Nils J.Nilsson: Principles of Artificial Intelligence, Elsevier, 1980.*
2. *Krishan Mehrotra, Chilkuri K. Mohan, Sanjay Ranka: Artificial Neural Networks, Penram International Publishing, 1997.*
3. *B.Yegananarayana: Artificial Neural Networks, PHI, 2001.*
4. *ACM, ACM transaction on Multi-Agent System.*
5. *IEEE, IEEE transaction for computational Intelligence.*
6. *Springer, Springer transaction for security based intelligent systems.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	1			1		2								
CO2		1		1			2							
CO3	2		1		2									
CO4	1		2					3						

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

Application Development for any the following topics:

1. Personality Prediction System through CV Analysis: This system will help the HR department to easily shortlist the candidate based on the CV ranking policy. This system will focus not only in qualification and experience but also focuses on other important aspects which are required for particular job position. This system will help the human resource department to select right candidate for particular job profile which in turn provide expert workforce for the organization. Candidate here will register him/herself with all its details and will upload their own CV into the system which will be further used by the system to shortlist their CV. Candidate can also give an online test which will be conducted on personality questions as well as aptitude questions. After completing the online test, candidate can view their own test results in graphical representation with marks.

2. Website Evaluation Using Opinion Mining: Here an advanced Website Evaluation system should be developed that rates the website based on the opinion of the user. Website will be evaluated based on factors such genuineness of the website, timely delivery of the product after online transaction and support provided by the website. User will comment about the website, based on the comment system will rate the website. The system takes opinion of various users, based on the opinion; system will decide whether the website is genuine or not. The system uses opinion mining methodology to achieve desired functionality. A database of sentiment-based keywords along with positivity or negativity weight in database should be used and then based on these sentiment keywords mined in user comment is ranked. The system contains keywords related to fraud, genuineness, timely delivery of the product and service meters in the database. Based on these factors system will rate the website.
   The working of the system is follows: -
   - The user logins to the system he can view various websites posted by the admin and can comment about the website.
   - User can see the comment of another user.
   - System will rate the website based on the comment of various users.
   - The role of the admin is to add various website to the system and to add keywords in database.
   - So that system will match the comment with the keywords in database and will rate the website based on the sentiment analysis.

3. Student Information Chatbot: A Student bot project is built using artificial algorithms that analyzes user's queries and understand user's message. This System is a web application which provides answer to the query of the student. Students just must query through the bot which is used for chatting. Students can chat using any format there is no specific format the user has to follow. The System uses built in artificial intelligence to answer the query. The answers are appropriate what the user queries. If the answer found to invalid, user just need to select the invalid answer button which will notify the admin about the incorrect answer. Admin can view invalid answer through portal via login. System allows admin to delete the invalid answer or to add a specific answer of that equivalentquestion. The User can query any college related activities through the system. The user does not haveto personally go to the college for enquiry. The System analyzes the question and then answers to theuser. The system answers to the query as if it is answered by the person. With the help of artificial intelligence, the system answers the query asked by the students. The system replies using an effectiveGraphical user interface which implies that as if a real person is talking to the user. The user can queryabout the college related activities through online with the help of this web application. This system helps the student to be updated about the college activities.

4. Fake Product Review Monitoring & Removal for Genuine Ratings: As most of the people require review about a product before spending their money on the product. So, people come across various reviews in the website, but these reviews are genuine, or fake is not identified by the user. In some review websites some good reviews are added by the product company people itself to make to produce false positive product reviews. They give good reviews for many different products manufactured by their own firm. User will not be able to find out whether the review is genuine or fake. To find out fake review in the website this "Fake Product Review Monitoring and Removal for Genuine Online Product Reviews Using Opinion Mining" system is introduced. This system will find out fake reviews made by posting fake comments about a productby identifying the IP address along with review posting patterns. User will login to the system using his user id and password and will view various products and will give review about the product. To find out the reviewis fake or genuine, system will find out the IP address of the user if the system observes fake review send by the same IP Address many at times it will inform the admin to remove that review from the system. This system uses data mining methodology. This system helps the user to find out correct review of the product.

System works as follows: -

- Admin will add products to the system.
- Admin will delete the review which is fake.
- User once access the system, user can view product and can post review about the product.
- System will track the IP address of the user.
- If the system observes fake review coming from same IP address many a times this IP address will be tracked by the system and will inform the admin to remove this review from the system.

5. Android Attendance System: The mobile attendance system has been built to eliminate the time and effort wasted in taking attendances in schools and colleges. It also greatly reduces the amount of paper resources needed in attendance data management. This is an android mobile app. It's built to be used for school/college faculty so that they may take student attendance on their phones.

The system is divided into following modules:

- Student Attendance List Creation: Once this App is installed on a phone, it allows user to create a student attendance sheet consisting of name, roll number, date, Absent/Present mark and subject. He must fill student names along with associated roll numbers.

- Attendance Marking: The faculty has the list on his phone now. He may see the list call roll numbers and select absent id the student is absent or select present if student is present.
- Attendance Storage: This data is now stored in the faculty mobile phone. Faculty may also view it anytime on their phone.
- Attendance sheet transfer: The faculty can transfer the file to a server (normal computer) via a Bluetooth connection where this data can be stored and maintained by the school or college.

Thus, this system automates attendance system and eliminates the use of paperwork needed for attendance marking and monitoring student attendance.

Reference site for projects: (http://nevonprojects.com/artificial-intelligence-projects)

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6020	**Business Intelligence and Process Management**	HC	4	0	0	0	4	4

Prerequisites:

Database Management Systems [B19IT4030]

Course Description:

Business Intelligence and Robotic Process Management (BPM) offers many challenges for software developers and scientists. This course introduces the business intelligence process management concepts, where a student gains overview of all aspects of business intelligence and process modelling.

Course Objectives:

1. Explain the basic concepts of Business Intelligence.
2. Discuss the concepts of Robotics Process automation.
3. Demonstrate the use of UiPath studio.
4. Describe the Process Management Architectures and Methodology.

Course Outcomes (Cos):

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

CO1: Outline the modern concepts and theories of Business Intelligence.
CO2: Identify the Robotics Process automation tools
CO3: Implement the concepts of UiPath studio in a real world application.
CO4: Make use of the UiPath studioand Methodology in a real world application.

Course Content:

UNIT - 1:
Introduction to Business Intelligence: Overview; Changing Business Environments and computerized decision support, A framework for Business cy and legalIntelligence (BI), Why a BI Program?, Transaction

processing vs. Analytic processing, Successful BI Implementation, Major Tools and Techniques of BI.

UNIT - 2:

What Is Robotic Process Automation: Scope and techniques of automation? Robotic process automation, About UiPath

UNIT- 3:

Record and Play :Downloading and installing UiPath StudioLearning UiPath Studio,Task recorder,Step-by-step examples using the recorder.

UNIT- 4:

Handling User Events and Assistant Bots: What are assistant bots?Monitoring system event triggers

Self-learning components:
Handling User Events and Assistant Bots

Text books

1. *Learning Robotic Process Automation Alok manitripathi*Kindle Edition, Published rch by Packt Publishing .

2.*E. Turban, R. Sharda, D. Delen, David King, Business Intelligence, 2nd ed. Pearson India, 2010.*

Reference books

1. *Marlon Dumas et. al., Fundamentals of Business Process Management, Springer, ebook, 2012.*
2. *Van der Aalst, Process Mining: Discovery, Conformance and Enhancement of Business Processes, Third edition, 2011.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3									3			2	
CO2	3	3	3		3					3				
CO3	3	3	3		3					3	2		3	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Download and install UIPathStudio (Community edition)
2. Perform recording in UIpath studio.

- Basic

- Desktop
- Web
- Citrix

3. Empty a folder in Gmail with help of UIpath Robot.
4. Empty a Recycle Byn with help of UIpath Robot.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6030	Information and Network Security	HC	4	0	0	0	4	4

Pre-requisites:

Computer networks (B19IT5010).

Course Description:

The most important issue in organization operations, services and individuals is security of the exchanged data. This course introduces security policy, standards and tools used to provide security, such as shared key encryption (DES), public key encryption, and digital signature (Diffie-Hellmann, RSA, etc.). It then reviews how these tools are utilized in the internet protocols and applications and the system security issues, such as viruses, intrusion, and firewalls, will also be covered.

Course Objectives:

Objectives of this course are to:

1. Explain the security planning, standards and practices.
2. Describe the different cryptographic algorithms.
3. Demonstrate the use of the various authenticating functions.
4. Discuss Firewalls and Intrusion Detection system.

Course Outcomes (Cos):

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

CO1: Analysethe security planning, standards and practices.
CO2: Identify the different cryptographic algorithms.
CO3: Identify the various hashing functions and analyse it.
CO4: Interpret and analyse the different types of network issues.

Course Content:

UNIT- 1

Planning for Security: Introduction; Information Security Policy, Standards, and Practices; The Information Security Blue Print; Contingency plan and a model for contingency plan. **Introduction to Security Technology**: Physical design; Firewalls; Protecting Remote Connections.; Intrusion Detection Systems (IDS); Honey Pots, Honey Nets, and Padded cell systems; Scanning and Analysis Tools.

UNIT- 2

Computer Security Concepts: The OSI Security Architecture, Security Attacks, Security Services , Security Mechanisms, A Model for Network Security Symmetric Ciphers, Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography , Block Ciphers and the Data Encryption , The Data Encryption Standard, A DES Example, Block Cipher Design Principles, Advanced Encryption Standard . Public-Key Cryptosystems , The RSA Algorithm , Diffie-Hellman Key Exchange,

UNIT- 3

Authentication Applications: Kerberos, X.509 Directory Authentication Service. **Electronic Mail Security:** Pretty Good Privacy (PGP); S/MIME. **Transport level Security, Web Security Considerations:** Web Security Threats, Web Traffic Security Approaches, SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Hand shake Protocol, Cryptographic Computations.

UNIT- 4

Firewalls: Introduction, Identification, Authentication, Authorization, Accountability, Firewall processing modes, Firewalls categorized by generation, Firewalls categorized by structure, Firewalls architectures, Selecting of right firewalls, Content Filters, Protecting remote connections, Remote Access, Virtual Private Networks. **Intrusion Detection and Prevention Systems**: IDPS terminology, Use of an IDPS, Types of IDPS, IDPS detection methods, IDPS response, Selecting IDPS approaches and products, Strength and limitations of IDPS, Honeypots. Tools: Auditing tools, Pocket PC hacking, wireless hack walkthrough.

Text books

1. William Stallings, Cryptography and Network Security, Pearson Publications, 6th edition,2014.

2. *M. E. Whitman and Herbert J. Mattored, Principles of Information Security, Information Security Professional, 4th edition, 2014.*

Reference books:

1. *Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw-Hill, 2007.*
2. *Joseph MiggaKizza, Guide to Computer Security, Springer Science & Media Inc., 3rd edition, 2015*
3. *Springer Journal of Cryptographic Engineering, ISSN 2190-8508*
4. *ACM, ACM- International Journal of Applied Cryptography,ISSN:1753-0563*
5. *IEEE, IEEE Transactions on Information Forensics and Security.*
6. *Elsevier, Journal of Information Security and Applications.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	2			3	2	2	1		3		2		1
CO2			2		3		2				3			
CO3		2	3	3	3		2	2						
CO4	2	2			3	2	2	1		3	3	2	3	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. A generalization of the Caesar cipher, known as the affine Caesar cipher, has the following form: For each plaintext letter p, substitute the ciphertext letter C:

   $C = E([a, b], p) = (ap + b) \bmod 26$

   A basic requirement of any encryption algorithm is that it be one-to-one. That is, if p _ q, then E(k, p) _ E(k, q). Otherwise, decryption is impossible, because more than one plaintext character maps into the same ciphertext character. The affine Caesar cipher is not one-to-one for all values of a. For example, for a = 2 and b = 3, then E([a, b], 0) = E([a, b], 13) = 3.

   a. Are there any limitations on the value of b? Explain why or why not.
   b. Determine which values of a are not allowed.
   c. Provide a general statement of which values of a are and are not allowed. Justify your statement.

2. How many one-to-one affine Caesar ciphers are there?

3. A cipher text has been generated with an affine cipher. The most frequent letter of the ciphertext is "B," and the second most frequent letter of the cipher text is "U." Break this code.

4. It is possible to use a hash function to construct a block cipher with a structure similar to DES. Because a hash function is one way and a block cipher must be reversible (to decrypt), how is it possible?

5. If F is an error-detection function, either internal or external use will provide error-detection capability. If any bit of the transmitted message is altered, this will be reflected in a mismatch of the received FCS and the calculated FCS, whether the FCS function is performed inside or outside the encryption function. Some codes also provide an error-correction capability. Depending on the nature of the function, if one or a small number of bits is altered in transit, the error-correction codecontains sufficient redundant information to determine the errored bit or bits and correct them. Clearly, an error-correction code will provide error correction capability when used external to the encryption function. Will it also provide this capability if used internal to the encryption function?

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6041	**Cyber Security**	SC-4	4	0	0	0	4	4

Prerequisites:

Computer Networks, Information & Network Security, Cryptography

Course Objectives:

The objectives of this course are to:

1. Explain the basic concepts of cyber security.
2. Demonstrate the use of Intrusion Detection and Prevention in a real world application.
3. Illustrate the use of cryptography and network security ina real world application.
4. Discuss the implications of cyber space and Law on public.

Course Outcomes:

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

CO1: Summarize the basic concepts of cyber security..

CO2: Develop a real world application to make use of Intrusion Detection and Prevention technique.
CO3: Apply the concepts of cryptography and network security to develop network security solutions for given applications.
CO4: Analyze the implications of cyber space and Law on public.

Course Content:

UNIT 1: Introduction to Cyber Security

Overview of Cyber Security & Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Cyber Security Vulnerabilities- Overview, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT 2: Intrusion Detection and Prevention

Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Security Information Management.

UNIT 3: Cryptography and Network Security

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

UNIT 4: Cyberspace and the Law

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.

Cyber Forensics

Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E- mail header information, Tracing Internet access, Tracing memory in real-time.

Text books

1. *Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition,*
2. *Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.* • *Whitman, Michael E. and Herbert J. Mattord.*
3. *Roadmap to Information Security for IT and Infosec Managers. Boston, MA: Course Technology, 2011.*

Reference books

1. *CYBER SECURITY ESSENTIALS, James Graham, Richard Howard, Ryan Olson, 2011 by Taylor and Francis Group, LLC.*
2. *DATA ANALYSIS FOR NETWORK CYBER-SECURITY, Niall Adams and Nicholas Heard, Imperial College London, Heilbronn Institute for Mathematical Research, University of Bristol, 2014 by Imperial College Press.*
3. *Cyber-Physical Security - Protecting Critical Infrastructure at the State and Local Level, Robert M. Clark and Simon Hakim, 2017 Springer International Publishing Switzerland.*
4. *Computer Network Security and Cyber Ethics, FOURTH EDITION, Joseph MiggaKizza, 2014, McFarland & Company, Inc., Publishers Jefferson, North Carolina*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	3					3					1		
CO2	3	3		2						2				
CO3	3										2		2	2
CO4	3	3		2						2	2			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

5. Identify the Cyber security strategy for SMEs
6. Collect the details about the Cyber security risk assessment
7. Implement Governance solutions to each threat in Cyber security
8. Evaluate various Cyber Security technologies so far implemented

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT6042	**Advanced Web Technology**	SC	4	0	0	4	4

Prerequisites:

Web Application Development [B19IT5030].

Course Description:

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 Objectives:

The objectives of this course are to:

1. Explain the features of HTML 5 and CSS-3.
2. Illustrate the use of ASP.Net and Angular JS as front end and MYSQL as backend in real world applications.
3. Demonstrate the use of AJAX and Ruby in real world applications.
4. Discuss the different RESTFul Web Services available for users.

Course Outcomes:

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

1. Outline the features of HTML 5 and CSS-3.
2. Make use of the features of ASP.Net and Angular JS for creating a front end and MYSQL as backend in real world applications.
3. Develop a real world application using AJAX and Ruby.
4. Design an application for making use of the different RESTFul Web Services available.

Course Content:

UNIT-1

HTML 5 and CSS-3: Basic HTML Structure, Text, Images, CSS Building Blocks, Working with Style Sheets-Creating an External Style Sheet, Linking to External Style Sheets, Creating an Embedded Style Sheet, Formatting Text with Styles, Layout with Styles.

UNIT-2

ASP.Net and AngularJS : ASP.Net-Overview of .NET Framework, Introduction to C#, ASP.NET, ASP.NET Controls, Web Services, Architectures for Database Access, MYSQL Database System, Database Access with JDBC and MYSQL, AngularJS- The Basics of AngularJS, Databinding and first AngularJS Web Application.

UNIT-3

Ruby and AJAX: Origins and uses of Ruby, Scalar types and their operations, Simple input and output, Control statements, Arrays, Hashes, Methods, Classes, Code blocks and iterators, Pattern matching. Basic communication techniques – XHR, AJAX with images, Dynamic script loading, Cache control, AJAX patterns-Communication control patterns – predictive fetch, page preloading, submission throttling, periodic refresh, and multi-stage download, Fallback patterns, AJAX libraries – JQuery, JSON.

UNIT-4

Restful Web Services: What Makes RESTful Services Different?- Introducing the Simple Storage Service, Object-Oriented Design of S3, Resources, HTTP Response Codes, An S3 Client, Request Signing and Access Control, Using the S3 Client Library, Clients Made Transparent with ActiveResource, Parting Words, The Resource-Oriented Architecture, REST and ROA Best Practices, Ajax Applications as REST Client.

Self-learning Component:

Rails, Angular JS complete study.

Text books

1. *Elizabeth Castro, Bruce Hyslop, HTML5 and CSS3, 7th Edition, Peachpit Press, 2012*
2. *Robert W. Sebesta, Programming the World Wide Web, 4th Edition, Pearson Education, 2008.*
3. *Nicholas C Zakas et al, Professional AJAX, 2nd Edition, Wrox publications,2007.*
4. *Ari Lerner, The Complete Book on AngularJS, Fullstack.io, 2013.*
5. *Leonard Richardson and Sam Ruby, RESTFul Web Services, 1st Edition, O'Reilly publications, 2007*

Reference books

1. *Deitel P, Deitel HM, Internet and World Wide Web How To Program, Pearson Education, 2012*
2. *AchyutS. Godbole and AtulKahate, Web Technologies, Tata McGraw Hill, 2003.*
3. *Jason Hunter, William Crawford, Java Servlet Programming, O'Reilly Publications, 1998.*
4. *Paul S Wang, SandaKatila An introduction to Web design and programming Cengage Course, 2003.*
5. *ACM Transactions on Internet Technology*
6. *IEEE International Conference on Enterprise Computing and E-Commerce.*
7. *ACM Transactions on Information Systems.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01
CO1	3		3										
CO2	3	2						3		3			
CO3			3		3								
CO4	3		3	2							3		

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Sample Assignments:

1. Design and create the page(s) for accepting the values of name and marks in a table then displays them in the descending order of the marks.
2. Design HTML forms with proper syntax of the corresponding HTML tags using Text Input, Selectable list with multiple selection option and Radio Buttons
3. Design a frame with a table contents on the left side of the window, and have each entry in the table of contents. Use internal linking to scroll down the document frame to the appropriate subsection using HTML.
4. Develop dynamic web pages using Angular JS.
5. Build a web page which can interface client and server using Ruby technology.
6. Make use of HTML 5 features to enhance a web page created using HTML 3.
7. Illustrate the syntactic differences between the "JavaScript if" statement and "Ruby if" with a suitable example.
8. Illustrate how the parameters are passed in a GET Ajax request with a suitable example?
9. Illustrate with an example the use of two integer classes of Ruby.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT6043	**Advanced Java Programming**	SC	4	0	0	4	4

Object Oriented Programming with Java [B19IT3030], Data Structures [B19IT3040].

Course Description:

This course intends to provide a clear understanding of each of the topics of Advanced Java Programming. The course covers advanced concepts of JAVA programming JSP, Servlets, Networking and database programming, Advanced GUI, Java Beans and Distributed Objects. The course also introduces students to advanced research topics. Students are expected to do independent reading of research papers and make class presentations.

Course Objectives:

The objectives of the course are to:

1. Explain the concepts required for developing the web applications using JSP and Servlets.
2. Demonstrate the use of networking and databases in real world applications.
3. Illustrate the development of GUI programs using Swings and AWT concepts.
4. Discuss the use of Java Beans and distributed objects in real world applications.

Course Outcomes (COs):

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

CO1: Develop Web applications using JSP and Servlets.

CO2: Implement Networking and database concepts using Java.

CO3: Design GUI Programs using Swings and AWT concepts.

CO4: Make use of Distributed objects concepts like RMI and JAX-WS in real world applications.

Course Content:

UNIT- 1

JSP and Servlets: JSP: Introduction, Jsp Life Cycle, Jsp Implicit Objects & Scopes, Jsp Directives,Jsp Scripting Elements, Jsp Actions, JSTL & Tag Library; Servlets: Introduction, Web application Architecture, Http Protocol & Http Methods, Web Server & Web Container, Servlet Interface, GenericServlet, HttpServlet, Servlet Life Cycle, ServletConfig, ServletContext, Servlet Communication-Servlet-Browser communication, Web-component Communication, Servlet-Applet Communication, Session Tracking Mechanisms, Filters & Wrappers, Listeners, Web-Security;

UNIT -2

Networking and Database Programming: Networking: Connecting to a Server, Implementingservers, Interruptible Sockets, Sending Email, Making URL Connections; Database Programming: The Design of

JDBC, SQL, JDBC Configuration, Executing SQL statements, Query Execution, Result sets, row sets, Metadata, Transactions, Connection Management in Web and Enterprise Applications, Introduction to LDAP.

UNIT- 3

Advanced Swings and AWT: Advanced Swings: Lists, Tables, Trees, Text Components, ProgressIndicators, Components Organizers; Advanced AWT: The Rendering Pipeline, Shapes, Areas, Strokes, Paint, Coordinate Transformations, Clipping, Transparency and Composition, Readers and Writers for Images, Image Manipulation, Printing, Clip Board, Drag and Drop, Platform Integration,

UNIT- 4

Java Beans and Distributed Objects: Bean- Writing Process, Using Beans to Build and Application,Naming Patters for Bean Properties and Events, Bean Info Classes, Property editors, Customizers, JavaBean Persistence; Distributed Objects: Remote Method Calls, The RMI Programming Model, Parameters and Return Values in Remote Methods, Remote Object Activation, Web Services and JAX-WS.

Self-learning component:

File handling and Extended Mark-up Language (XML).

Text books

1. Steven Holzner, Java Black Book, Black Group Books, 2000
2. Uttam K Roy, Advanced Java Programming, Oxford Press, 2015.
3. Joe Wigglesworth and Paula McMillan, Java Programming: Advanced Topics,3rd edition, Thomson Press, 2003.

Reference books

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Java, 6th Edition, Wiley, 2014.
2. Robert Lafore, Data Structures and Algorithms in Java, 2nd Edition, Sams, 2002.
3. Danny Poo; Object-Oriented Programming and Java; Second Edition; Springer; 2008
4. H.M.Dietel and P.J.Dietel; Java How to Program; Sixth Edition; Pearson Education/PHI
5. Cay.S.Horstmann and Gary Cornell; Core Java 2, Vol 1, Fundamentals; Seventh Edition; Pearson Education/PHI
6. Cay.S.Horstmann and Gary Cornell; Core Java 2, Vol 2, Advanced Features; Seventh Edition; Pearson Education/PHI.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3							3						
CO2			2	2								2		
CO3			3			3			3		3			
CO4			3	3										

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Projects:

1. NET BANKING PROJECT:

Net banking project does banking online. This aims in functioning always as in Banking. The Net banking project constitutes of modules like

Savings Account: This module contains of normal Bank transaction such as deposit and withdrawal of funds by Bank employee and transaction by customers directly using net banking, Viewing account details by customers, Viewing accounts by bank employee for any customers Bank employee are allowed to add customers are done here.

Demat Account: In this module Customers can be updated from Savings Account to Demat account. Their shares can be de materialized and be converted to electronic format. The account maintenance charges are collected. Demat customers can view their account of demat account.

Trading Account & Share Trading: By this module customers are allowed to view their trading account details, transfer amount from or to Savings account , Trade ie, to buy any new shares available based on amount available in trading account and sell the holding shares on prevailing rates. Share rates are now manually updated by admin part based on prevailing rates.

Customer Service: Customers are provided with variety of service like Change of address online, Change of password, registering cheque book request, Bill Payments etc. In Bill payment the customer can pay any bill enabled online. Customers request of their password are served by mail

Administration & Communication: Admin are enabled to view the accounts of bank income, view the status of customer service, like the status of cheque book request etc. Almost all activity related to customers are made known to customer by mail like new entry are welcomed, cheque book registration Bill Payments and more.

Human Relation: In this module Admin is enabled to add Branches add and delete employee in a branch and to transfer employee from one branch to another etc.

2. IPL GAME APPLICATION PROJECT

This is a social networking application and fun game application. This application is based on the IPL (Indian premier league). It just like playing cricket match, but we won’t play directly. As we know different teams are participating in IPL under different franchises. In this IPL Game Application Java Project each user is a franchise and he will select the players from list and he will create his own team. And he can invite his friends to site also.

Then he will create a group. Once IPL matches’ started he will get the score based on the player score, scored on a particular match. If player hits 1 run then user will get 1 point, if payer hit 4 runs he will get bonus points etc.

Finally one user will win among his friends group. The IPL game application includes modules;

<u>Admin:</u> Adding players: Here admin will add the player to site. He will add player profile, strength.

<u>Adding Team:</u> Create Cricket teams as per IPL.

<u>Add Score:</u> Update the live score details of the players to view by team players.

<u>Selecting players:</u> Here user will select the payers from the list.

<u>Choose Players:</u> User will select the players from the list of players from each team.

Invite Friends: Here user will invite his or her friends to participate in IPL.

View Score: User can view the live score updated by the admin.

Updating profile: User will update his profile.

3. CLIENT SERVER NETWORK PROTOCOLS PROJECT

Client server protocol implementation project is implemented in java platform. Main aim of this project is to implement a gateway protocol for improving routing mechanism and updating routing tables on different connected gateways and nodes in the network. At present most of the internet works on client server technology where clients are servers are connecting through gateways which will route packets form source to destination based on ip address provided in packet. Gateways are key for any client servermodel; gateways need to communicate with nodes in side network and other gateways by updating routingtable.

4. CONGESTION CONTROL PROTOCOL PROJECT

Congestion Control Using NETWORK BASED PROTOCOL project is a networking project which is implemented in java platform. Main aim of this project is to implement a new model called congestion avoidance mechanism called CRF for controlling congestion in network and improve efficiency of communication without any time delay.

In present network congestion is important factor where researches are working to reduce congestion and increase scalability and robustness in network communication. CRF will control and restrict unwanted traffic before they enter the network and communicate with routers which are located at borders and restrict unwanted traffic.

5. DATA TRANSMISSION USING MULTI-TASKING SOCKET PROJECT

Data Transmission Using Multi-Tasking-Socket project is implemented in java platform. Main aim of this project is to explain importance of multitasking socket programming in network communication when dealing with large amount of data from different sources. In this paper we propose a new model in which feedback system is created. When there is any break in socket connection users is informed with connection loss information and similarly packet delay and packet loss information is send to user in the form of feedback message. This method is not available in regular methods which are developed in this project.

6. MANPOWER ACQUISITION PLANNING AND EMPLOYEE RECRUITMENT SYSTEM

This project will be designed and developed for any educational universities or colleges for making recruitment process. “Manpower Acquisition Planning and Employee Recruitment System” is a web-based tool to reduce communication gap between Placement Officers (Applicants) & Job Providers (MNC Companies). Especially in fast growing IT market technologies are changing very fast, based on technology trend Organizations has to recruit the people. This process will make recruitment process very easy and fast.

This project can be very easily used in the process of decision making in new recruitment’s and it will reduce the amount of time required to complete the recruitment process of any organization. This system will allow the Job providers (i.e. HR department) to post the required jobs (Opportunities) which will be available to University’s/College’s placement officers. Then Placements officers can check the student’s profiles, if matches with opportunities then they will forward the student’s profiles to respective HR department. So this system will allow the Job providers to search from database for suitable candidate for a position based on skill set.

The project contains seven modules:

a. Registration Module
b. User Management Module
c. Employee Management Module
d. Resumes Module
e. Opportunities Module
f. Schedule Interviews Module
g. Results Module

7. ONLINE CHILD ABUSE DATABASE PROJECT

Online child abuse database is a application developed to move beyond addressing the impact of child abuse by seeking out the root cause and identifying ways to prevent it. This is a application created to trace out the statistics based on the reports about children. This is a web based application. This application maintains a centralized repository of all scheme related information. This system verifies and reports incidents of abusive parents, physical and sexual abuse. Child abuse application maintains information about child laws.it provides details about those children who are in risk. The project may include the following modules,

Administrator module: Administrator has full access to all the modules of this system. Administrator is responsible for all approving the NGO/Police registrations and has to approve the newsletters generated by NGO and police.

User module: In our system all users are anonymous users, so any user can give complaint and they view newsletters posted by NGO and police.

Investigation Agencies (Police) module:

The investigating agencies will be able to build conclusive picture of the suspect on the basis of reports and statistics provided by the Admin. And they can solve the problem.

Social Activists (NGO's) module: A regular newsletter shall be sent to the registered users (NGO's, Investigation agencies &other users).NGOs in our project captures the information from admin and they posts newsletters.

Reports Module: This module is used by administrator to generate reports based on various criteria such as scheme details, applicant's details, applications details, status of applications, etc.

Sample Assignments:

1. Design webpage for collecting students information, use servlets for validation of phone number, date of birth, pin number, name etc data (Task based)
2. Write notes on Networking using JAVA (Assignment)
3. Write notes on JDBC connectivity (Assignment)

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./ Wk.
B19IT6044	**Real Time Systems**	**SC**	**4**	**0**	**0**	**0**	**4**	**4**

Prerequisites:

Operating systems [B19IT4040]

Course Description

This course familiarizes the fundamental problems concepts and approaches in the design and analysis of real-time systems. It also introduces various approaches, abstract models and terminologies for real-time scheduling. It also outlines various Priority-Ceiling Protocols used in resource sharing. Also gives the Impart knowledge of Real Time Operating Systems and Databases.

Course Objectives

The objectives of the course are to:
1. Discuss real-time systems and describe their functionality.
2. Explain algorithms to analyze and design a real-time system.
3. Describe access Control in Multiple-UNIT Resources to analyse, design and schedule the real-time systems.
4. Illustrate working of characters of Real Time Operating Systems and Databases in new projects.

Course Outcomes

On successful completion of this course, the student shall be able to:
CO1.Characterize real-time systems and describe their functionality.
CO2.Apply the appropriate algorithms to analyze and design a real-time system.
CO3.Illustrate access Control in Multiple-UNIT Resources to analyse, design and schedule the real-time systems.
CO4. Employ the characters of Real Time Operating Systems and Databases in new projects.

Course Content:

UNIT-1:

Introduction: Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing, Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.

UNIT- 2:

Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

UNIT-3:

Resources Sharing: Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority-Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-UNIT Resources, Controlling Concurrent Accesses to Data Objects.

UNIT- 4:

Real Time Operating Systems and Databases: Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of Temporal data, Temporal Consistency, Concurrency Control, Overview of Commercial Real Time databases.

Self-Learning Component:
Case study on features of VxWorks and QNX.

Text books:

1. Jane W. S. Liu, Real Time Systems, Pearson Education Publication 2000.
2. Mall Rajib, “Real Time Systems”, Pearson Education, 2007

Reference books:

1. Albert M. K. Cheng, “Real-Time Systems: Scheduling, Analysis, and Verification”, Wiley, 2003
2. Springer, International Journal of Time-Critical Computing Systems
3. Inderscience, International Journal of Embedded and Real-Time Communication Systems
4. Research Science Press, International Journal of Embedded Systems and Computer Engineering.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2	3	2						3					
CO2		3				2		2						
CO3	2		2	2									2	
CO4	3			2				2				2		

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments for Internal Assessments:

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./ Wk.
B19IT6045	Advanced Database Management Systems	SC	4	0	0	0	4	4

1. Demonstrate Application of mutual exclusion protocols with an example. Implement the concept on a shared variable protected using mutex on VxWorks RTOS.

2. Develop program to show resource access control in POSIX application.

3. Implement Accumulating time drift, a simple cyclic executive which does some periodic computation and simple waiting.Measure the accumulating drift under different conditions, for example:
   • different hardware or operating system,
   • different "background" load of the computer,
   • several parallel task of the same type (as processes, as threads).
   Do the measurements repeatedly and focus not just on the average results, but also on the variance. Provide summary and interpretation of your measurements. Implement a solution without an accumulatingdrift, e.g., by use of timers or simply by measuring the current time and delaying for the remaining time.
4. List the names of RTOS available in the market and write features of each Real Time operating system. Also discuss where they are currently used.
5. Develop a program to illustrate passing of message from one thread to another using pipes.

Prerequisites:

Data Base Management system [B19IT4030]

Course Description:

Advanced database system deals with current and emerging technologies which enables to handle complex applications, provides a comprehensive understanding of data modelling techniques, OLAP, OLTP,Data warehouse and its practical implementation.

Course Objectives:

1. Discuss object oriented concepts and object relational data bases.
2. Describe Parallel and distributed database.
3. Illustrate queries for distributed data storage and processing
4. Explain enhanced data models for applications

Course Outcomes (Cos):

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

CO1: Outline the object oriented concepts and object relational data bases.

CO2: Develop applications for processing parallel and distributed databases.

CO3: Implement queries for distributed data storage and processing.

CO4: Apply enhanced data models for developing industry applications

Course Content:

UNIT- 1

Introduction to various tools and frameworks: Introduction to OLAP, OLTP and Data warehousesystem, data modelling, star schema, snow flake schema. Build Data warehouse/data mart using opensource tools like pentaho data integration tool, pentaho business analytics. OLAP versus OLTP, Introduction to various toolsOverview of Object-Oriented Concepts, Object and Object-Relational Databases: Objects, Encapsulation, Polymorphism, Type and class hierarchies etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Overview of C++ language binding; Conceptual design of Object database; Overview of object relational features of SQL; Object-relational features of Oracle.

UNIT -2

Parallel and Distributed Databases: Architectures for parallel databases; Parallel query evaluation;Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.

UNIT- 3

Enhanced Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts

UNIT- 4

Data Warehousing and Data Mining: Introduction to decision support, OLAP, multidimensionalmodel, Window queries in SQL, Finding answers quickly, Implementation techniques for OLAP, Data Warehousing, Introduction to Data Mining, Counting co-occurrences, Mining for rules, Tree-structured rules, Clustering, Similarity search over sequences, Incremental mining and data streams;

Self-learning Component:

More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management, P-P database, Transaction Management

Text Books:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw- Hill, 2003.
2. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education, 2007.
3. Jiawei Han, MichelineKamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier, 2011.

Reference Books:

1. Connolly and Begg, Database Systems, 4th Edition, Pearson Education, 2002.
2. Journal of Data and Information Quality (JDIQ)
3. ACM Transactions on Knowledge Discovery from Data (TKDD)
4. ACM Transactions on Database Systems (TODS)
5. IEEE Transactions on Knowledge and Data Engineering

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3							3						
CO2			2	2								2		
CO3			3			3			3		3			
CO4				3				3		2				

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Projects:

1. Railway system Database Project.

A railway system, which needs to model the following: Stations Tracks, connecting stations. You can assume for simplicity that only one track exists between any two stations. All the tracks put together to form a graph. Trains, with an ID and a name

Train schedules recording what time a train passes through each station on its route.

You can assume for simplicity that each train reaches its destination on the same day and that every train runs every day. Also for simplicity, assume that for each train, for each station on its route, you store

Time in,

Timeout (same as time in if it does not stop)

A sequence number so the stations in the route of a train can be ordered by sequence number. Passenger booking consisting of train, date, from-station, to station, coach, seat and passenger name.

3. Library Management system Database Project.

A student and faculty can issue books. Different limits for the number of books a student and teacher can issue. Also, the number of days will be distinct in the case of students and teachers for issue any book. Each book will have different ID. Also, each book of the same name and same author (but the number of copies) will have different ID. Entry of all the book will be done, who issue that book and when and also duration. Detail of Fine (when the book is not returned at a time) is also stored.

3. Health Care Organization Database Project.

Emergency Care 24x7

Support Groups

Support and Help Through calls

Any new Patient is first registered in their database before meeting the doctor. The Doctor can update the data related to the patient upon diagnosis (Including the disease diagnosed and prescription). This organization also provides rooms facility for admitting the patient who is critical. Apart from doctors, this organization has nurses and ward boy. Each nurse and ward boy is assigned to a doctor. Also, they can be assigned to patients (to take care of them). The bill is paid by the patient with cash and E-banking. Record of each payment made is also maintained by the organization. The record of each call received to provide help and support to its existing person is also maintained

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6051	Finite Automata Formal Languages	SC -5	4	0	0	0	4	4

Prerequisites:

Problem Solving with programming (B19IT1030), Discrete Mathematics and Graph Theory (B19IT3050) and Design and Analysis of Algorithms (B19IT4010)

Course Description:

The course introduces some fundamental concepts in automata theory and formal languages including finite automaton, regular expression, formal language, grammar, pushdown automaton, and Turing machine. These form basic models of computation; they are also the foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems, etc.

Course Objectives (Cos):

1 Explain the concepts of Deterministic and Non-Deterministic Automata.

2. Demonstrate the use of regular expressions for constructing DFA and NFA.

3. Illustrate the construction of context free grammar for a given data.

4. Describe computing Machine including PDA and Turing Machine

Course Outcomes (Cos):

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

CO1: Outline the concepts of Deterministic and Non-Deterministic Automata.
CO2: Make use of regular expressions for constructing DFA and NFA.
CO3: Construct context free grammars for given data.
CO4: Apply the concepts of Push down Automata and Turing machine for a given data..

Course Content:

UNIT - 1:
Introduction to finite automata: Alphabets; Languages; strings; Deterministic and non-deterministic finite automata (with and without epsilon transitions) and their applications; Equivalence of finite automata; Minimization of Finite Automata

UNIT - 2:
Regular Expressions, regular languages and their properties: Regular Expressions; Finite Automata and Regular Expressions; Equivalence of finite automata and regular expressions; Pumping lemma for regular languages;

UNIT - 3:
Context free Grammars and Normal forms: Context Free Grammars; Parse Trees; Ambiguity in Grammars and languages; Normal forms-CNF and GNF.

UNIT - 4:
Push Down Automataand Turing Machine: Push down automata (PDA); Languages of a PDA; Deterministic PDA; Turing Machine.

Self-Learning:
Applications of Finite Automata and Applications of Regular Expressions.

Text Books:

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2009.

2. Peter Linz, An Introduction to formal Languages and Automata, 4/ E, Jones and Bartlett Publishers, 2006.

Reference Books:

1. Kamala Krithivasan, Rama R, Introduction to Formal Languages, Automata Theory and Computation, Pearson, 2009.
2. B N Srinivasa Murthy, Formal Languages and Automata Theory, Sanguine Publishers, 2006.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2			1			2							
CO2	2				2		2							
CO3	1						2							
CO4	2		1		2		2							

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Design a Finite automaton to accept valid Identifiers of C programming language.
2. Construct Finite Automata to accept the floating numbers.
3. Design a context free grammar to solve dangling else problem of a programming language.
4. List the differences between various finite automata DFA, NFA and epsilon NFA.
5. Design and implement a program in C that read an NFA as input and results an equivalent DFA.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6052	System Modeling and Simulation	**HC**	**4**	**0**	**0**	**0**	**4**	**4**

Prerequisites:

Probability and Statistics (B19IT2010).

Course Description:

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 Objectives:

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):

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

CO1: Make use of the simulation and its tools in real world examples.

CO2: Analyse the concept of schedulingw.r.t time and events, simulation analysis

CO3: Develop an application program for generation of random numbers and random variates using different techniques.

CO4: Differentiate between Verification and Validation of simulation models.

Course Content:

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.

Self-learning component:

Types of simulations with respect to output analysis;Output analysis for terminating simulations; Output analysis for steady-state simulations.

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
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

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3				2									
CO2			3										2	
CO3		1	1		3									
CO4					3					2				
CO5		3	2		1									

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments for Internal Assessment:

1. Suppose you just arrived to the USA and are going through immigration and customs at the airport – a two-step process. For the first step, passengers arrive to be processed according to an exponential distribution with a mean inter arrival time of 10 minutes. Upon arrival, passengers select one of three lines to be have their passport inspected – they choose Line 1, Line 2, or Line 3 based on the smallest number in queue. There is a single inspector for each line and the time she spends inspecting your immigration visa/passport follows an exponentially distribution with a mean of 22 minutes (Line 1),

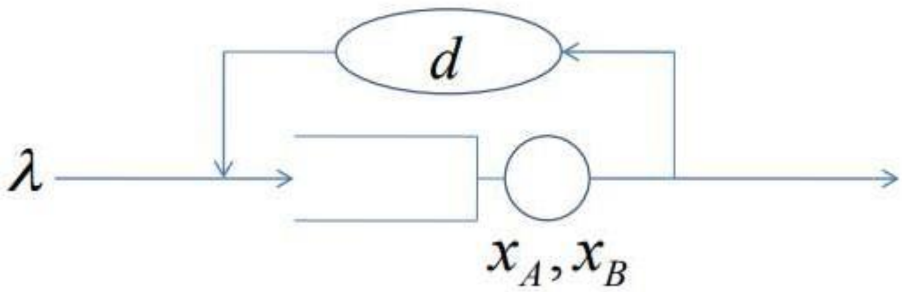
26 minutes (Line 2), and 36 minutes (Line 3). Due to new chemical detection machines, everyone must stay in Line 1, Line 2, or Line 3 for at least 30 seconds – even if the associated inspector is free. After having their paperwork inspected in Step 1, passengers from Line 1 next wait in a new queue (called Line 4), passengers from Line 2 wait in Line 5, and passengers from Line 3 wait in Line 6. Passengers are waiting in this line to get processed by a customs agent who inquires as to what they are bringing into the country and potentially inspects their luggage. There are two customs agents. Customs agent 1 inspects passengers waiting in Line 4 and Line 5. When free, customs agent 1 chooses the next passenger from the longer of their two respective lines. Customs agent 2 priority is to inspect passengers waiting in Line 6. When he is free and no one is in Line 6, he selects the next person from Line 5. If Line 5 is empty, he selects from Line 4.

The inspection time by customs agent 1 takes UNIF(4, 14) minutes; customs agent 2 takes UNIF(5,16) minutes.
Simulate this system for 24 hours and collect the following statistics based off of 25 replications of your model:
(1-1) the total number of people from line 4 processed by Customer Agent 1**(1-2)** the total number of people from line 5 processed by Customer Agent 1**(1-3)** the total number of people from line 4 processed by Customer Agent 2**(1-4)** the total number of people from line 5 processed by Customer Agent 2**(1-5)** the total number of people from line 6 processed by Customer Agent 2

NOTE: Write a simul8 model to simulate the above description.

2. Assume that we have two queuing systems, let us call them Q1 and Q2. All customers first arrive to Q1. Q1 has 10 queuing places and one server. If a customer arrives to Q1 and all queuing places are occupied, the customer is rejected and never returns. When a customer has been served in Q1, it continues to Q2. Q2 has an infinite number of queuing places and one server. The times between the arrivals to Q1 are constant. The service time in Q1 is exponential with mean 2.1 seconds and the service time in Q2 is constant and equal to 2 seconds.
Write a simulation program and use it to answer the following questions:
1. Find the mean number of customers in Q2 for the following interarrival times to Q1: 1, 2 and 5 seconds.
2. For interarrival times in question 1 you should also find the probability that a customer is rejected at Q1.
Let the times between measurements of the number of customers in Q2 be exponentially distributed with mean 5 seconds and make at least 1000 measurements.

3. We shall study a model that can be used to investigate the capacity of the control processor in a switch in a network. A request for the establishment of a new virtual connection that arrives to the switch generates a job of type A. If that job has to wait for other jobs it is put in a buffer. Finally the job is executed and the connection is established. When the connection shall be taken down, a new job is generated. The jobs that teardown connections (jobs of type B) have a higher priority than jobs of type A. Thus, when a job has been served, one first looks if there are any jobs of type B in the buffer. If there are the processor starts to serve oneof the jobs of type B. If there are no jobs of type B in the buffer, the processor can start to serve jobs of type Aif there are any. A job that is being served is never interrupted. The model is illustrated in the figure below



We assume that requests for the establishment of a connection arrive to the switch as a Poisson process of rate λ, i.e. the times between arrivals are exponentially distributed. Each request generates a job of type A. This job represents the work that must be done at the establishment of a connection and has a constant service time$x_{Æ}$. After that the job is put in a delay of constant length d that represents the lifetime of the connection. After the delay the job is put in the queue again, now as a job of type B. Finally it gets one more service, which models the teardown of the connection. This second service time is constant with lengthx_B. After the second service the job leaves the system. We assume that the buffer has an infinite number of places. The parameters have the following values: λ = 150 s^{-1},$x_{Æ}$= 0.002 s, x_B= 0.004 s and d = 1 s.

You shall write a simulation program for this model and answer the questions below.

In all questions, let the time between measurements be 0.1 seconds and collect 1000 samples. 1. Find the mean number of jobs in the buffer for the system above.

2. Let the delay distribution be exponential instead of always having the same value, but let its mean still be 1 s. What is now the mean number of jobs in the buffer?

3. Let the distribution be of constant length = 1 s again. Change the priorities so that jobs of type A have the higher priority. What is now the mean number of jobs in the buffer?

4. In this task you shall compare results from simulation programs to analytical results obtained by queuing theory. We shall study two connected queuing systems (a queuing network) as shown below:

Both queues have an infinite number of buffer places, i.e. customers are never rejected. The service times in the queues have an exponential distribution with mean 1. We also assume that the times between arrivals to the first queue are exponentially distributed (the means are given below). Assume the following:

x = mean time between arrivals

T = the mean time of a customer from the arrival to the first queue to the departure from the second

N= mean number of customers in both the queues Then one can derive the following formulas:

$N = \frac{2}{x-1}$ and $T = \frac{2x}{x-1}$

Do the following: 1. Modify the simulation program written for the first task in this home assignment so that it simulates this system instead.

2. For the mean arrival times 2, 1.5 and 1.1 simulate the system and measure:

a. the mean number of customers in the queuing network

b. the mean time a customer spends in the queuing network

3. Compare the simulation results to the formulas above!

5. The system you shall simulate works as follows: arrivals come to the system in accordance with a Poisson process of rate λ per second. There are n servers in the system. The service time of a customer is x seconds. There is no buffer in the system, which means that if all servers are busy when a customer arrives the customer is rejected. We also set T = the time between measurements and M = number of measurements that should be done. Write a simulation program for this system and do the following:

1. Let N = 1000, x = 100, λ = 8, T = 1 and M = 1000. Write the number of customers in the system at each measurement in a file and use matlab to plot the number in the system versus the measurement. Use the command 'load' to read a file into matlab and then 'plot' to plot the data. How long is approximately the transient phase?

2. Run the program again but change x to 10 and increase λ to 80. How long is the transient phase now? Observe that the mean number of customers in equilibrium is the same as in 1 above.

3. Now increase x to 200 and reduce λ to 4. How long is the transient phase in this case? Observe that the mean number of customers in equilibrium is the same as in 1 and 2 just above.

6. The system you shall simulate works as follows: arrivals come to the system in accordance with a Poisson process of rate λ per second. There are n servers in the system. The service time of a customer is x seconds. There is no buffer in the system, which means that if all servers are busy when a customer arrives the customer is rejected. We also set T = the time between measurements and M = number of measurements that should be done. Write a simulation program for this system and do the following:

1. Now we shall see how the number of measurements and the distance between them affects the accuracy of the simulation. In 4, 5 and 6 we set n = 100, x = 10 and λ = 4 but we let T and M vary. First let T = 4 and M = 1000 and find the length of the 95 % confidence interval.

2. It is tempting to make the times between measurements shorter. Let T = 1 and M = 4000. How long will the confidence interval be? Explain the result.

3. Let now T = 4 again and let M = 4000. How long is the confidence interval? Explain the result.

7. The following table shows the number of journal paper submissions received per month by an ACM journal for the past three years (n = 36 months):

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	7	6	6	8	5	6	6	5	11	13	8	5
2016	7	8	15	4	8	9	4	10	5	4	9	8
2017	10	11	4	7	7	7	8	6	13	9	5	7

The editor of the journal suspects that this data follows a Poisson distribution, but is not sure. Your task is to use a Chi-square test to find out the following.

1. Compute a histogram of this data, and sketch a diagram of it. Does it look Poisson? Why or why not?

2. Compute the mean and variance of the number of paper submissions per month. Do these statistics suggest that the data is from a Poisson distribution? Why or why not?

3. Using a Chi-square test at $\alpha = 0.05$ level of significance, does this data obey a Poisson distribution? Justify your answer.

8. Assume that we have a system that consists of five components; each one of them has a uniformly distributed life length in the interval from 1 to 5. We also assume that if component 1 breaks down, also component 2 and 5 breaks down and if component 3 breaks down also component 4 breaks down. There are no other dependencies between the life lengths of the components. The system works as long as at least one component works. Find the mean time until the system breaks down. Simulate at least 1000 “runs” of the system.

9. Consider designing a two-runway (one each for landing and takeoff) airport for propeller driven aircrafts. The time to land an airplane is known to be exponentially distributed, with mean of 1.5 minutes. If airplane arrivals are assumed to be Poisson, what arrival rate can be tolerated if the average wait time in sky is not to exceed 3 minutes?

10. Alex requests a video file from a popular Web server. The server delivers this file as a sequence of 10 equal-sized User Datagram Protocol (UDP) packets. Suppose that each UDP packet can be independently corrupted in the network with probability $p = 0.1$ (i.e., 10% of the UDP packets are, on average, corrupted). What is the probability that at least 8 corruption-free packets are received at Alex’s computer?

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
			L	T	P	C	
B19IT6053	Computer Vision	HC	4	0	0	4	4

Prerequisite:

Data mining concepts, Matrices

Course description:

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 Objectives

The objectives of this course are to:

1. Explain the fundamentals of Computer vision
2. Experiment with different segmentation techniques
3. Demonstrate the use of techniques for registration and classification of images.
4. Illustrate the object detection in a given application.

Course Outcomes

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

1. Outline the fundamentals of Computer vision.
2. Apply and compare different segmentation techniques.
3. Implement registration and classification of images.
4. Develop application to perform object detection

Course Content:

UNIT 1: Introduction and overview to computer vision

Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms , Sampling and Aliasing, Filters as Templates , Technique: Normalized Correlation and Finding , Technique: Scale and Image Pyramids.Local Image Features: Computing the Image Gradient , Representing the Image

Gradient, Finding Corners and Building Neighborhoods , Describing Neighborhoods with SIFT and HOG Features , Computing Local Features in Practice , Texture

UNIT – 2 MID-LEVEL VISION

Segmentation by Clustering, Human Vision: Grouping and Gestalt, Important Applications, Background Subtraction, Shot Boundary Detection, Interactive Segmentation, Forming Image Regions , Image Segmentation by Clustering Pixels . Basic Clustering Methods , The Watershed Algorithm , Segmentation Using K-means , Mean Shift: Finding Local Modes in Data ,Clustering and Segmentation with Mean Shift ,Segmentation, Clustering, and , Terminology and Facts for Graphs , Agglomerative Clustering with a Graph ,Divisive Clustering with a Graph.

UNIT – 3 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

UNIT – 4 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?

Self-Learning:

Implementation of applications using the above topics

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
3. David Marr, Tomaso A. Poggio, Shimon Ullman "A Computational Investigation into the Human Representation and Processing of Visual Information", , eBook - Amazon.com

Reference books

1. Gary Bradski, Adrian Kaehler, " Learning OpenCV: Computer Vision with the OpenCV Library" Amazon
2. International Journal of Computer Vision, Springer
3. Image and Vision Computing, Elsevier
4. Computer Vision and Image Understanding, Elsevier
5. IEEE Transactions on Image Processing
6. IEEE Transactions on Pattern recognition and machine intelligence

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1									3	2		2		
CO2		3	2		1					3	3		3	3
CO3		2	3							2	2		3	3
CO4		2	3								2	1	3	3

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Lab Experiments/Assignments: (details of the experiment/s)

1. Segmentation of certain applications need background detection, List the various methods for background detection and implement the same.

2. Segmentation could be interactive. Explain Interactive segmentation and implement the same

3. Clustering has become very popular as they are used to group things having similar attributes. There are various clustering techniques used for segmentation. Implement the below

i) The Watershed Algorithm

ii) Segmentation Using K-means

iii) Agglomerative Clustering with a Graph

iv) Divisive Clustering with a Graph

4. Image registration involves aligning of images of the same thing taken at different time. Given two images captured at different time slots, perform Image registration

5. When images are being captured, there could be deformation, Explain the techniques used when there is deformation and implement the technique.

6. Classifiers are used to classify the given image. Using any dataset, compare the performance of various classifiers

7. Object detection and localization are used for drawing bounding boxes for objects in an image. Perform object detection and localization

8. Sliding window is used in computer vision. List out various computer vision tasks using sliding window and also implement them.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
			L	T	P	C	
B19IT6054	**Data Mining and Ware Housing**	**SC**	**4**	**0**	**0**	**4**	**4**

Database Management systems [B19IT4030]

Course Description:

Data warehousing and data mining are two major areas 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, association rules. It then teaches high volume data processing mechanisms by building warehouse schemas such as snowflake, and star.

Course Objectives

The objectives of this course is to:

1. Describe the basic concepts of Data Warehouse and Data Mining techniques.
2. Illustrate the processing of raw data to make it suitable for various data mining algorithms.
3. Explain the measurement of interesting patterns in different databases
4. Discuss the techniques of clustering, classification, association finding, feature selection and visualization to real world data.

Course Outcomes (Cos):

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

CO1: Outline the basic concepts of Data Warehouse and Data Mining techniques.

CO2: Develop an application to process raw data to make it suitable for various data mining algorithms.

CO3: Identify interesting patterns in different databases

CO4:.Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.

Course Content:

UNIT- 1

Data Warehousing: Introduction, Operational Data Stores (ODS), Extraction TransformationLoading (ETL), Data Warehouses, Design Issues, Guidelines for Data Warehouse Implementation, Data Warehouse Metadata, Online Analytical Processing (OLAP): Introduction, Characteristics of OLAP systems, Multidimensional view and Data cube.

UNIT -2

Data Mining: What is Data Mining? Motivating Challenges, The origins of data mining, Data MiningTasks, Types of Data, Data Quality, Data Pre-processing, Measures of Similarity and Dissimilarity, Data Mining Applications, Visualization.

UNIT- 3

Association Analysis: Basic Concepts and Algorithms, Frequent Itemset Generation, RuleGeneration, Compact Representation of Frequent Itemsets, Alternative methods for generating Frequent Itemsets, FP GROWTH Algorithm, Evaluation of Association Patterns .

UNIT- 4

Clustering: Clustering Techniques: Overview, Features of cluster analysis, Types of Data andComputing Distance, Types of Cluster Analysis Methods, Partitional Methods, Hierarchical Methods, Density Based Methods, Quality and Validity of Cluster Analysis.

Self-learning component:

Decision Trees, Rule Based Classifiers, Nearest Neighbour Classifiers.

Text Books:

1. A Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2007.

2. Jiawei Han and MichelineKamber, "Data Mining Concepts and Techniques" Second Edition, Elsevier, Reprinted 2008.

Reference Books:

1. K.P. Soman, ShyamDiwakar and V. Ajay, "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
2. G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
3. Data Mining and Knowledge Science – Springer.
4. Inderscience,The International Journal *of*DataMining, Modelling and Management-
5. IEEE, IEEE Transactions on Knowledge and Data Engineering.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1		2									2			
CO2		2												
CO3	1	1	3	3										
CO4	1	1	3	3		2								

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments for Internal Assessment:

1. Cross-selling: In an marketing model, we can use data mining to discover cross-selling opportunities and build cross-selling models to target right customers for cross-selling. Illustrate the Market Basket for Association analysis for cross-selling.

2.Customer segmentation: Customer segmentation is to divide customers into different groups in which each has a different profile and characteristics. The simplest segmentation method is to divide customers into different age groups, sex groups and income groups. Although such segmentation is useful for certain purposes and still in use in many cases, it is too coarse and no longer satisfies the new business requirements in direct marketing, recommendation and personalized service. Propose an Data mining technique to create fine customer segments to satisfy the new business requirements.(clustering).

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6061	Wireless and Mobile Networks	SC -6	4	0	0	0	4	4

Pre-requisites:

Computer Networks (18BCS53)

Course Description:

This course will introduce to wireless communication and mobile computing. It covers the fundamentals of wireless transmission and telecommunication system such as GSM, GPRS, DECT, and UMTS. Mobile network layer and transport layers covers about mobile IP, Traditional TCP and the architecture of LTE and its protocol.

Course Objectives:

1. Explain the basic concepts of wireless communication.
2. Describe wireless network architecture and concepts of Ad-hoc network.
3. Demonstrate the working of wireless Local area networks and wireless ad-hoc networks.
4. Discuss various applications using the wireless technologies

Course Outcomes (Cos):

On successful completion of this course; student shall be able to:
CO1: Outline the fundamental concepts of wireless communication.
CO2: Analyse the working of wireless network and wireless Ad-hoc network.
CO3: Make use of the Wireless Application protocol in a real world application.
CO4. Develop applications using the wireless technologies.

Course Content:

UNIT -1
Introduction: Fundamentals of wireless communication: Wireless communication system, Wireless media, Frequency spectrum, Wireless communication channel specifications, Types of wireless communication systems.
Basics of wireless networks: Wireless network architecture, Wireless network reference model, Wireless networking issues.
UNIT -2
Telecommunication System: Global system for mobile communications (GSM) Services, System Architecture, Radio interface, protocol, handover, General packet radio service (GPRS). DECT System Architecture, protocol, TETRA, UMTS System Architecture.

Wireless Body Area Networks, Properties, Network architecture, Components, Network Protocols, Bluetooth and Zigbee, Applications.

UNIT -3
Wireless Local Area Networks: Network Components, Network architecture, WLAN standards, WLAN protocols, IEEE 802.11p, WLAN applications.

Wireless Ad Hoc Networks: Wireless Ad Hoc Networks, Mobile Ad Hoc networks, Wireless sensor networks, Vehicular Ad Hoc networks (VANETs).

UNIT -4

Wireless Application protocol: Version 1.X Architecture, WAP 2.0.

4G LTE Networks: Introduction, LTE, LTE Architecture, Protocol layer Architecture, LTE Advanced, 5G Networks overview.

Self-learning components:

Network Function Virtualization (NFV),Capability-based Security,5G,Cyber Physical Systems (CPS), and Capability-based Security.

Text books

1. *Sunil Kumar S.Manvi,MahabaleshwarS.Kakkasageri, Wireless and mobile networks concepts and protocols- ,second edition, Wiley,2016.*
2. *Jochen H. Schillier, Mobile Communications, 2nd edition, Pearson publishers.*

Reference books

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, Mobile computing technology, Application and service creation, Second edition, Tata McGraw Hill Education Private limited, 2010.
2. IEEE Transactions on Vehicular Technology
3. IEEE Transactions on Wireless Communications
4. Springer Wireless Networks Journal

Mapping COs with POs (Program outcomes):

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3			2			3	3					3	
CO2	3		2	2	3		3					2		
CO3			3	2	3	3	3		3					
CO4				2			3							

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Simulate an NS3 program that implements a simple network scenario which provides the communication between three nodes in which the second node acts as a router.
2. Wi-Fi stands for wireless fidelity and uses the 802.11 standard. Implement a wifi network (wired and wireless network) consisting of 5 to 6 nodes and provide the communication between the nodes considering any one node as a hub using NS3 simulator tool.

3. Implement aCognitive Radio Ad hoc network scenario which provides the secure data transmission between the numbers of nodes over the network using NS3 simulator tool.
4. Implement LTE WIFI WIMAX Radio Access network protocol using NS3 simulator tool.
5. Create a Customized Wireless Mesh Network consisting of 10 nodes in a network for communication using NS3 simulator tool.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT6062	**High Performance Computing**	**HC**	**4**	**0**	**0**	**4**	**4**

Prerequisites:

Computer organization and architecture [B19IT3020], Programming for Problem Solving [B19IT1030].

Course Description:

This course provides foundations for developing parallel algorithms. It focuses on types of parallelism and Flynn's classification of Computer Architectures. It provides a practical feeling of how algorithms map to and behave on real systems and supplement algorithmic theory with hands-on exercises on modern HPC systems, such as CUDA for graphics co-processors (Graphics Processing UNIT).

Course Objectives:

The objective of this course are to

1. Explain the basic concepts related to HPC architecture and parallel computing.
2. Illustrate the use of CUDA concepts in real world applications.
3. Describe the concepts of NVIDIA SLI.
4. Discuss different Parallel algorithms and their applications in real world examples.

Course Outcomes:

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

CO1: Outline the basic concepts related to HPC architecture and parallel computing.

CO2: Implement the concepts of CUDA for scientific computations.

CO3: Make use of concepts of NVIDIA SLI in real world applications.

CO4: Analyse performance of different parallel algorithms.

Course Content:

UNIT-1:

Parallel Processing Concepts: Levels of parallelism –Bit, instruction; Data, transaction; task; thread;memory; function; Flynn's Classification of Computer Architectures: SISD,SIMD, MISD, MIMD. Dataflow Models, Demand-driven Computation, Introduction to superscalar architectures; multi-core; multi-threaded.

UNIT-2:

Parallel Programming with CUDA: Processor Architecture; Interconnect; Communication; MemoryOrganization; and Programming Models in high performance computing architecture Memory hierarchy and transaction specific memory design ;

Thread Organization. Heterogeneous Computing; Blocks; Threads; Indexing Shared memory sync threads (); Asynchronous operation; Handling errors; Managing devices.

UNIT-3:

NVIDIA SLI: What is SLI? , Choosing SLI Modes, Avoid CPU Bottlenecks, Disable VSync byDefault, DirectX SLI Performance Tips, OpenGL SLI Performance Tips.

Multi-GPU Performance: Moving to Multiple GPUs, Subdividing Computation across Multiple GPUs, Peer-to-Peer Communication on Multiple GPUs, Finite Difference on Multi-GPU, Scaling Applications across GPU Clusters

UNIT 4:

Parallel Algorithms and Applications: Numerical Algorithms: Dense Matrix Algorithms -Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Solving a System of Linear Equations; Non-numerical algorithms: Sorting: Bubble Sort and its Variants and Quicksort

Self-learning component:
Open-MP, Open MPI, Quantum computing.

Text books

1. Nielsen, Frank,Introduction to HPC with MPI for Data Science, Springer, 2nd Edition, 2016
2. Ananth Grama, Anshul Gupta, George Karypis, and VipinKumar, Introduction to Parallel Computing,, 2nd edition, Addison-Welsey, 2003.
3. Grama, A. Gupta, G. Karypis, V. Kumar, An Introduction to Parallel Computing, Design and Analysis of Algorithms: 2 e, Addison-Wesley, 2003.
4. NVIDIA GPU Programming Guide Version 2.5.0, by NVIDIA Corporation, 2006.
5. John Cheng, Max Grossman ,Ty McKercher, PROFESSIONAL CUDA C Programming, by John Wiley & Sons, Inc,.2014
6. Kai Hwang ,Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill 1993

Reference books

6. J. Dongarra, I. Foster, G. Fox, W. Gropp, K. Kennedy, L. Torczon, A. White, editors, The Sourcebook of Parallel Computing, Morgan Kaufmann, 2002.
7. G.S. Almasi and A. Gottlieb, Highly Parallel Computing, 2ndEdition, Addison-Wesley, 1994.
8. Wilkinson and M. Allen, Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers, 2nd Edition, Prentice Hall, 2005.
9. M.J. Quinn, Parallel Programming in C with MPI and OpenMP, McGraw-Hill, 2004.
10. G.E. Karniadakis, R.M. Kirby II, Parallel Scientific Computing in C++ and MPI: A Seamless Approach to Parallel Algorithms and their Implementation, Cambridge University Press, 2003
11. Elsevier Journal on hign performance computing for Big data.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1											3	2		
CO2			3		2						3	2		1
CO3				3	1							3	2	2
CO4		3	1									3		

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Develop a Program using CUDA basics
2. Write a Program for implementing blocks using CUDA
3. Build a Program for implementing threads using CUDA
4. Illustrate the addition of two vectors using CUDA.
5. Demonstrate multiplication of two matrices using CUDA.
6. Show howPoint to Pointcommunicationcan be implemented in open MPI .
7. Demonstrate the use of Collective communication functions in open MPI
8. Build a Program for adding two matrices of same size in open MPI
9. Write a Program for adding two arrays of same size in open MPI.
10. Develop a Program for implementing Reduce function in open MPI.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6063	**Pattern Recognition**	SC	4	0	0	0	4	4

Prerequisites:

Probability and statistics [B19IT2010]

Course Description:

The course provides an overview of the theory, principles and algorithms used to construct high performance information processing systems that learn from experience. The course discusses main and modern concepts for model selection and parameter estimation in recognition, decision making and statistical learning problems. The objectives of the course are to;

Course Objectives

1. Explain pattern recognition concepts and its applications.
2. Discuss various mathematical models required for pattern recognition tasks.
3. Describe the nearest neighbour classifier and bayes classifier
4. Demonstrate the supervised and unsupervised tasks

Course Outcomes (Cos):

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

CO1: Identify the areas where Machine Learning can offer a solution to Pattern Recognition.

CO2: Illustrate the nearest neighbour classifier

CO3: Implement learning algorithms for supervised and unsupervised tasks

CO4: Develop algorithms for Pattern Recognition.

Course Content:

UNIT- 1

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR,Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems.

UNIT -2

Representation: Data structures for PR, Representation of clusters, proximity measures, size ofpatterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation.

UNIT- 3

Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NNalgorithms use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities,

estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayessian belief network.

UNIT- 4

Decision Trees: Introduction, DT for PR, Construction of DT, Splitting at the nodes, Over-fitting &Pruning, Examples.

Self-learning component:

Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Iso-data), clustering large data sets, examples.

Text Books:

1. V Susheela Devi, M Narsimha Murthy, Pattern Recognition (An Introduction), Universities Press, 2011.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost,Pattern Recognition & Image Analysis, PHI, 1996

Reference books:

1. Duda R. O., P.E. Hart, D.G. Stork., Pattern Classification, John Wiley and sons, 2000.
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, Academic Press, 4th Edition, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	3		3	3			3		3				
CO2	3		2		3							2		
CO3	3	3			3			3				2		
CO4	3	3	1									2		

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments for Internal Assessment:

1. Apply nearest neighbor classification for document categorization. (Project Based)
2. Demonstrate how clustering method works on a given numerical data. (Task Based)
3. Develop a program to obtain features from Medical data set that are suitable for medical data classification. (Project)

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT6064	Web and Text Mining	**SC**	**4**	**0**	**0**	**4**	**4**

Prerequisites:

Probability and statistics [B19IT2010] and Database Management system [B19IT4030].

Course Description:

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 Objectives:

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:

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

CO1: Apply data mining methods in different applications.
CO2: Extract an interesting pattern from text using clustering techniques.
CO3: Classify text data using classification techniques in different applications.
CO4: Analyse web data and retrieve interesting information using link analysis.

Course Content:

UNIT- 1

Introduction to Data Mining Techniques: Text Extraction and Document Clustering. Introduction todata 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-learningalgorithms: 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, PreferentialCrawlers, 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.

Self-learning component:
PageRank for Social network analysis, Focused Crawlers

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

Reference 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.

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1		3		3				3		3				
CO2	3		2		3							2		
CO3	3				3			3				3		
CO4	3	3										2		

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets A. Explore various options in Weka for Preprocessing data and apply (like Discretization Filters,
2. Load each dataset into Weka and run Aprior algorithm with different support and confidence values. Study the rules generated.
3. Apply different discretization filters on numerical attributes and run the Aprior associationrule algorithm. Study the rules generated. Derive interesting insights and observe the effect of discretization in the rule generation process.
4. Load each dataset into Weka and run id3, j48 classification algorithm, study the classifier output. Compute entropy values, Kappa ststistic.
5. Extract if-then rues from decision tree gentrated by classifier, Observe the confusion matrix and derive Accuracy, F- measure, TPrate, FPrate , Precision and recall values. Apply cross-validation strategy with various fold levels and compare the accuracy results.
6. Load each dataset into Weka and perform Naïve-bayes classification and k-Nearest Neighbor classification, Interpret the results obtained.
7. Explore visualization features of weka to visualize the clusters. Derive interesting insights and explain.
8. Load each dataset into Weka and build Linear Regression model. Study the cluster formed. Use training set option. Interpret the regression model and derive patterns and conclusions from the regression results.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
			L	T	P	C	
B19IT6065	**Research Methodology**	**SC**	**4**	**0**	**0**	**4**	**4**

Pre-Requisites:

Fundamental knowledge in C/C++, Java & MS-World

Course Description:

This course offers "An overview of research methodology including basic concepts employed in quantitative and qualitative research methods. Includes computer applications for research.

Prerequisites: Admission to the Doctoral Program. Note: Meets requirements for a Level I research tool course" (Graduate Catalog, 2012-2013, online version). This course introduces research methods as they apply to the higher education (HIED) field of study. HIED 695 provides a macro perspective of the methods associated with conducting scholarly research in all follow-on core, elective, quantitative and qualitative courses; and the doctoral dissertation. Completion of HIED 695 is a prerequisite for follow-on tools courses.

Course Objectives:

The objectives of this course are to:

1. Discuss the dimensions and methods of research.
2. Describe alternative methods and experimental designs available
3. Enable the student to present a good research proposal.
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:

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

CO-1. Outline the basic concepts of research and its methodologies

CO-2. Select and define appropriate research problem and parameters

CO-3. Prepare a project proposal (to undertake a project)

CO-4. Organize and conduct research (advanced project) in a more appropriate manner

Course Content:

UNIT - 1:

Research Methodology: An Introduction - meaning of research - objectives of research - motivation in research - types of research - research approaches - significance of research -research methods versus methodology - research and scientific method - importance of knowing how research is done - research processes - criteria of good research (Kothari)

Defining research problem: selecting the problem - necessity of defining the problem - techniques involved in defining a problem. (Kothari)

UNIT - 2:

Research design: Meaning of research design - need for research design - features of good design - different research designs - basic principles of experimental design. (Kothari)

Originality in Research- research skills - time management - role of supervisor and scholar - interaction with subject experts. (Oliver, Stephen Covey, Slides from Net)

Review of Literature Description: Review of Literature: Significance of review of literature - source for literature: books -journals – proceedings - thesis and dissertations - unpublished items. On-line Searching: Database – SciFinder – Scopus - Science Direct - Searching research articles - Citation Index - Impact Factor - H-index etc, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. (Slides from net)
Thesis Writing: The preliminary pages and the introduction - the literature review - methodology - the data analysis - the conclusions - the references (in IEEE and ACM format). (Oliver, Slides from Net)

UNIT – 3:

Data Collection and Preparation: Sample surveys, sampling errors, types of sampling designs, experiment and surveys, collection of primary data and secondary data, methods, data preparation process, outliers, analysis, statistics. (Kothari)

Descriptive Statistics: measures of central tendency, dispersion, skewness, relationship, kurtosis, sampling distribution, central limit theorem, statistical inference (Kothari)

Introduction to Tools used in Computer Science: MATLAB, NS2/3, C, C++, Java, Web Service, SPSS, SAS, LOTUS, Excel, Latex and Ms Word. (From net)

UNIT – 4:
Testing hypothesis: Concepts, testing, critical region, decision, and hypothesis testing for mean proportion and variance, limitations, chi-square test, one-way ANOVA. (Kothari)

Linear Regression Analysis: Simple model, multiple model and T-test. (Kothari)

LaTeX and Beamer Description: Writing scientific report - structure and components of research report - revision and refining' - writing project proposal - paper writing for international journals, submitting to editors - conference presentation - preparation of effective slides, pictures, graphs - citation styles. Software for detection of Plagiarism. IPR and Patent filing.

Note: Every batch of students comprising maximum of 4 members should define a research problem. Develop solution for the problem. Write a technical paper and publish it in IEEE/reputed conference/ Journal.

Mapping COs with POs (Program outcomes)

Course	Program Outcomes												
Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1									3			3		
CO2	2			1	3				2			2	2	
CO3		3												
CO4		3		2					3					

Recommended Learning Resources: (Text Books)

1. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
2. R. Panneerselvam, Research Methodology, New Delhi: PHI, 2005.
3. P. Oliver, Writing Your Thesis,New Delhi:Vistaar Publications, 2004.
4. F. Mittelbach and M. Goossens,The LATEX Companion, 2nd. ed. Addison Wesley, 2004.

Recommended Learning Resources: (Reference Books)

1. J. W. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 3nd. ed. Sage Publications, 2008.
2. Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd. ed. Indian: PE, 2005.
3. B. C. Nakra and K. K. Chaudhry, Instrumentation, Measurement and Analysis,2nd. ed. New Delhi: TMH publishing Co. Ltd., 2005.
4. I. Gregory, Ethics in Research, Continuum, 2005.
5. COLIN NEVILLI , " The complete guide to referencing and avoiding plagiarism" , Second Edition published by Open Up Study Skills.
6. **RUDRA PRATAP** , " Getting Started with MATLAB " , published by Oxford University Press-2010
7. **TEERAWAT, ISSARIYAKUL, EKRAM, HOSSAIN – 2008 , "Introduction to Network Simulator NS2"**
8. https://www.stir.ac.uk/media/services/registry/quality/**Book**of**Plagiarism**.pdf
9. ceur-ws.org/Vol-706/poster22.pdf
10. https://**books**.google.co.in/**books**?isbn=1446281094
11. www.nalsarpro.org/pl/projects/modelproject2.pdf

5. www.uninova.pt/cam/teaching/SRMT/SRMTUNIT11.pdf
6. http://matlab_tools.myetang.com/index_e.htm

Sample Assignment:

1. Consolidate the various research approaches.
2. Summarize the research methods versus methodology - research and scientific method
3. Explore the importance of knowing how research is done
4. Explain the various criteria of good research
5. Enumerate the significance of review of literature

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6071	Advanced Computer Networks	SC - 7	4	0	0	0	4	4

-Prerequisites:

Computer Organization and Architecture [B19IT3020], Computer Networks [B19IT5010]

Course Description:

This course is designed to introduce advanced topics in computer networks. Algorithms and protocols at the application, transport, network and medium access layers. The course explores emerging research challenges in the field of information and content centric networks. This course assumes students with graduate level knowledge in Computer Networks, familiarity with Operating Systems, Statistics and proficiency in at least one programming language. The course is also organized in traditional lectures, and also students will have chance to study the state-of-art research in Computer Networks field that is particularly interesting to them, and work on it.

Course Objectives:

1. Explain the concepts of SONET and ATM.
2. Discuss the different application protocols.
3.Describe the **Congestion Control and Resource Allocation techniques.**
4. Demonstrate the management of computer network.

Course Outcomes:

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

CO1. Outline the concepts of SONET and ATM.
CO2.Make use of different application protocols in real world applications.
CO3. Develop a program to overcome the problem of congestion control and also implement a resource allocation technique.
CO4. Design a program for management of computer network.

Course Content:

UNIT-1

SONET: Architecture, SONET Layers, Frames, Multiplexing, Networks.
ATM: Design Goals, Problems, Architecture, ATM Layers, ATM switch structure, ATM LAN's. Applications of ATM networks.

UNIT-2

Application Protocols: BGP, Traditional Applications- SMTP, MIME, IMAP, HTTP, Web services, FTP, TELNET. Multimedia Applications, Infrastructure services-DNS, SNMP.

UNIT-3

Congestion Control and Resource Allocation: Issues in Resource Allocation, Network Model, Taxonomy, Evaluation Criteria. Queuing Disciplines: FIFO, Fair Queuing, Congestion-Avoidance Mechanisms: DECbit, Random Early Detection (RED), Source-Based Congestion Avoidance, Quality of Service: Application Requirements, Integrated Services (RSVP), Differentiated Services (EF, AF), and Equation-Based Congestion Control.

UNIT-4

NetworkManagement: Introduction, SNMP, ASN.1
Socket Programming in Java: Introduction, Programming with UDP, Programming with TCP.

Self-Learning Component:
Project development using (NS3 Tool or NetSim). MPLS, VPN, IGMP. SSH, AES, Blowfish.

Text books

1. *Larry L. Peterson & Bruce S. Davie: Computer Networks A Systems Approach, 4th Edition, Elsevier.*
2. *Behrouz A Forouzan: Data Communications and Networking, 5th Edition, McGraw – Hill, 2006.*

Reference books

1. *Nader F. Mir: Computer and Communication Networks, Pearson Education, 2009*
2. *Alberto Leon-Garcia and Indra Widjaja: Communication Networks – Fundamental Concepts and Key Architectures, 2nd Edition Tata McGraw – Hill, 2004.*
3. *Andrew S. Tanenbaum: Computer Networks, 4th Edition, Pearson Education, 2005.*
4. *Larry L. Peterson and Bruce S. Davie: Computer Networks- A system Approach, 5th Edition, Elsevier, 2012.*
5. *William Stallings: Data and Computer Communications, 10th Edition, Pearson Education, 2008.*
6. *Douglas E. Comer: Internetworking with TCP/IP Vol.1, 6th Edition, Pearson, 1995.*
7. *IEEE Network Magazine*
8. *IET Communications*
9. *Elsevier Computer Networks*
10. *Springer Journal of Networks and Systems Management.*

Mapping COs with POs (Program outcomes):

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1		2	2		1				2				3	
CO2		2	2		2				2	2	1			
CO3			3		3				3	1	3			
CO4			3		3			1		2	3		3	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Sample Assignments:

1. Setup Network of 100 computers with a given topology.
2. Develop intrusion detection system.
3. Compare the Congestion control and congestion avoiding algorithms for any specific communication application.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6072	User Interface(UI)/User Experience(UX) Design	SC-7	4	0	0	0	4	4

Prerequisites:

Object Oriented Programming with Java [B19IT 3030], Computer Graphics and Animation [B19It 6063]

Course Description:

This course is designed to give a foundational understanding of how people interact with computers and computing technology, and will provide with a set of basic skills for evaluating and designing for this type of interaction. These are valuable skills to have, especially if a student is considering post-baccalaureate work in the fields of psychology, design, computer science, or plan to work in industry with such technology. Even if a student does not plan to pursue a career in such areas, this is useful information to know to improve his/her own interaction with technology.

The overall objectives of the Course are as follows:

1.Explain user interface design process for a given problem

2: Illustrate the selection of designs, utilize the design thinking processes with UX/UI tools.

3: Describe the assumptions and prototype potential design solutions.

4: Discuss the issues and challenges to achieving a human-centered design process, especially with regard to user experience design

Course Outcomes (Cos):

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

CO1: Develop user interface design process for a given problem

CO2: Interpret the selection of designs, utilize the design thinking processes with UX/UI tools.

CO3: Discriminate the assumptions and prototype potential design solutions.

CO4: Describe the issues and challenges to achieving a human-centered design process, especially with regard to user experience design

Course Content:

UNIT- 1

A Design Process for Digital Products; A Design Process for Digital Products; Modeling Users:

Personas and Goals.

UNIT -2

Setting the Vision: Scenarios and Design Requirements; Designing the Product: Framework andRefinement; A Basis for Good Product Behavior

UNIT- 3

User Experience and Why It Matters? Meet the Elements; Understanding the Strategy Plane;Understanding the Scope Plane.

UNIT- 4

Understanding the Structure Plane; Understanding the Skeleton Plane; Understanding the SurfacePlane; UI/UX Designing for the Desktop, Mobile and other devices. UI/UX Designing for the web.

Self-Learning Components:

Implementation of Common sight patterns in the Interaction design, Prediction of User expectations, Choosing and using the best UI patterns.

Text books:

1. Alan Cooper, About Face-Essential of the User Interface Design, Wiley, 4th edition, 2014
2. Jenifer Tidwell, Designing Interfaces, O'Reilly Media, 2nd edition, 2010.

Reference books:

1. William Buxton, Sketching user experiences-getting the design right and the right design, Elsevier-

   Morgan Kaufmann, 2007.

2. Don Norman, The Design of Everyday Things - Revised and Expanded Edition, 2013.

3. Jesse James Garrett - The Elements of User Experience-User-Centred Design for the Web and Beyond, 2nd Edition, New Riders Press, 2010.

4. ACM, International Journal of Human-Computer Studies.

5.IEEE, Transactions on Human-Machine Systems.

5. 6.Elsevier, International Journal of Human-Computer Studies.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2		1	3				1				2	1	1
CO2		2	2		2			1			2	2	2	
CO3		2			1			1			2		2	2
CO4	1		2		1			1				2		2

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Projects:

1. New typeface system design and promotion design Individual project.
2. Data visualization graphics (Information & user interface design): Competition based project, Group or Individual project.
3. Service design: Creating user centred (interaction design) design for public needs, Group or Individual project.

Sample Assignments for Internal Assessment:

1. Observing Users: Observe Users with a GUI.
2. Usability Analysis: Evaluate the GUI
3. Specifying and Prototyping: Propose a Better GUI.
4. Task Analysis, User-Centered Design: Sketch People-Icons, Task Decomposition, Ethnographic, Observation, Allocation of Functions

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6073	Computer Graphics and Animation	SC - 7	4	0	0	0	4	4

Prerequisites:

Problem Solving with Programming [B19IT1030]

Course Description:

This course introduces techniques, algorithms and principles of interactive computer graphics and animation, this course also prepares for study in real-time rendering, realistic image synthesis, and computer animation.

Course Objectives:

Objectives of this course are to:

1. Explain the basic principles of 3-dimensional computer graphics using Software and Hardware.
2. Describe the basics of Geometric transformation systems.
3. Demonstrate the use of two and three dimensional viewing pipeline.
4. Illustrate the use of Animation and Flash overview.

Course Outcomes (Cos):

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

CO1: Develop interactive computer graphics programs using OpenGL
CO2: Apply three dimensional transformations for a real world application
CO3: Identify requirements and constraints of two and three dimensional viewing pipeline.
C04: Design Animations using ADOBE Flash.

Course Content:

UNIT- 1

Introduction to various graphical tools and platforms,OPENGL: Open GL Primitives & Attributes Pixel addressing and object geometry, Fill Area Primitives, Polygon Fill Areas, OpenGL Polygon Fill, Area functions, OpenGL Vertex arrays, Pixel Array Primitives, OpenGL Pixel array functions, Character Primitives, OpenGL Character Functions, OpenGL Display Lists, Open GL Display Window Reshape

Functions; OpenGL state variables, Colour and gray scale, openGLcolour functions, Point Attributes, Line Attributes, General Scan Line Polygon Fill Algorithm

UNIT -2

Geometric Transformations Basic Two-dimensional Geometric Transformations, Matrix representation and Homogeneous Coordinates, Inverse Transformations, Two Dimensional Composite Transformations, Geometric transformations in Three dimensional Space, Three dimensional Translation, Three dimensional Rotation, Three dimensional Scaling, Composite Three dimensional Translation, Other Three dimensional Translation, Transformations

UNIT- 3

Viewing The Two and Three Dimensional Viewing Pipeline, The clipping window, Normalization and view port transformation., OpenGL Two Dimensional Viewing functions, Clipping algorithms,; Over view ofThree dimensional Viewing concepts, The Three dimensional Viewing pipeline, Three dimensional Viewing coordinate parameters, transformation from word to viewing coordinates, Projections transformation, Orthogonal projections, Oblique parallel projections, Perspective Projections, Open GL Three dimensional viewing functions

UNIT- 4

Animation and Flash overview: Development of animation, Non Computer and computer based animation, Flash basics, Flash Work Environment, drawing overview, creating text boxes, creating animation.

Self-learning components:

Lighting and shading models, Tools for graphics and animation, VFX

Text books

1. Edward Angel, Interactive Computer Graphics A Top Down Approach with OpenGL, Addison-Wesley, 5th Edition,2008

2. Malay K. Pakhira, Computer Graphics and Animation, PHI Learning Pvt. Ltd., First edition, 2010

Reference books

1. Foley, Van Damn, Feiner and Hughes, Computer Graphics: Principles and Practice. Addison Wesley.

2. Modeling in Computer Graphics: Proceedings of the IFIP WG 5.10 Working Conference Tokyo, Japan, April 8–12, 1991 (IFIP Series on Computer Graphics) by Tosiyasu L Kunii

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3									3			2	
CO2	3	3	3		3					3				
CO3	3	3	3		3					3	2		3	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Draw a color cube and spin it using opengl transformation functions and also allow the user to move the camera using perspective functions
2. Animate the 3D Indian flag using suitable opengl functions.
3. Write a program to create 2D windmill and apply openggl rotate functions for clockwise and anticlockwise
4. Implement Cohen-Sutherland line clipping algorithm and specify input line, window for clipping and viewport for displaying the clipped image.
5. Write a program to display chess board of 8*8 -64 blocks.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
B19IT6074	Project and Risk management	SC - 7	**4**	**0**	**0**	**4**	**4**

Prerequisites:

Software Engineering (**B19IT3060**)

Course Description:

This course provides an introduction to Software Project Management including Risk management. It explains Project evaluation, Software estimation, Planning, Project monitoring and control techniques .

Course Objectives:

1. Describe the importance of software project management and explain how to apply basic project evaluation techniques
2. Explain basic estimation techniques and preparation of activity plan
3. Discuss project progress charts to monitor the progress of the project
4. Illustrate the identification of the factors putting the project at risk and categorization of actions for risk elimination or containment

Course Outcomes:

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

CO1:Explain the importance of software project management and apply basic project evaluation techniques

CO2:Apply basic estimation techniques and prepare activity plan

CO3:Develop project progress charts to monitor the progress of the project

CO4: Identify the factors putting the project at risk and categorize actions for risk elimination or containment

Course Content:

UNIT-1:

Introduction to Software project management: Importance of software project management, project, activities covered by software project management, contract management versus technical project management, stakeholders, setting objectives, business case, management, management control, project portfolio management

UNIT-2:

Overview of Project planning: Introduction to stepwise project planning, select project, Identify project scope and objective, identify project infrastructure, analyze project characteristics, identify project product and activities, estimate effort for each activity, identify activity risks, allocate resources, review /publicize plans, execute plan/lower levels of planning

Estimation: Basis for software estimating, software effort estimation techniques, bottoms up estimating, top down approach and parametric models, caper jones estimating rules of thumb, expert judgement, estimating by analogy, Albrecht function point analysis

Activity planning: Objectives of activity planning, project schedules, sequencing and scheduling activities, network planning models, formulating a network model, forward pass, backward pass, identifying critical path

UNIT-3:

Resource allocation: Nature of resources, identifying resource requirements, scheduling resources, publishing resource schedule

Project monitoring: Creating framework, collecting data, review, visualizing progress, cost monitoring, earned value analysis, prioritizing monitoring, getting the project back to target

UNIT 4:

Risk management:

Business Risk: Business risk evaluation, risk identification and ranking, risk and net present value,cost benefit analysis, risk profile analysis, Using decision trees

Project Risks: Project risk, categories of risk, Framework for dealing with risk,
risk identification, risk assessment, risk planning

Risk management: Contingency, Deciding on risk actions, Creating and maintaining risk register

Self-learning component:

1. Project Management Professional certification
2. Directing a software engineering project
3. Software metrics and visibility of progress

Text book:

1. Software project management by Bob Hughes, Mike Cotterill, Rajib Mall, 5th edition, 2011.

Reference books

1. Managing global software projects by Gopalaswamy Ramesh. 2013
2. Software Engineering project management by Richard H Thayer, Edward Yourden, 2014.
3. https://www.managementstudyguide.com/software-project-management.htm

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1				3									2	
CO2													2	3
CO3								3					2	
CO4								3					2	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. For a project the activities , their duration and the precedence activities are as follows:

Activity	Duration(in weeks)	precedence
A	4	-
B	7	A
C	5	A
D	8	B
E	5	B,C
F	2	C
G	1	D,E,F

a. Draw precedence network

b. Identify critical activities

c. Identify critical path

d. Find project duration

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6080	Skill Development – 6	RULO	0	0	0	1	1	2

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT6090	Soft Skills - 4	RULO	0	0	1	0	1	2

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

SEVENTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT7031	**Internet Computing and Applications**	OE	3	0	0	0	3	3

Prerequisites:

Nil

Course Description:

The course aims to provide an understanding with the principles on which the Internet and other distributed systems are based. Emphasizes the power of Javascript, PHP to design web pages that dynamically interact with databases that reside on a server. Scripting tools to build web pages that connect to servers and Client-Side Programming, Server-Side Programming, Database Connectivity to web applications.

Course Objectives:

The objectives of this course are to:

1. Describe the different types of computer networks.

2. Illustrate the use of distributed system technologies in real world applications.

3. Demonstrate the use of Java script in real world applications.

4. Explain the features of PHP, HTML and MySQL.

Course Outcomes:

On successful completion of this course, the student will be able to:

CO1: Outline the different types of computer networks.
CO2: Make use of distributed system technologies in real world applications.
CO3: Develop real world applications using Java script.
CO4: Apply the features of MySQL, HTML and PHP for developing real world application.

Course Content:

UNIT -1:

Introduction to Networks: Data Communications, Networks: LAN, MAN, WAN, Layers, Protocolsand Interfaces of OSI Reference Model and TCP/IP Model.

Internet: URLs, the World Wide Web, WWW Architecture, Web Browsers, Web Servers, Web Search Engines, MIME, HTTP, FTP, Web Service, Software as a service

UNIT -2:

Distributed Computing: Client Server, Cloud, parallel computing and Grid computing, RemoteProcedure Call (RPC) and Remote Method Invocation (RMI).

UNIT 3:

JavaScript: Introduction: Overview of Java Script, Object orientation and Java Script, Data types andVariables - Operators, Expressions, and Statements - Functions - Objects - Array, Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form handling and validations, Errors in scripts, Examples.

UNIT 4:

PHP: 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, PHP myadmin and database bugs.

Self-learning component:

Dynamic Documents with Javascript: Positioning elements, Moving elements, Element Visibility, Changing colors and fonts, Dynamic content, Stacking elements, Locating the mouse cursor, Reacting to a mouse click, Dragging and dropping elements, E-Commerce, Real Estate Business, Education, Health, Research and Social Networks like Facebook, FlipKart etc.

Text books:

1. *M.L.Liu, Distributed computing, Principles and Applications, Pearson Education, 4th edition, 2008.*

2. *Grid Computing, Joshy Joseph & Craig fellenstein, Pearson Education, 3rd edition, 2004.*
3. *Robert W. Sebesta: Programming the World Wide Web, 4th Edition, Pearson Education, 2008.*

Reference books:

1. *Deitel, Goldberg, 'Internet & World Wide Web How to Program', Third Edition, PearsonEducation, 2006.*
2. *Behrouz A , Forouzan , Data Communication and Networks, Tata McGrahill, 4th Edition, 2006*
3. *Achyut S. Godbole and AtulKahate, Web Technologies, Tata McGraw Hill, Third edition, 2003.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1										3				
CO2						2				3				
CO3	1				1	2		1		3				
CO4						2		3		3	3			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. An organization wants to implement a very simple distributed file system (DFS) from where, a DFS client retrieves a file from a central DFS server and caches it in it's /tmp directory for better performance. Design and develop such a simple distributed file system.
2. A user wants to generate `n' consecutive Fibonacci numbers. He wants the program to ask for the value of `n', generate and display the required number of Fibonacci. Design and develop a program to carry-out these activities.
3. A user wants to display a table which consists of following information.

1	2	3	4	5	6	7	.	.	.
1	4	9	16	25	36	49	.	.	.

Design and develop a program that asks for an integer to be entered, generate and display the above table.

4. An Organization wants to create a database which consists of its Employee's name, Employee code, address and e-mail ids. It requires a provision to retrieve and display the employee details based on the Employee code. Design and develop an XML form suitably.

5. A student who is learning Javascript wants to know different methods to read the input and display the result, so explain him the methods how input can be read from keyboard and display the results on the screen. And also illustrate him how a Javascript can be written to find the largest of 3 numbers using alert box.

6. In a corporate organization, employees across different geographical locations are given access to the books library web site. For the librarian using PHP develop a web page that accepts book information such as Title, authors, edition and publisher and store information submitted through web page in MySQL database. For the employee- 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. A student developing an HTML document that has six short paragraphs to text. And he want to incorporate three different paragraphs styles p1, p2 and p3. The p1 style must use left and right margins of 20 pixels, a background color of yellow, and a foreground color of blue. The p2 style must use font size of 18 points, font name 'Arial' and font style in italic form. The p3 style must use a text indent of 1 centimeter, a background color of green and foregrounded color of white. The 1st and 4th paragraph

8. An organization wants to implement a very simple distributed file system (DFS) from where, a DFS client retrieves a file from a central DFS server and caches it in it's /tmp directory for better performance. Design and develop such a simple distributed file system.

9. A user wants to generate `n' consecutive Fibonacci numbers. He wants the program to ask for the value of `n', generate and display the required number of Fibonacci. Design and develop a program to carry-out these activities.

10. A user wants to display a table which consists of following information.

1	2	3	4	5	6	7	.	.	.
1	4	9	16	25	36	49	.	.	.

Design and develop a program that asks for an integer to be entered, generate and display the above table.

11. An Organization wants to create a database which consists of its Employee's name, Employee code, address and e-mail ids. It requires a provision to retrieve and display the employee details based on the Employee code. Design and develop an XML form suitably.

12. A student who is learning Javascript wants to know different methods to read the input and display the result, so explain him the methods how input can be read from keyboard and display the results on the screen. And also illustrate him how a Javascript can be written to find the largest of 3 numbers using alert box.

13. In a corporate organization, employees across different geographical locations are given access to the books library web site. For the librarian using PHP develop a web page that accepts book information

such as Title, authors, edition and publisher and store information submitted through web page in MySQL database. For the employee- 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

14. A student developing an HTML document that has six short paragraphs to text. And he want to incorporate three different paragraphs styles p1, p2 and p3. The p1 style must use left and right margins of 20 pixels, a background color of yellow, and a foreground color of blue. The p2 style must use font size of 18 points, font name ‘Arial’ and font style in italic form. The p3 style must use a text indent of 1 centimeter, a background color of green and foregrounded color of white. The 1st and 4th paragraph mustuse p1, the second and 5th must use p2, and the 3rd and 6th must use p3. Help him to create the HTML document

15. An organization wants to implement a very simple distributed file system (DFS) from where, a DFS client retrieves a file from a central DFS server and caches it in it’s /tmp directory for better performance.Design and develop such a simple distributed file system.

16. A user wants to generate `n’ consecutive Fibonacci numbers. He wants the program to ask for the value of `n’, generate and display the required number of Fibonacci. Design and develop a program to carry-out these activities.

17. A user wants to display a table which consists of following information.

1	2	3	4	5	6	7	.	.	.
1	4	9	16	25	36	49	.	.	.

Design and develop a program that asks for an integer to be entered, generate and display the above table.

18. An Organization wants to create a database which consists of its Employee’s name, Employee code, address and e-mail ids. It requires a provision to retrieve and display the employee details based on the Employee code. Design and develop an XML form suitably.

19. A student who is learning Javascript wants to know different methods to read the input and display the result, so explain him the methods how input can be read from keyboard and display the results on the screen. And also illustrate him how a Javascript can be written to find the largest of 3 numbers using alert box.

20. In a corporate organization, employees across different geographical locations are given access to the books library web site. For the librarian using PHP develop a web page that accepts book information such as Title, authors, edition and publisher and store information submitted through web page in MySQL database. For the employee- 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

21. Design and implement a very simple distributed file system (DFS) in that a DFS client retrieves a file from a central DFS server and caches it in its /tmp directory for better performance.

22. Ajay is interested to know about the level of style sheet that is having high priority. So explain him what are the different levels of style sheets and demonstrate with sample program about priority.

23. Abdul started developing web pages. He want to make use of heading tags, subscript, superscript, bold, italic, insert an image and also want to preserve white spaces. Demonstrate him how to apply these tags in a web page.

24. John observed that URL started with HTTP and also observed Internal Server Error for a web page he was accessing. So explain him what is HT

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT7032	Web Application Development	**OE**	**3**	**0**	**0**	**0**	**3**	**3**

Prerequisites:

Object Oriented Programming with Java (B19IT3030) and Basics of Database Management System (B19IT4030).

Course Description:

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, Perl and PHP.

Course Objectives:

1. Explain the basic concepts of HTML code.
2. Illustrate the use of Cascading Style Sheets in web pages.
3. Demonstrate the use of Angular JS, Java Scripts and XML in real world applications.
4. Describe the principles of object oriented development using Perl and PHP.

Course Outcomes (Cos):

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

CO1: Build web pages using HTML syntax and semantics.
CO 2: Make use of Cascading Style Sheets in developing web applications.
CO 3: Develop Web based applications using Angular JS, Java Scripts and XML concepts.
CO 4: Apply the principles of object oriented development using Perl and PHP

Course Content:

UNIT- **1**

Introduction to HTML, HTML Syntax, Semantic Markup, Structure of HTML Documents, HTML Elements, HTML Semantic Structure Elements, HTML Web Storage. HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Micro formats

UNIT -**2**

Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, CSS Text Styling. Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

UNIT- **3**

Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, Caching, JavaScript and jQuery, Angular JS, JavaScript Pseudo-Classes, XML Processing and Web Services, XML Processing, Overview of Web Services.

UNIT- **4**

Introduction to Perl and PHP. Arrays and Superglobals, Arrays, GET and POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting, PHP Error and Exception Handling.

Self-learning component:

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

Text books

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 1st Edition, 2016

2. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 1st Edition, 2006.

3. Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 4th Edition, 2007.

Reference books

1) Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", O'Reilly Publications, 4th Edition, 2015.

2) Luke Welling, Laura Thomson, "PHP and MySQL Web Development", Pearson Education, 5th Edition 2016.

3) Nicholas C Zakas, "Professional JavaScript for Web Developers", Wrox/Wiley India, 3rd Edition 2012.

4) David Sawyer Mcfarland, "JavaScript & jQuery: The Missing Manual", O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 1st Edition, 2014

5) Zak Ruvalcaba Anne Boehm, "Murach's HTML5 and CSS3", Murachs/Shroff Publishers & Distributors Pvt Ltd, 3rd Edition, 2016.

6) Gerardus Blokdyk, "Representational State Transfer: Practical Integration", CreateSpace Independent Publishing Platform, 1st Edition, 2018

7) Michael Fitzgerald, 'Learning Ruby", O'Reilly, 1st Edition, 2007

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3							3			3			
CO2			2									2		
CO3			3			3			3		3			

CO4			3				3							

Where L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Create a static REVA University web page using HTML tags
2. Create a web page that will have separate links to show map of India and World. When user will open a map of India, create links to display the information of each state i.e. highlighted in the map in a separate window/document. (The information should be brief i.e. not more than 3-4 sentences.) When user will open a world map, show the list of countries on clicking the image in a new window.
3. Write an HTML page to display information of three products. The name of three products should be displayed at the top. The hyperlink should be provided to move to the details of the product like its features, size, price etc .alongwith its image. The link should be internal link.
4. Explain the following tags with the attributes that often required. Write suitable example for each. 1) SELECT 2) TEXTAREA
5. What is CSS and List out the properties of CSS.
6. Differentiate between java and JavaScript.
7. Explain with sample program perl.
8. Explain with sample program php.

Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Hrs/ Wk**
B19IT7033	Data Structures with C	**OE**	**3**	**0**	**0**	**0**	**3**	**3**

Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Hrs/ Wk**
B19IT7041	Advanced Storage Area Networks	SC	4	0	0	0	4	4

Prerequisites:

DBMS (B19IT4030), Computer Networks (B19IT5010).

Course Description:

The course provides students with an understanding of the need for SAN, caching, local file systems, SAN hardware, and SAN Architecture on going through this course**.**

Course Objectives:

1. Explain the architecture of Server Centric IT and discuss its Limitations.

2. **Describe the role of Caching** with respect of storage of data.

3. Discuss theuse of local file systems with respect of storage of data.

4. Demonstrate the creation of network storage for a given application.

Course Outcomes (Cos):

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

CO1: Outline the features of Server Centric IT Architecture and its Limitations.

CO2: Develop an application to make use of Cachingfor storage of data.

CO3: Make use of local file systems for storage of data.

CO4: Create a network storage for a given application.

Course Content:

UNIT 1:
Server Centric IT Architecture and its Limitations; Storage: Centric IT Architecture and its advantages; Case study: Replacing a server with Storage Networks; The Data Storage and Data Access problem; The Battle for size and access. Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels, JBOD, Storage virtualization using RAID and different RAID levels;

UNIT2:

Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems; Availability of disk subsystems. The Physical I/O path from the CPU to the Storage System; SCSI.
Fiber Channel Protocol Stack; Fiber Channel SAN; IP Storage The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system.

UNIT 3:

Local File Systems: Network file Systems and file servers; Shared Disk file systems; Comparison of fiber Channel and NAS, Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.

UNIT 4:

Overview, creating a Network for storage: SAN Hardware devices, the fiber channel switch, Host Bus adaptors; putting the storage in SAN; Fabric operation from a Hardware perspective. The switch's Operating system, Device Drivers, The Supporting the switch's components, Configuration options for SANs. Panning for business continuity.

Self-learning component:
Storage virtualization on Block or file level, Storage virtualization on various levels of the storage Network, Symmetric and Asymmetric storage virtualization in the Network.

Text books

1. *U. Troppens, R. Erkens and W. Muller,* ***Storage Networks Explained,*** *John Wiley and Sons, 2003.*
2. *R. Spalding,* ***Storage Networks: The Complete Reference,*** *Tata McGraw Hill, 2003.*

Recommended Learning Resources (Reference books):

1. *R. Barker and P. Massiglia, Storage Area Network Essentials: A Complete Guide to understanding and Implementing SANs, John Wiley India, 2002.*
2. *M. Farley, Storage Networking Fundamentals, Cisco Press, 2005*
3. *IEEE,Introduction to the IEEE Transactions on control of network systems,*
4. *ACM DL, ACM Transactions on Storage (TOS)-ACM*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	3			2			3	3	3	3			
CO2		3	2	2					3	3	3	2		
CO3		3	3			3			3	3	3			
CO4		3							3	3	3			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Write a case study on Utilizing a Community Area Network (CAN) to store and back up patient data efficiently, two hospitals implemented compelling, reliable and cost-effective healthcare IT solutions to enhance patient care
2. Write a case study on how Cisco Migrated to a SAN Environment in Small European Data Center.

3. Citibank's DAS infrastructure couldn't keep pace with its growing customer base. It wanted a platform that would let it reduce cycle time for loan processing and beat the competition in terms of online response times. Write a case study to resolve the issue associated with Citibank.
4. The client required a high availability centralized data storage solution with extensive upgrades to the LAN infrastructure. It also provide minimal single points of failure. List out different storage to solve the above problem.
5. The millions of the thing go wrong while running any technology as the compound storage system have. Categorize the failures type into different categories.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./ Wk.
B19IT7042	Network Programming	SC	4	0	0	0	4	4

Prerequisites

Problem solving with Programming.[B19IT1030], Operating systems [B19IT 4040], Computer Networks [B19IT5010].

Course Description:

This course is focusing on the programming aspects of computer networks. The goal of this course is to understand the current trends of communication protocols, socket programming, interprocess communication, and to understand how network research is done. Further, this course introduces the basics of computer networks, network Security and Internet programming. Students acquire knowledge of client-server architecture and secure network communication.

Course Objectives:

The objectives of this course are to:

1. Illustrate the use of socket programming in a real world application.
2. Explain the features of client and server Architecture required for developing real world applications.
3. Demonstrate the various methods of securing a network application.
4. Discuss the Case Study of Networked Application and Secure Networked Application

Course Outcomes (Cos):

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

CO1: Make use of features of socket programming in a real world application.

CO2: Develop an application using client and server Architecture for a real world application.

CO3: Design a securing a network application for a real world problem.

CO4: Analyze Case Study of Networked Application and Secure Networked Application

Course Content:

UNIT - 1

Networks and Protocols: Circuits vs. Packets, Internetworking, Ethernets, Ethernet Frames, Addressing, Internet Protocol, User Datagram Protocol, Transmission Control Protocol, The Client-Server Model, The Domain Name System, State vs. Stateless, Methods for Maintaining State;

Socket Programming: What Is a Socket, Using Sockets, User Datagram Protocol, File Transfer, and Error Handling.

UNIT - 2

Client-Server Architecture: Client Test Program, Multiplexing, Forking, Multithreading, Combining Preforming and Pre-threading, Method Choosing, Dealing with Large Amounts of Data, Debugging and Development Cycle;

Custom Protocol Implementation: Designing a Custom Protocol, Our Chat Protocol, Protocol Registration, TCP vs. UDP, Application Protocol Choices, Client-Server Architecture, Client-Side Considerations, Server-Side Considerations

UNIT - 3

Securing Network Communication: Tunnelling, Public Key Infrastructure, Secure Network Programming Using OpenSSL, The Old Scenario, The Present-Day Scenario, The PAM Library, Public Key Authentication, Single Sign-on, Common Attacks, Buffer Overflow, Secure Coding, Tools of the Trade

UNIT - 4

Case Study1: A Networked Application: The Server, The Client

Case Study2: A Secure Networked Application: The Necessary Decisions, Code Design and Layout, The Code, Analysis.

Self-Learning Component:

Creating TCP clients, Creating TCP servers, Servers handling multiple clients, Malticast applications.

Text books

1. Keir Davis, John Turner and Nathan Yocom, "The Definitive Guide to Linux Network Programming'', Apress, First edition, 2004.
2. Warren Gay, "Linux Socket Programming by Example", Que, 1st edition, 2000.

Reference books

1. Graham Glass and King abls, "UNIX for Programmers and Users", Pearson Education, 3rd edition, 1998.
2. M. J. Rochkind, "Advanced UNIX Programming", Pearson Education, 2nd edition, 2004.
3. IEEE Transactions on Networking (IEEE TON)
4. ACM Transactions on Networking (ACM TON)

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1					1					2				
CO2					2									
CO3										2				
CO4										3	3			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Design a client-server program in C (internet domain, stream socket) which does the following:
   a. The server starts on a port (given as parameter in the command line).
      a. The client is started (server IP and port are provided in command line).
      b. Client connects to the server and waits for user messages on terminal. User messages are sent to server by the client using the socket created.

c. The server waits for user messages from client. If server receives message "Bye" from client, it replies "Bye". For any other string, server replies the same message but after making it into capital letters.
d. The client is closed, when it gets the message "Bye" from server.

2. By using Java's Remote Method Invocation or CORBA, create an online auction with the following description:

3. People can join the auction, leave the auction, and bid for an item in the auction. The current price of an item gets flashed as soon as anybody bids a valid price for the item. This is similar to the online stock market where the current prices of the shares are flashed as soon as their value changes. You need to create an auction server. The server should support at least the following methods:

a. join auction leave auction bid on an item.

4. You can read the initial list of items and minimum prices from a file or from standard input. When somebody joins the auction, you need to send the items on sale and their current price. Then, you need to create a client, either as an applet, or as an application. The client joins the auction, displays the items for sale along with their current price, and lets the user place a bid for a particular item. Since multiple clients will be bidding at the same time, the methods on the server must be properly synchronized. Whenever any client makes a successful bid, the current price at allthe clients must reflect this change. All the exceptions must be properly handled.

5. Write a Python network server program that will accept an unlimited number of connections, one at a time . Upon receiving a connection, it should send back to the client the client's IP address. Then it should wait for commands from the client. Valid commands are "TIME", "IP" and "EXIT". To the *TIME* command, the server should return the current time. To the *IP*command, it should again return the client's IP address. If the client closes the connection or does not respond with a command in a reasonable time (10 seconds), the server should close the current connectionand wait for another connection. To the *EXIT* command, your server should close all open socketsand exit.

Sample Projects:

1. Client protocol implementation.

The dream global communication is solved in a great deal by the introduction of Internet. This made the necessity of networking in communication clear. The internet protocol TCP/IP uses computers called gateways, which provide all interconnections among physical networks. A gateway is a special purpose, dedicated computer that attaches to two or more networks and routes packets from one to other. It will be having the information regarding the network connected to it. The gateways exchange routing information periodically to accommodate network changes and keeps their route up-to-date. In this context implement the client protocol.

2. Server protocol implementation.

Handle multiple socket connections with threads. A simple server waits for a client to connect and then read a message sent from the client. read() is a blocking function so the server will block until a client writes to it. If we assume two clients are concurrently writing to the server. The server will wake up to one of them but what will happen to the other one? Is the server still "listening" while handling the request from the first client? I know that the bind function takes an int as the second argument that specifies the backlog (5 by default). Does that mean that only 5 clients can connect concurrently to a server? If that’s true, how are servers that handle multiple concurrent connections are implemented?

1. Network Load Balancing has several potential use cases and advantages. By distributing network traffic across multiple servers or virtual machines, traffic can be processed faster than in a scenario in which all traffic flowed through a single server. The feature can also enable an organization to quickly scale up a server application (such as a Web server) by adding hosts and then distributing the application's traffic among the new hosts. Similarly, if demand decreases, servers can be taken offline and the feature will balance traffic among the remaining hosts. Network Load Balancing can also ensure network traffic is re-routed to remaining hosts if one or more hosts within the cluster fail unexpectedly. Implement the Network Load Manager

2. Distributed Applications

ATM withdrawal Internet Banking

Reservation system for train/flight Real time logistic tracking

Implementation of Application Protocols

TELNET FTP

SMTP SNMP

3. IPv6 Networks: As IPv4 has been used for many years and the ISPs are running out of the IP addresses, new and current organizations will have to use the IPv6 networks. So, in this project students have to design and develop the IPv6 networks for medium organizations and deploy IPv6 networks for current organizations that have IPv4 running.

4. A graphical map of the network is the fundamental data used for each node. To produce its map, each node floods the entire network with information about the other nodes it can connect to. Each node then independently assembles this information into a map. Using this map, each router independently determines the least-cost path from itself to every other node using a standard shortest paths algorithm such as Dijkstra's algorithm. The result is a tree graph rooted at the current node, such that the path through the tree from the root to any other node is the least-cost path to that node. This tree then serves to construct the routing table, which specifies the best next hop to get from the current node to any other node. In this context implement the Link-state algorithm.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./Wk.
B19IT7043	**Multimedia Systems**	**SC**	**4**	**0**	**0**	**4**	**4**

Prerequisites:

Computer Networks (B19IT5010), Operating Systems (B19IT4040)

Course Description:

The course includes fundamental concepts of multimedia, Speech, Image and video processing including international standards, Fundamentals of multimedia data compression, standards and synchronization.

Course Objectives:

The objectives of this course are to:

1. Explain various multimedia components
2. Describe the different Lossy and Lossless compression techniques with respect to multimedia data
3. Discuss the different compression techniques for Image and video
4. Illustrate the use of synchronization concepts.

Course Outcomes (COs):

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

CO1. Summarize the working of multimedia components
CO2. Develop applications using Lossy and Lossless compression techniques for multimedia data
CO3. Design the applications using different compression techniques for Image and video
CO4. Analyse the working of synchronization in multimedia data.

Course Content:

UNIT I

Introduction to Multimedia - What is Multimedia?, Multimedia- Past and Present, Multimedia Software Tools- A Quick Scan

Graphics and Image Data Representations - Graphics/Image Data Types, Popular File Formats, Colour Models in Images

UNIT 2

Multimedia Data Compression - Lossless Compression Algorithms, Basics of Information Theory, Run-Length Coding, Dictionary-Based Coding, Arithmetic Coding, Lossless Image Compression.

Lossy Compression Algorithms - Introduction, Distortion Measures, theRate-Distortion Theory, Quantization, Transform Coding.

UNIT 3

Image and Video Compressions - The JPEG Standard, the JPEG2000 Standard, the JPEG-LS Standard, Bi-level Image Compression Standards, Introduction to Video Compression, Video Compression Based on Motion Compensation, H.261, H.263, MPEG-1.

UNIT 4

Synchronization - Defining "Synchronization", Particularities of Synchronization in Multimedia Systems, Requirements to the Presentation, Reference Elements for Synchronization, Synchronization Types, System Components Involved in Synchronization, A Reference Model for Multimedia Synchronization, Synchronization Specification, Specification Methods for Multimedia Synchronization.

Self-Learning Concepts:

Multimedia applications including digital libraries, system software, toolkits, conferencing paradigms, structured interaction support, and examples from video/audio/graphics conferencing.Latest Web technologies, such as XML, X3D and Semantic Web.

Text books

1. *Li, Ze-Nian, Drew, Mark S., Liu, Jiangchuan, "Fundamentals of Multimedia", Springer, 2014.*
2. *Steinmetz, Ralf, Nahrstedt, Klara, "Multimedia Systems" Springer, 2004*

Reference books

1. *Fred Halshall "Multimedia communication - Applications, Networks, Protocols and Standards", Pearson education, 2007.*
2. *R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education. 2008.*
3. *KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007.*
4. *Introduction to Multimedia Networks, Andrew W. Davis*
5. *Rao, Bojkovic, Milovanovic: Introduction to Multimedia Communications, Wiley & Sons, Hoboken, NJ, 2006*
6. *IEEE, IEEE Transactions on Multimedia.*
7. *ACM, ACM Transactions on Multimedia Computing, Communications, and Applications.*
8. *Elsevier, Elsevier Journal on Multimedia Computing.*
9. *Springer, Springer Journals on Communication Networks.*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1				3									2	
CO2													2	3
CO3								3					2	
CO4								3					2	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Sample Assignments:

1. Run-length encoding is a fast and simple method of encoding strings. The basic idea is to represent repeated successive characters as a single count and character. For example, the string "AAAABBBCCDAA" would be encoded as "4A3B2C1D2A".Implement run-length encoding and decoding. You can assume the string to be encoded have no digits and consists solely of alphabetic characters. You can assume the string to be decoded is valid.

2. The Lempel-Ziv-Welch (LZW) algorithm employs an adaptive, dictionary-based compression technique. Determine LZW Compression for String ABABBABCABABBA and write a program to implement LZW algorithm.

3. **Arithmetic coding** allows using "fractional" parts of bits and is Used in PPM, JPEG/MPEG (as option), Bzip. Code the system having five symbols using Arithmetic coding. Write an algorithm to implement this code.

Symbol	Probability	Range
A	0.2	[0, 0.2)
B	0.1	[0.2, 0.3)
C	0.2	[0.3, 0.5)
D	0.05	[0.5, 0.55)
E	0.3	[0.55, 0.85)
F	0.05	[0.85, 0.9)
$	0.1	[0.9, 1.0)

(a)

4. Lossy compression is most commonly used to compress multimedia data (audio, video, and images), especially in applications such as streaming media and internet telephony. Make a survey on recent lossy compression techniques for images.

5. List out the hurdles one can face in a Video conference. Explain how they can be handled ?

Course Code	Course Title	Course Type	Credit Pattern & Credit Value					Hrs/ Wk
B19IT7044	C# and .Net	SC-8	4	0	0	0	4	4

Prerequisites:

problem solving with Programming [B19IT1030] and Object Oriented Programming with Java [B19IT3030].

Course Description:

The course is geared towards providing students with the knowledge and skills they need to develop C# applications. C# is the core language of the Microsoft .NET framework, designed specifically to take advantage of CLI (Common Language Interface) features. The course focuses on C# program structure, language syntax, and implementation details. It is a simple, object-oriented, and type-safe programming language that is based on the C and C++ family of languages.

Course Objectives:

The objectives of the course are to:

1. Discuss Building Blocks of the .NET Platform.

2. Explain the fundamentals of C# language.

3. Demonstrate the use of the Object Oriented Programming features and Interfaces

4. Illustrate the use of exceptions in real world application.

Course Outcomes:

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

1. Identify the basic components of the .NET Framework.
2. Develop application using C# data types.
3. Make use of inheritance, polymorphism and encapsulation.
4. Design a C# program for making use of .NET exception handling mechanisms.

Course Content:

UNIT - 1

Introducing C# and .NET Platform: The Building Block of the .NET Platform (CLR, CTS, andCLS), The Role of the .NET Base Class Libraries, What C# Brings to the Table, An Overview of.NET Binaries (aka Assemblies), the Role of the Common Intermediate Language, The Role of .NET Type Metadata, The Role of the assembly Manifest, Understanding the Common Type System, Intrinsic CTS Data Types, Understanding the Common Languages Specification, Understanding the Common Language Runtime.

UNIT - 2

C# Language Fundamentals : The Anatomy of Basic C# Class, Creating objects: ConstructorBasics, The Composition of a C# application, Default assignment and Variable Scope, The C# Member Initialization Syntax, Basic Input and Output with the Console Class, Understanding Value Types and Reference Types, The Master Node: System.Object, The System Data Types (and C# Aliases), Converting Between Value Types and Reference Types: Boxing and Unboxing, C# Iteration Constructs, C# Controls Flow Constructs, The Complete Set of C# Operators, Defining Custom ClassMethods, Understating Static Methods, Methods Parameter Modifies, Array Manipulation in C#, String Manipulation in C#, C# Enumerations.

UNIT - 3

Object Oriented Programming and Interfaces: Formal definition of a C# class, Definition the"Default Public Interface" of a Type, Recapping the Pillars of OOP, The First Pillars: C#'sEncapsulation Services, Pseudo- Encapsulation: Creating Read-Only Fields. The Second Pillar: C#'sInheritance Supports, keeping Family Secrets: The "Protected" Keyword, Nested Type Definitions, And the Third Pillar: C #'s Polymorphic Support, Casting Between. Defining Interfaces Using C# Invoking Interface Members at the object Level, Exercising the Shapes Hierarchy, Understanding Explicit Interface Implementation. Understanding Callback Interfaces.

UNIT - 4

Exceptions and Interfaces: Ode to Errors, Bugs, and Exceptions, The Role of .NET ExceptionHanding, The System. Exception Base Class, Throwing a Generic Exception, Catching Exception, CLR System – Level Exception (System. System Exception). Custom Application-Level Exception (System. System Exception), Handling Multiple Exception, The Family Block, Understanding object Lifetime.

Self-learning Component:

Basics of Garbage Collection, Finalization a Type, the Finalization Process, Building an Ad Hoc Destruction Method, Garbage Collection Optimizations, the System. GC Type.

Text books

1. *Andrew Troselen; Pro C# with .NET 3.0, Seventh edition, 2007.*
2. *E Balaguruswamy: Programming in C#, 5th reprint, Tata McGraw Hill 2004*

Reference books

1. *Vijay Nicoel, Visual C#.NET, 5th reprint, Tata McGraw Hill 2004*
2. *IEEE Transactions on Computers*
3. *ACM Transactions on Algorithms*

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3						2			3				
CO2	3	3	3				2				3	2		

CO3	3	3	3		2		2				3	2		

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

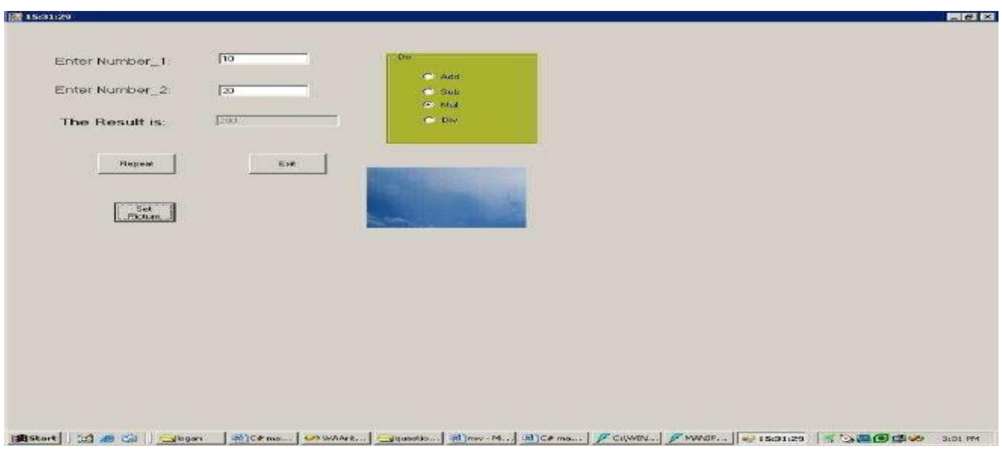
Sample Assignments:

1. REVA Library has essential tasks of book issue and return. The can be automated with help of object oriented programming in C#. Design and develop an objected oriented system to automate the tasks at REVA library.
2. Write a program in C# Sharp to generate all possible permutations of an array using recursion.
3. Write a program in C# Sharp to create a recursive function to calculate the Fibonacci number of a specific term.

Lab Experiments: (Implement following using MATLAB)

1. A student is instructed to build a calculator widget in windows application using C#. This application needs to be designed in the form with buttons and textbox like a calculator.

2. Develop an application for the above (Q.No. 1) concept, but which results as follows.



3. ABC Inc. wants you to design a standalone application using C#.NET, they want a login based access to their forms which have all the validations in place for all controls.

4. XYZ Bank wants to design a web application form having loan amount, interest rate and duration fields. Calculate the simple interest and perform necessary validation.

a. Ensures data has been entered for each field.

b. Checking for non numeric value.

5. For a standard 10th student you are required to design an application to help him with mathematics homework. The application should support mathematical operations, formulas etc.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./Wk.
B19IT7051	Multimedia Computing & Networks	SC	4	0	0	0	4	4

Prerequisites:

Computer networks [B19IT5010] and Operating Systems [B19IT4040]

Course Description:

This Course provides the knowledge of multimedia operating Systems and Quality of Service, compression standards, Network Protocols for multimedia communication and multimedia over wireless networks.

Course Outcomes (Cos):

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

CO 1: Identify requirements and constrainsts for a good Quality of service in multimedia environment.

CO 2: Develop a multimedia buffer management technique.

CO 3: Analyze the performrmance of the protocols used for multimedia networking.

Course Content:

UNIT - 1:

Introduction - Interdisciplinary Aspects of Multimedia, Quality of Service, Multimedia Operating Systems, Multimedia Networking and Communication, Synchronization.

Quality of Service - Requirements and Constraint, Quality of Service Concepts, Resources, Establishment Phase, Run-time Phase of Multimedia Call, QoS Management Architectures.

UNIT - 2:

Multimedia Operating Systems - Process Management, Real-Time Processing Requirements,Traditional Real-Time Scheduling, Real-time Scheduling: System Model, Soft-Real-Time Scheduling Concepts, Scheduling Policies, Prototype Operating Systems, Interposes Communication and Synchronization, Memory Management, Reservation Concept for Memory Management, Buffer Management Techniques, Buffer Management for Client/Server Systems, Device Management, System Architecture.

UNIT - 3:

Network Services and Protocols for Multimedia Communications - Protocol Layers of ComputerCommunication Networks, Local Area Network and Access Networks, Internet Technologies and Protocols, Multicast Extension, Quality-of-Service for Multimedia Communications, Protocols for Multimedia Transmission and Interaction, Case Study: Internet Telephony

UNIT - 4:

Internet Multimedia Content Distribution - Broadcast/Multicast for Heterogeneous Users,Application-Layer Multicast, Peer-to-Peer Video Streaming with Mesh Overlays, HTTP-Based Media Streaming. Multimedia Over Wireless and Mobile Networks - Characteristics of Wireless Channels, Wireless Networking Technologies, Multimedia Over Wireless Channels, Mobility Management.

Self-Learning component:

Social Media Sharing- Representative Social Media Services, User-Generated Media Content Sharing, Media Propagation in Online Social Networks

Text Books:

1. Li, Ze-Nian, Drew, Mark S., Liu, Jiangchuan, “Fundamentals of Multimedia”, Springer, First edition, 2014.
2. Steinmetz, Ralf, Nahrstedt, Klara, “Multimedia Systems” Springer, Second edition, 2004

Reference books:

1. Fred Halshall “Multimedia communication - Applications, Networks, Protocols and Standards”, Pearson education, Second edition, 2007.
2. R. Steimnetz, K. Nahrstedt, “Multimedia Computing, Communications and Applications”, Pearson Education, Sixth edition, 2008.
3. IEEE, IEEE Transactions on Multimedia.
4. ACM, ACM Transactions on Multimedia Computing, Communications, and Applications

5. Elsevier, Elsevier Journal on Multimedia Computing. Springer, Springer Journals on Communication Networks

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO 2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3				2									
CO2	2											2		
CO3			3			3			3					

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignment for Internal Assesment:

1. Given a task set (I1, I2, I3) with period pi and processing time ei for each task: p1 = 3, e1 = 1; p2 = 4, e2 = 1; p3 = 5, e3 = 1. Compare earliest deadline First and Real time monotonic algorithms.
2. In multimedia systems, the notion of Quality of Service (QoS) assumes importance. Multimedia applications have requirement in terms of bandwidth, delay and delay jitter and to specify these requirements, the application uses the notion of QoS. Discuss the various issues and means and mechanism to manage them.

3. The goal of multimedia transport protocols is to transmit multimedia signals from one point to another point. These points are connected by communication network employing specific protocols. Generally, multimedia original signals are encoded to reduce the bit rate. When the encoded stream is to be sent to another location in the network, the transport protocols are responsible for the packetization and the delivery of that stream. Write a note on Multimedia transport protocols.

4. The rapid growth in interactive multimedia applications, such as video telephonies, video games and TV broadcasting have resulted in spectacular strides in the progress of wireless communication systems. The current third generation (3G) wireless systems and the next generation (4G) wireless systems in planning support higher bit rates. However, the high error rates and stringent delay constraints in wireless systems are still significant obstacles for these applications and services. On the other hand, the development of more advanced wireless systems provides opportunities for

proposing novel wireless multimedia protocols and new applications and services that can take the maximum advantage of the systems. Discuss the wireless multimedia protocols in brief.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value				Hrs/ Wk
			L	T	P	C	
B19IT7052	**Data Analytics using R**	**SC**	**4**	**0**	**0**	**4**	**4**

Pre-requisites

Database Management Systems [B19IT4030].

Course Description

This course describes that, Data Analytics is the science of analyzing data to convert information to useful knowledge. This knowledge could help us understand our world better, and in many contexts enable us to make better decisions. While this is broad and grand objective, the last 20 years has seen steeply decreasing costs to gather, store, and process data, creating an even stronger motivation for the use of empirical approaches to problem solving. This course seeks to present you with a wide range of data analytic techniquesand is structured around the broad contours of the different types of data analytics, namely, descriptive, inferential, predictive, and prescriptive analytics

Course Objectives

1. Explain the concepts of big data
2. Describe the different ways of Data Analysis
3. Demonstrate the use of data streams
4. Illustrate how to do mining and clustering

Course Outcomes

On successful completion of this course; the student will be able to:
CO1: Outline use of the concepts of Big Data
CO2: Apply the different ways of data analysis
CO3: Analyze data using Stream data model.
CO4: Design data mining application.

Course Content:

UNIT – 1 INTRODUCTION TO BIG DATA
Introduction to Big Data Platform –Challenges of conventional systems ,Web data ,Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting –Modern data analytic tools,Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT – 2 DATA ANALYSIS

Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics –Rule induction –Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods

UNIT – 3 MINING DATA STREAMS

Introduction to Streams Concepts –Stream data model and architecture –Stream Computing, Sampling data in a stream –Filtering streams –Counting distinct elements in a stream –Estimating moments –Counting oneness in a window –Decaying window –Real-time Analytics Platform(RTAP)applications –case studies –real time sentiment analysis, stock market predictions

UNIT – 4 FREQUENT ITEMSETS AND CLUSTERING

Mining Frequent item sets –Market based model –Apriori Algorithm –Handling large data sets in Main memory –Limited Pass algorithm –Counting frequent item sets in a stream –Clustering Techniques –Hierarchical –K-Means –Clustering high dimensional data –CLIQUE and PROCLUS –Frequent pattern based clustering methods –Clustering in non-Euclidean space –Clustering for streams and Parallelism.

Self-Learning Component:

FRAMEWORKS AND VISUALIZATION- Map Reduce –Hadoop, Hive, MapR –Sharding –NoSQL Databases –S3 –Hadoop Distributed file systems –Visualizations –Visual data analysis techniques, interaction techniques; Systems and applications

Text books

1. *Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.*
2. *Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.*

Reference books

1. *Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.*
2. *Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O" Reilly, 2011.*
3. *Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.*
4. *Springer, International Journal of Data Science and Analytics.*
5. *Elsevier, Computational Statistics & Data Analysis*
6. *IEEE, Transactions on Big Data.*

Mapping Cos With POs (Program Outcomes)

Course Outcomes	Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01
CO1									3			3	
CO2	2			1	3				2			2	
CO3		3											
CO4		3		2					3				

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT7053	Deep Learning	SC -9	4	0	0	0	4	4

Prerequisites:

Machine Learning [B19IT5040]

Course Description:

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 Objectives:

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:

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

CO1: Develop a Mathematical model for a real world application.

CO2: Identify a suitable learning algorithm for the given real world applications.

CO3: Design a deep learning neural network for a real world application.

C03: Apply the deep learning techniques in neural networks and natural language processing

Course Content:

UNIT - 1

Introduction: Applied math and Machine Learning Basics: Linear Algebra-Scalars, 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.

Self-Learning Components:

Linear factor Models, Structured probabilistics Models, Monte-Carlo Methods, Deep generative Modles.

Text Book:

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-Interscience. 2nd Edition. 2001.*
2. *Theodoridis, S. and Koutroumbas, 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.*
4. *Springer Journal of Machine Learning.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	1			1										
CO2	1				2				1	1				
CO3			1	2				2		1				

CO4	3			1	2			2		1	2			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

List of Experiments

1. Write a program to classify movie reviews using IMDB dataset.
2. Write a program to predict house price use Boston Housing Price dataset.
3. Write a program for recommendation system for job recruiting company.
2. Write a program to identify objects in photographs and then generate textual descriptions of those objects, a complex multi-media problem that was previously thought to require large artificial intelligence systems.
3. Learn linear regression from scratch and build a programin Python for data analysis.
4. Build a program in Python for deriving and implementing word2vec,
5. Build a program in Python for GLoVe,
6. Build a program in Python for word embedding.
7. Build a program in Python for sentiment analysis with recursive nets
8. Write a python program to implement Multiclass Classification of Flower Species.
9. Write a python program to implement Binary Classification of Sonar Returns.
10. Write a python program to implement Regression of Boston House Prices.
11. Write a python program to implement Handwritten Digit Recognition.
12. Write a python program to implement Object Recognition in Photographs.
13. Write a python program to implement Predict Sentiment from Movie Reviews.
14. Write a python program to implement Sequence Classification with LSTMs for Movie Reviews.
15. Write a python program to implement Text Generation with Alice in Wonderland.

Sample Assignments:

Implement following using Python:

1. Write a program for face detection and classification using deep learning. Kindly use data set from UCI repository.
2. Write a program for printed document clustering using deep learning.
3. Develop E-mail classification system using deep learning.

Course Code	Course Title	Course Type	Credit Pattern & Credit Value					Hrs/ Wk
			L	T	P	J	C	
B19IT7054	Introduction to Genomic Data Science	SC-9	4	0	0	0	4	4

Prerequisites:

Nil

Course Description:

This is the first course in the Genomic Data Science Specialization. This course introduces to the basic biology of modern genomics and the experimental tools that is used to measure it. Central Dogma of Molecular Biology is introduced and how next-generation sequencing can be used to measure DNA, RNA, andepigenetic patterns is done is covered. An introduction to the key concepts in computing and data science, howdata from next-generation sequencing experiments are generated and analyzed are covered.

Course Objectives:

1. Explain the basic concepts of bioinformatics.
2. Demonstrate the working of the tools for information search and data retrieval.
3. Discuss various Genome Mapping techniques.
4. Describe Gene prediction methods and tools to find gene patterns.

Course Outcomes:

CO1: Summarize the basic concepts of bioinformatics.

CO2: Identify the tools for Information search and data retrieval.

CO3: Analyze Genome Mapping techniques

CO4: Apply various gene prediction. Methods and tools.

Course Content:

UNIT-1:

Bioinformatics: An Introduction
Introduction, Historical Overview and Definition, Bioinformatics Applications, Major Databases in Bioinformatics, Data Management and Analysis, Molecular Biology and Bioinformatics, Central Dogma of Molecular Biology, Biological Databases Considerations.

UNIT-2:

Information Search and Data Retrieval:
Introduction, Electronic Libraries, Tools for Web Search, Data Retrieval Tools, Data Mining of Biological Databases.

UNIT-3:

Genome Analysis and Gene Mapping
Introduction, Genome Analysis, Genome Mapping, The Sequence Assembly problem, Genetic Mapping and Linkage Analysis, Physical Maps, Cloning the entire Genome, Genome Sequencing, Applications of Genetic Maps, Sequence Assembly Tools, Identification of Genes in Contigs, The Human Genome Project.

UNIT 4:

Gene Identification and Prediction

Introduction, Basics of Gene Prediction, Pattern Recognition, Gene Prediction Methods, Other Gene Prediction Tools.

Self-learning component:
Genome data management, sequencing the pairs of genomes, Hidden Markov Models, Phylogenetics.

Text books

1. S.C. Rastogi, N. Mendiratta, P. Rastogi,Bioinformatics Methods and Applications, 4th Edition, EEE, PHI, 2013.
2. Andreas D. Baxevanis, B. F. Francis Ouellette, BIOINFORMATICS A Practical Guide to the Analysis of Genes and Proteins, 2nd Edition, Wiley Interscience, 2001.
3. Lloyd Low, Martti Tammi, Bioinformatics-Practical-Generation-Sequencing-Applications, 2017
4. T. R. Sharma, Genome-Analysis-Bioinformatics-Practical-Approach, I.K. International Publishing House Pvt. Ltd, 2009

Reference books

1. Genomic Data Science | Coursera

2. Introduction to Genomic Data Science | edX

3. Computational Genomics and Data Science Program, National Human Genome Research Institute.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	2			2		3			3					
CO2		3					2				3			
CO3		2	3								3			
CO4			2											

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Assume that you have constructed the BAC contig map shown below. What additional steps would you use to validate the map and do so in a highly efficient manner? (Task based)

.... 29F19

.... 84J03

.... 19B16
.... 65J15

2. List the importance of Shine Dalgarno in gene identification. (Assignment)
3. Write notes on Chou-Fasman rules and their implications. (Assignment)

Sample Mini Projects:

1. Using the Entrez microbial genomes tables, you are interested in studying things that grow at very high temperatures(Hyperthermophilic).
a) Is the genome of*Carboxydothermushydrogenoformans Z-2901* completely sequenced?
b) What toxic substance does this organism use as its carbon source?
c) How many protein genes are there in this genome?
d) What is the optimal growth temperature for this organism?
e) What domain of life does it belongs to?

2. Design a dynamic programming table for determining the optimum global alignment between sequences ACTG and CGGA. Assume that a match is scored +3 and that mismatches and spaces are scored -1 each. Calculate the optimum alignment corresponding to the table in part and its score.

3. Compare MUSCLE and ProbCons tools for MSA.

4. Hypothetical organism X has the following DNA sequence. Part of the promoter is indicated by the sequence indicated in **bold**. Transcription starts at the non-bold A/T base pair.
xxxx**TATTTGATAG CTCT**ATGCAT GCATGGGTCC TGAAGTTCAG ATCTTTGAGT CATAGGAGTC 3
xxxx**ATAAACTATC GAGA**TACGTA CGTACCCAGG ACTTCAAGTC TAGAAACTCA GTATCCTCAG 5

5. The following Markov chain model governs the intracellular (I) and extracellular (E) placement of amino acids residues in transmembrane proteins.
Transition Probabilities

	E	I
E	0.7	0.3
I	0.2	0.8

Emission Probabilities

E		I	
L	0.00	L	0.45
V	0.16	V	0.25
D	0.50	D	0.25
K	0.34	K	0.05

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT7080	Project Work and Dissertation Phase - I	HC	0	0	0	1	1	2

EIGHTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT8031	Software Defined Networks and Network Function Virtualization	SC - 10	4	0	0	0	4	4

Prerequisites

Computer Networks (B19IT5010)

Course Description:

The course introduces the concepts of Software Defined Networks, how SDN works and SDN in other environments. It also describes OpenFlow which is used for open network switching experiments. The last section covers Network Function Virtualization, its architecture and some of the research challenges in the design of NFV.

Course Objectives:

The objectives of this course are to:

1. Explain the basic packet switching terminology , Software defined networks
2. Describe how SDN will work, its fundamental characteristics and operation
3. Demonstrate the use of openflow in real world.
4. Discuss the history of network function virtualization.

Course Outcomes:

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

CO1: Outline the significance of SDN.
CO2: Analyse the functions of different types of software defined networks.
CO3: Make use of Openflow additions in a real world application
CO4: Develop a virtual environment to provide various services to users

Course Content:

UNIT - 1:
Software Defined Networks – Introduction: Basic Packet-Switching Terminology, Historical Background. The Modern Data Centre, Traditional Switch Architecture, Autonomous and Dynamic Forwarding Tables, Can We Increase the Packet-Forwarding IQ?
Why SDN? : Evolution of Switches and Control Planes, Cost, SDN Implications for Research and Innovation, Data Centre Innovation, Data Centre Needs.
The Genesis of SDN: The Evolution of Networking Technology, Forerunners of SDN, Software Defined Networking is Born, Sustaining SDN Interoperability, Open Source Contributions, Legacy Mechanisms Evolve toward SDN, Network Virtualization.

UNIT - 2:
How SDN Works: Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods and Conclusion.

SDN in Other Environments: Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, In-Line Network Functions, Optical Networks, SDN vs. P2P/Overlay Networks and Conclusion.

UNIT - 3:

The OpenFlow Specification: Chapter-Specific Terminology, OpenFlow Overview, OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 Additions, OpenFlow 1.2 Additions, OpenFlow 1.3 Additions, OpenFlow Limitations and Conclusion.

UNIT - 4:

Network Function Virtualization: Introduction, History of Network Function Virtualization, NFV Examples and Related Work and Open Questions.

NFV Architecture: NFV Infrastructure (NFVI), Virtual Network Functions and Services, NFV Management and Orchestration (NFV MANO).

Business Model And Design Considerations: Business Model, NFV Design Considerations, NFV, SDN and Cloud Computing, NFV Standardization Activities, Collaborative NFV Projects, NFV Implementations.

Research Challenges: Management and Orchestration, Energy Efficiency, NFV Performance, Resource Allocation, Security, Privacy and Trust Modelling of Resources, Functions and Services and Research Directions in Selected NFV Use Cases.

Self-learning Components:

Explore SDN in the data centre and also SDN applications.

Text books

1.Paul Göransson, Chuck Black, "Software Defined Networks - A Comprehensive Approach", Morgan Kaufmann, 2014.

2.Rashid Mijumbi, Joan Serrat, Juan-Luis Gorricho, Niels Bouten, Filip De Turck, Raouf Boutaba, "Network Function Virtualization: State-of-the-art and Research Challenges", IEEE COMMUNICATIONS SURVEYS & TUTORIALS, 2015.

Reference books

1. SiamakAzodolmolky, "Software Defined Networking with OpenFlow", Packt Publishing Ltd, 2013.

2. Sreenivas Voruganti, Sriram Subramanian,"Software Defined Networking with OpenStack", Packt Publishing Ltd, 2016.

3. Jim Doherty, "SDN and NFV Simplified", Pearson Education, 2016.

4. Doug Marschke, Jeff Doyle, Pete Moyer, "Software Defined Networking: Anatomy of OpenFlow", Lulu Publishing services, 2015

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3							2						
CO2		2							3					
CO3		2									3			
CO4	2	2												

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

1. Implement a control application for a software defined network-
   (SDN). A layer-3 routing application will install rules in SDN switches to forward traffic to hosts using the shortest, valid path through the network.

2. Implement a control application for a software defined network-A distributed load balancer application that will redirect new TCP connections to hosts in a round-robin order.
3. Implement a control application for a software defined network-A distributed load balancer application that will redirect new TCP connections to hosts in a FCFS order.
4. <u>How to reduce the forwarding delay from Openflow switch to controller in SDN?</u>
5. Shiva would like to get a topology information among openflow switches which are controlled by ryu. Please suggest a method for Shiva to listen to the network..

Course Code	Course Title	Course Type	Credit Pattern & Credit Value					Hrs/ Wk
B19IT8032	**Augmented and Virtual Reality**	**SC-10**	**4**	**0**	**0**	**4**		**4**

Prerequisites:

Problem Solving with Programming (C/C++)-[B19IT1030], Data Structures-[B19IT3040], Computer Graphics and Animation-[B19IT6063]

Course Description:

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 Objectives:

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:

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

CO1: Summarize the fundamentals of Augmented Reality and Virtual Reality.
CO2: Applymultimodal user interaction and perceptiontechniques involved in Virtual Reality.
CO3:Design different objects using Simulation and Interactive techniques for real world applications.
CO4: Develop innovative Virtual Reality solutions for industrial and Social relevant applications.

Course Content:

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.

Self-learning component:
UNITy 3D, Manus 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.*
4. *International Journal of Virtual and Augmented Reality (IJVAR).*
5. *Springer, Virtual Reality.*

Mapping COs with POs (Program outcomes):

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3									3			2	
CO2	3	3	3		3					3				
CO3	3	3	3		3					3	2		3	
CO4	3									3	2		2	3

where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments:

5. Build a Virtual Reality application for the promotion of a tourist destination of your choice. This could be an application providing information about a particular destination, providing 360-degree pictures and videos of the location.
   The user should be able to navigate scene-by-scene through the destination that you have built the tour for.

6. Build an Augmented Reality application for making your syllabus topics interactive and fun to learn. This could be an application providing information about particular topics or subject.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs./Wk.
B19IT8033	**Natural Language Processing**	SC-12	4	0	0	0	4	4

Prerequisites:

Finite Automata and Formal Language [B19IT6041] and Artificial Intelligence [B19IT7063].

Course Description

The course provides the basics of Natural-language processing (NLP), which is an area of computer science and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to fruitfully process large amounts of natural language data. Natural language processing (NLP) is the ability of a computer program to understand human language as it is spoken. NLP is a component of artificial intelligence (AI). Challenges in natural-language processing frequently involve speech recognition, natural-language understanding, and natural-language generation.

Course Objectives:

The objectives of this courses are to:

1. Explain the different linguistic components in a given sentence.

2. Describe the features of automatic Speech Recognition.

3. Demonstrate the design of a parse tree using context free grammar for a given sentence.

4. Illustrate the semantic and pragmatic interpretation.

Course Outcomes

Upon completion of this course, the student should be able to:

CO1: Identify the different linguistic components in a given sentence.

CO2: Develop a program for implementing automatic Speech Recognition.

CO3: Create a parse tree using context free grammar for a given sentence.

CO4: Apply the semantic and pragmatic interpretation.

Course Content:

UNIT - 1:

Morphology and part-of speech processing: Introduction –Regular Expressions and Automata- Non-Deterministic FSAs. Tranducers –English Morphology - Finite-State Morphological Parsing - Porter Stemmer - Tokenization- Detection and Correction of Spelling Errors. N-grams – Perplexity - Smoothing - Interpolation - Backoff. Part-of- Speech Tagging – English Word Classes - Tagsets - Rule-Based - HMM - Transformation-Based Tagging - Evaluation and Error Analysis.

UNIT - 2:

Speech processing: Phonetics – Articulatory Phonetics - Phonological Categories - AcousticPhonetics and Signals - Speech Synthesis – Text Normalization – Phonetic and Acoustic Analysis - Diphone Waveform synthesis – Evaluation- Automatic Speech Recognition –Architecture - MFCC vectors - Acoustic Likelihood Computation - Evaluation. Triphones – Discriminative Training - Modeling Variation. Computational Phonology-Finite-State Phonology.

UNIT - 3:

Syntax analysis : Formal Grammars of English – Constituency - Context-Free Grammars –GrammarRules – Treebanks - Finite-State and Context-Free Grammars - Dependency Grammars. Syntactic Parsing – Parsing as Search - Ambiguity - Dynamic Programming Parsing Methods –CKY- Earley and Chart Parsing- Partial Parsing-Evaluation. Statistical Parsing – Probabilistic Context-Free Grammars – Probabilistic CKY Parsing of PCFGs –Probabilistic Lexicalized CFGs –Collins Parser. Language and Complexity

UNIT - 4:

Semantic and pragmatic interpretation : Representation of Meaning – Desirable Properties -Computational Semantics -Word Senses - Relations Between Senses – WorldNet - Event Participants-Proposition Bank -Frame Net -– Metaphor. Computational Lexical Semantics – Word Sense Disambiguation.

Applications: Information Extraction – Named Entity Recognition - Relation Detection and Classification – Temporal and Event Processing - Template-Filling, Properties of Human Conversations - Basic Dialogue Systems - VoiceXML - Information- State and Dialogue Acts, Machine Translation –Issues in Machine Translation - Classical MT and the Vauquois Triangle - Statistical MT - Phrase-Based Translation Model.

Self-learning Components:

Syllabification - Learning Phonology and Morphology, Summarization - Single and Multi-Document Summarization - Focused Summarization - Evaluation. Dialog and Conversational Agents, Alignment in MT – IBM Models –Evaluation

Text books:

1. *Jurafsky and Martin, "Speech and Language Processing", Pearson Prentice Hall, Second Edition, 2008.*
2. *Christopher D. Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing", MIT Press, First edition, 1999.*

Reference books:

1. *Stevan Bird, "Natural Language Processing with Python", Shroff, 2009. 4. James Allen, "Natural Language Understanding", Addison Wesley, Second Edition, 2007.*
2. *Nitin Indurkhya, Fred J. Damerau, "Handbook of Natural Language Processing", (Chapman & Hall/CRC Machine Learning & Pattern Recognition), Second Edition, 2010.*
3. *Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, Second edition, 2012.*
4. *IEEE/ACM Transactions on Audio, Speech, and Language Processing.*
5. *Elsevier Journal of Computer Speech and Language.*

6. *Springer Journal of Natural Language Processing.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01
CO1		2	3					1	2	2	2		
CO2					1				1	1			
CO3					1					1		2	
CO4			1							2			

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments for Internal Assessment:

1. Indexes are a common way to access the words of a text, or, more generally, the elements of any list. Develop a program to determine the topic of an article or a book
2. Some of the methods we used to access the elements of a list also work with individual words, or strings. Develop a program to decide if an email is spam or not
3. A collocation is a sequence of words that occur together unusually often. Thus *red wine* is a collocation, whereas *the wine* is not. A characteristic of collocations is that they are resistant to substitution with words that have similar senses. Develop a program to determine who wrote a text
4. Most programming languages permit us to execute a block of code when a conditional Expression. Write a program to determine the meaning of a word in a particular context
5. Read in the texts of the State of the Union addresses, using the state_union corpus reader. Write a program to Count occurrences of men, women, and people in each document.
6. Create a variable phrase containing a list of words. Develop a program with the operations addition, multiplication, indexing, slicing, and sorting.
7. Write a function to process a large text and plot word frequency against word rank using pylab.plot. Do you confirm Zipf's law? (Hint: it helps to use a logarithmic scale.) What is going on at the extreme ends of the plotted line?
8. Generate random text, e.g., using random. Choice ("abcdefg "), taking care to include the space character. You will need to import random first. Use the string concatenation operator to accumulate characters into a (very) long string. Then tokenize this string, generate the Zipf plot as before, and compare the two plots. What do you make of Zipf's Law in the light of this?

9. Non-deterministic search using simulated annealing: Begin searching with phrase segmentations only; randomly perturb the zeros and ones proportional to the "temperature"; with each iteration the temperature is lowered and the perturbation of boundaries is reduced.
10. Save some text into a file corpus.txt. Define a function load(f) that reads from the file named in its sole argument, and returns a string containing the text of the file.

a. Use nltk.regexp_tokenize() to create a tokenizer that tokenizes the various kinds of punctuation in this text. Use one multiline regular expression inline comments, using the verbose flag (?x).

b. Use nltk.regexp_tokenize() to create a tokenizer that tokenizes the following kinds of expressions: monetary amounts; dates; names of people and organizations.

Course Code	Course Title	Course Type	L	T	P	J	C	Hrs/ Wk
B19IT8034	**Human Computer Interaction**	**SC-12**	**4**	**0**	**0**	**0**	**4**	**4**

Prerequisites:

Object oriented Programming with Java [B19IT3030], Computer Graphics and Animation [B19IT6063]

Course Description:

This course presents the foundations of Human Computer Interaction (HCI). The contents are structured into phases comprising: Basic definitions and motivations of HCI, interaction paradigms, design principles and models, User-centred design methods comprising user studies, design approaches for interfaces and interaction, evaluation methods and techniques for data analysis, Research frontiers of HCI, including accessibility, universal design, and pervasive computing (ubiquitous, mobile and wearable computing).

Course Objectives:

The overall objective of the Course is as follows:

1. Explain the capabilities of both humans and computers from the viewpoint of human information processing.

2. Describe typical human–computer interaction (HCI) models and styles, as well as various HCI paradigms.

3. Demonstrate the use of an interactive design process and universal design principles in designing HCI systems.

4. Illustrate the use of different evaluation methods.

Course Outcomes (Cos):

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

CO1: Identify the suitable positioning and pointing device to be used for a given application.

CO2: Select an effective style for a specific application

CO3: Make use of UI design rules to develop a user interface for a real world applicaiton.

CO4: Analyse the different evaluation techniques used to measure the quality of User Interface.

Course Content:

UNIT- 1

Introduction to Human and the Computer: Human: Input–output channels, Human memory,

Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems. The computer: Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning, Memory, Processing and networks.

UNIT -2

The interaction and Paradigms: Models of interaction, Frameworks and HCI, Ergonomics,Interaction styles, Elements of the WIMP interface, Interactivity, The context of the interaction. Paradigms: Paradigms for interaction. Interaction design basics: The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping.

UNIT- 3

HCI in the software process and Design rules: The software life cycle, Usability engineering,Iterative design and prototyping. Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns. Universal designs.

UNIT- 4

Evaluation techniques: Goals of evaluation, Evaluation through expert analysis, Evaluation throughuser participation, choosing an evaluation method.

Self-learning component:

Designing user support systems, Ubiquitous computing applications research, Hypertext, multimedia and the World Wide Web.

Text books:

1. *Alan Dix, Janet Finlay, Gregory Abowd & Russell Beale, Human-Computer Interaction. 3rd Edition. Prentice Hall, 2004.*

2. *Julie A. Jacko, Human-Computer Interaction Handbook, 3rd Edition, CRC Press, 2012.*

3. *Ben Shneiderman, Catherine Plaisant, Designing the User Interface, 6th Edition, Addison Wesley, 2017.*

Reference books

1. *Jonathan Lazar, Jinjuan Heidi Feng, & Harry Hochheiser Research Methods in Human-Computer Interaction, Wiley, Second edition, 2010.*
2. *ACM, International Journal of Human-Computer Studies.*
3. *IEEE, Transactions on Human-Machine Systems.*
4. *Elsevier, International Journal of Human-Computer Studies.*

Mapping COs with POs (Program outcomes)

Course Outcomes	**Program Outcomes**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3			1	2			1			3	3	3	3
CO2								2				2		1
CO3		2	2					1			3	3	3	3
CO4	1	3	3	2	2			1			3	3	3	3

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Sample Assignments for Internal Assessment:

1. Perform User Needs Analysis on any Interactive Website.
2. Implement different Mockups.
3. Illustrate parameter-based Analytical Evaluation of Interactive Websites.
4. Demonstrate Prototype Evaluation.
5. The so-called "Internet of things" (IoT) has led to increasing consideration of how technology can be embedded in our homes and automate them, creating "Smart Homes". Commercial products such as `app'-controlled lights, or internet connected thermostats to control temperature, have been developed. Discuss the positive and negative aspects of such technologies. What are their failings or limitations, and what are the ethical issues in connected homes?

6. Pokemon GO is a game that uses augmented reality to allow players to move through the environment and “catch” virtual Pokemon with their mobile phone. But why is it so popular? What ethical issues have been illustrated by encouraging people to capture Pokemon? What opportunities does this present to benefit society at large, or tackle real world problems?
7. Increasingly we are moving to a “cashless” society, using bank and credit cards and other services, such as Apple Pay (http://www.apple.com/apple-pay/) to buy goods and services instead of paper notes and coins. However, so far we have not removed cash as a payment option of last resort. What are the implications if this happens? Who will this affect, and in what way? What are the positive and negative impacts? How might negative impacts be addressed?

Sample Projects:

1. Personal information management, or life histories:

A growing problem with modern proliferation of devices is keeping track of documents, photos, music, email, web favourites, calendars/schedules, blogs, etc. As people store more and more information on their computers and across multiple electronic devices, tools such as Windows explorer and the desktop are rapidly becoming unusable. How can we design better alternatives to these tools that will help people save, track, find, remember, and reuse their personal information more efficiently? Consider possible targeted user groups or data types, such as personal digital photo collections, email, calendars/schedules, or newsgroups.

And interesting related problem is the notion of personal life histories. Imagine if your entire life was continually captured in electronic form, including continuous video/audio, communications, documents, etc. What new kinds of scenarios could this afford? How would people use this to find their lost keys, share experiences, manage their productivity, or any such a thing?

2. Visualizing inter-personal communications:

Continuous inter-personal communications are becoming central to the lives of younger generations. While it is useful to maintain contact with colleagues, friends, relatives for personal or work-related activities, it can also lead to overwhelming inundation of email, voicemail,instant messages, etc. Bogus communications (spam) is making the process even more tiring. Additional forms of communication, such as phone messaging, snail mail, instant messaging, web forums, and other devices, only add to the confusion. Maintaining multiple asynchronous conversions with many different people over long periods of time can overwhelm a person’s memory capacity.

How can we design better user interfaces that will help people communicate effectively, manage communication overload, track conversation history, find previous communications, and locate other people?

3. Intelligence analysis:

Government intelligence analysts must sift through massive amounts of information to 'connect the dots' and catch terrorists, such as with the recent London arrests. Generally they receive tons of snippets such as police reports, news items, telephone intercepts, emails, etc, that they must piece together to infer terrorist social networks, communication patterns, money flow, and the who/what/when/where of potential terror attacks.

4. High-resolution office:

Imagine the office (or dorm room) of the future, which is completely coated in high-resolution display. How can people's lives be improved? What problems do people have with current limited display capability? How can such a future environment offer a new 'desktop'? How will windows, attention, notifications, tasks, personal information, etc., be managed on such a large detailed display? For examples, see the GigaPixel Display.

5. Student recruiting information management:

Academic departments have difficulty maintaining information about its students and new recruits (typically potential graduate students). New solutions are needed that enable new recruits to express interest, faculty to maintain contact with recruits and share information with each other about recruits, and for students and faculty to manage students' academic experience while a and evaluate overall performance. Potential users arefaculty, admissions personnel, graduate applicants, and students.

6. Visualizing bioinformatics stories:

Biologists are attempting to reverse engineer the biological processes of living organisms. The goal is to learn how the genes, encoded in the DNA, react to stimuli and interact with other biomolecules to cause the behaviour of an organism. For example, by what process do Pine trees respond to and survive drought conditions? Potentially, this information could be used to cultivate more hearty trees. Biologists pursue answers to these questions by performing controlled scientific experiments on the organisms and genes. They must integrate and make sense of a variety of different types of information to attempt to derive answers.

7. The HCI of computer security:

With the waves of malicious attacks by hackers, viruses, and worms, keeping a networked computer system secure is a challenging task. Automated tools can detect obvious known intrusions, but vigilance by the computer user or administrator is the only defence against the rest. System hardening can prevent intrusions (e.g. unplugging the system!), but can also render the system unusable by its users. Enabling useful features for the user (such as file sharing), also opens holes for attack. Hence, users must monitor their system closely to ward off intruders. Methods for monitoring system events, running processes, open ports, incoming and outgoing packets, communications between processes, user status, etc., are needed to enable more secure systems and greater levels of trust.

How can users or administrators maintain a close watch over the internals of their system or entire sub-network? Can visualization be used to monitor this diverse array of information? How can these tools be designed to enable users to maintain alertness while working on other tasks without overly disrupting their work? How can the tools support in depth analysis of potential intrusions?

8. Digital Library for InfoVis Demos:

The following resource provides researchers, students, and practitioners of visualization with convenient access to interesting visualization demonstration software. These demos are useful for communicating new visualization design ideas for many different kinds of data. However, the current static page is difficult to maintain, out of date, and limited in scalability. A better approach is needed that will enable researchers and developers to submit, share, browse, search, and download software demos. This can become a Digital Library for Information Visualization Demos.

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:

- Willingness to learn
- Self motivation
- Team work
- Communication skills and application of these skills to real scenarios
- Requirement of gathering, design and analysis, development and testing skills
- Analytical and Technical skills
- Computer skills
- Internet searching skills
- Information consolidation and presentation skills
- Role play
- 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 Electronics and Communication Engineering is efficient leaders of repute, who can deal the real time problems with 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, leadership, and strategic management 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 Electronics and Communication Engineering 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 recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established 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 various skill/certification programs identified are as follows:

- Big-data and Cloud Computing, Internet of Things (IOT), Xilinx, NS-2, Cadence, ANSYS, Advanced C C++ and Internals of LINUX/UNIX
- Red-Hat certified programs on LINUX
- Management related programs like SAP, ERP and Business Analytics.
- Open Source software/hardware, Software Testing
- Advanced networking based CISCO / Microsoft technology.
- Web designing, System administration,
- IBM certified programs.

The University has 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.

LIST OF FACULTY MEMBERS

Sl.No	Name of the Faculty	Designation	Email ID
1	Dr. SunilKumar S. Manvi	Director	ssmanvi@reva.edu.in
2	Dr. Mallikarjuna Shastry	Professor	mallikarjunashastry@reva.edu.in
3	Dr. KiranKumari Patil	Professor	kirankumari@reva.edu.in
4	Dr. Mallikarjun M. Kodabagi	Professor	mallikarjunmk@reva.edu.in
5	Dr. Vishwanath R. Hulipalled	Professor	vishwanath.rh@reva.edu.in
6	Dr. P. V. Bhaskar Reddy	Professor	bhaskarreddy.pv@reva.edu.in
7	Dr. Ashwinkumar U. M.	Associate Professor	ashwinkumarum@reva.edu.in
8	Dr. Udaya Rani	Associate Professor	udayaraniv@reva.edu.in
9	Dr. M. Prabhakar	Associate Professor	prabhakar.m@reva.edu.in
10	Dr. Gopal Kirshna Shyam	Associate Professor	gopalkrishnashyam@reva.edu.in
11	Sathish G. C.	Associate Professor	sathish_gc@reva.edu.in
12	(Dr.) Venkatesh Prasad	Associate Professor	venkateshprasad@revainstitution.org
13	Mallikarjuna M.	Associate Professor	mallikarjunam@reva.edu.in
14	(Dr.) Meenakshi Sundaram A.	Associate Professor	meenakshisa@reva.edu.in
15	(Dr.) Laxmi B. Rananavare	Associate Professor	laxmibrananavare@reva.edu.in
16	Ananda Shankara A.	Associate Professor	anandshankar@reva.edu.in
17	(Dr.) Nirmala S Guptha	Associate Professor	nirmalaguptha@reva.edu.in
18	Akram Pasha	Associate Professor	akrampasha@reva.edu.in
19	(Dr.) Shantala Devi Patil	Assistant Professor	shantaladevipatil@reva.edu.in
20	Manjunath P.C.	Assistant Professor	manjunathpc@reva.edu.in
21	Kanaiya V. Kanzaria	Assistant Professor	kanaiyavk@reva.edu.in
22	(Dr.) Mylarareddy	Assistant Professor	mylarareddy@revainstitution.org
23	Sarvamangala D. R.	Assistant Professor	sarvamangaladr@revaedu.in

24	Vani K.	Assistant Professor	vanikrishnas@reva.edu.in
25	Ravishankar H.	Assistant Professor	ravishankar.h@reva.edu.in
26	Lithin K.	Assistant Professor	lithink@reva.edu.in
27	Priyanka Bhatri	Assistant Professor	priyankabharti@reva.edu.in
28	Pavithra P.	Assistant Professor	pavithra.p@revainstitution.org
29	Anilkumar Ambore	Assistant Professor	anilambore@reva.edu.in
30	Lalitha L. A.	Assistant Professor	lalitha@revainstitution.org
31	Rashmi C.	Assistant Professor	rashmic@revainstitution.org
32	Anooja Ali	Assistant Professor	anoojaali@revainstitution.org
33	Ranjitha U. N.	Assistant Professor	ranjitha.un@revainstitution.org
34	Sailaja Thota	Assistant Professor	sailajathota@revainstitution.org
35	Tanuja K.	Assistant Professor	tanuja@revainstitution.org
36	Shashikala	Assistant Professor	shashikalan@reva.edu.in
37	Sushma Ravindra Y.	Assistant Professor	sushmaravindray@reva.edu.in
38	Shilpa N. R.	Assistant Professor	shilpanr@reva.edu.in
39	K. Anitha	Assistant Professor	anitha@revainstitution.org
40	Ambika B. J.	Assistant Professor	ambikabj@revainstitution.org
41	Shruthi G.	Assistant Professor	shruthig@revainstitution.org
42	Sheelavathy K. V.	Assistant Professor	sheelakv@reva.edu.in
43	Sujatha K.	Assistant Professor	sujathak@reva.edu.in
44	Archana B.	Assistant Professor	archanab@reva.edu.in
45	Supreeth S.	Assistant Professor	supreeth.s@reva.edu.in
46	Kiran M.	Assistant Professor	kiranm@reva.edu.in
47	Shilpa K. A.	Assistant Professor	shilpaka@reva.edu.in

48	VinayKumar M.	Assistant Professor	vinaykumarm@reva.edu.in
49	Naveen Chandra Gowda	Assistant Professor	naveenchandrag@reva.edu.in
50	Geetha B.	Assistant Professor	geetha.b@reva.edu.in
51	Thirumagal E.	Assistant Professor	thirumagal.e@reva.edu.in
52	Shalini Tiwari	Assistant Professor	shalinitiwari@reva.edu.in
53	Bindushree D. C.	Assistant Professor	bindushreedc@reva.edu.in
54	Shivakumar R. Naik	Assistant Professor	shivakumarnaik@reva.edu.in
55	Priyadarshini R.	Assistant Professor	priyadarshinir@reva.edu.in
56	Asha K.	Assistant Professor	asha.k@reva.edu.in
57	Laxmi Jayannavar	Assistant Professor	laxmijayannavar@reva.edu.in
58	Raghavendra Reddy	Assistant Professor	raghavendrareddy@reva.edu.in
59	Raghavendra Nayaka P.	Assistant Professor	raghavendranayak@reva.edu.in
60	Sowmya Sundari L. K.	Assistant Professor	sowmyasundarilk@reva.edu.in
61	Shilpa V.	Assistant Professor	shilpa.v@reva.edu.in
62	Asharani V.	Assistant Professor	asharani.v@reva.edu.in
63	Keerti M. Hiremath	Assistant Professor	keerti.h@reva.edu.in
64	Chaithra M. H.	Assistant Professor	chaithra.mh@reva.edu.in
65	Jyoti Kiran Mirji	Assistant Professor	jyotimirji@reva.edu.in
66	Gopinath R.	Assistant Professor	gopinath.r@reva.edu.n
67	Nikhil S. Tengli	Assistant Professor	nikhil.tengli@reva.edu.in
68	Nimrita Koul	Assistant Professor	nimritakoul@reva.edu.in
69	A. Ajil	Assistant Professor	ajil.a@reva.edu.in
70	Surendra Babu K. N.	Assistant Professor	surendrababukn@reva.edu.in
71	Ila Chandrakar	Assistant Professor	ilachandrakar@reva.edu.in

72	Aruna Kumar B.	Assistant Professor	arunakumar.b@reva.edu.in
73	Rathan	Assistant Professor	rathan.m@reva.edu.in
74	Surekha Thota	Assistant Professor	surekha.thota@reva.edu.in
75	Chaithra N.	Assistant Professor	chaithra.n@reva.edu.in
76	Manju More E.	Assistant Professor	manjumore.e@reva.edu.in
77	Chaitra B.	Assistant Professor	chaitra.b@reva.edu.in
78	Basavaraj S. H.	Assistant Professor	basavarajshadimani@reva.edu.in
79	Spoorthi Rakesh	Assistant Professor	spoorthirakesh@reva.edu.in

Registrar
REVA University
Bengaluru - 560 064

OUR 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.

OUR MISSION

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

   and moral values;

BROAD OBJECTIVES

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

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university
2. Be regular and punctual to classes
3. Study regularly and submit assignments on time
4. Be respectful to your Teaches/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop andother valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammUNIT - ion etc.
5. Smoking and keeping any kind of such items.
6. Misusing college & hostel premises/facilities for activities other than studies.
7. Playing loud music in the room which may disturb studies of colleagues / neighbours.
8. Making noise and raising slogans.
9. Keeping electrical appliances, other than authorized ones.
10. Involvement in politics, ethnic, sectarian and other undesirable activities.
11. Proxy in any manner.
12. Use of mobiles in the academic areas.

Note: 1. Rules are revised / reviewed as and when required.
2. Healthy suggestions are welcome for betterment of Institution

10 YEARS OF UNIVERSITY RECOGNITION
20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY
Bengaluru, India

School of Aíchitectuíe

Handbook 2019-24

Registrar
REVA University
Bengaluru - 560 064

Rukmini Knowledge Park, Kattigenahalli Yelahanka, Bangalore 560064

- +91- 90211 90211 /080-46966966
- info@ieva.edu.in

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 onsoft-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!

Welcome to the portals of REVA University!

Dr. S. Y. Kulkarni

Vice-Chancellor, REVA University

Director’s Message

“A great building must begin with the immeasurable, must go through measurable means when it is being designed, and in the end must be unmeasured”. – Louis Kahn

“Architecture is bound to situation. In a strange way, architecture is really an unfinished thing, because even though the building is finished, it takes on a new life. It becomes part of a new dynamic: how people will occupy it, use it, think about it.” - Daniel Libeskind.

Above two quotes call for greater ability to analyze, synthesize and evaluate building design factors in order to produce efficient and effective architectural design solutions which satisfy performance, production and procurement criteria.

Architecture can be described as the design of the built and unbuilt spaces. The design projects range in size and complexity from small alterations for a single house to large, multi-level commercial, industrial or public buildings and building complexes or even parts of cities. Architects will have to work in groups bringing together experts with different skills and thereby the project undertaken gains greater success as each one would concentrate on those aspects in which he/ she is best. However, this requires team spirit, coordination and cooperative work culture.

The B. Arch program in REVA University is designed keeping in view the current situation highlighted above and possible future developments, both at national and global levels. The Scheme of Instruction and Curriculum is prepared by the Board of Studies consisting of notable architects, designers and scholars in the field and allied fields. Greater emphasis is laid on studio practice, field study and tutorials. The B Arch program of the university intends to teach students apart from the regular curriculum through skill development activities, workshops, seminars, conferences on various streams of Architecture. Students willhave access to electives drawn from different disciplines like Internet & Computing, Robotics, digital design,sustainability and urban design. Students will be given an exposure to the areas of building materials, photography, painting, sculpture, public art and more. The program aims to improve student’s aesthetic judgments and facilitate with exposure to a wide range of techniques and media.

The Architecture program offers wide range of learning methods. The students choosing B.Arch. program will enjoy their learning, update themselves in required skill, the student-centered teaching learning, ambience, hands-on experience helps to develop their personality to become successful professionals.

The curriculum caters to and has relevance to local, regional, and national, global development needs.

Maximum number of courses are integrated with cross cutting issues relevant to professional ethics, gender, human values, environment & sustainability.

Dr. Vimala Swamy
Director
School of Architecture

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 ofresearch 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.

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 recognised 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 NarayanaMurthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Memberof 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 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.

REVA organises 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 won medals and prizes in academic, cultural and sports activities are also recognised 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'severyday 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

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 ARCHITECTURE

The School of Architecture has highly experienced faculty members specialized in Architecture and allied fields and supported by well experienced architects as visiting faculty members. The school has the state-of-the-art class rooms and well-equipped laboratories, drawing and seminar halls, museum space and construction yard. Supported by DivyaSree a noted Infrastructure Development Group, there are lot of opportunities for students to visit, to study, to share and experience on site teaching - learning. The School offers 5 years B Arch program recognised by Council of Architecture.

Vision

“The School aspires to become innovative architectural school by preparing creative, committed, explorative architects with leadership qualities and research culture”

Mission

To create a team of competent young Architects of high caliber committed to their profession with ethics who can contribute to Architecture and allied fields in optimizing the usage of resources globally making the world eco-friendly to live in.

ACADEMIC OBJECTIVES

1. To groom ARCHITECTURE graduates to excel in their professional career and contribute with commitment and dedication to the progress of the society and the nation;
2. To prepare graduate with a solid foundation in basics of architectural design and technical skills needed to analyze and design competitive structures;
3. To engage in holistic learning, understanding, and practicing new evolving concepts and technologies in modern infrastructure field, to keep them tuned with the emerging techniques;
4. To distinguish the professional careers of our graduates and post graduates with a high degree of moral, ethical, legal and professional obligations to protect human health, human welfare, and the environment;
5. To prepare architecture graduates and post graduates to successfully address open-ended problems applying critical thinking and to become team leaders;
6. To encourage students to gain professional visibility through publications, presentations, patents and thereby to become architects of distinction; and
7. To provide a creative and energizing environment where in students will proactively take part in inter-disciplinary, team-oriented activities which will develop their team spirit and also prepare them for future endeavors in whichever field they choose.

ADVISORY BOARD

S. No.	Name	Designation
1	Ar. Dinesh Verma	Managing Director, Ace Group Architects Pvt. Limited, Bangalore
2	Ar. Itty.Zachariah	Managing Director, Zacharia Consultants, Bangalore
3	Ar. JaisimKrishnarao	Managing Director, Fountainhead, Former Chairman, Indian Institute of Architects
4	Ar. H.C.Thimmaiah	Managing Director, Thimmaiah Associates, Ex-President Indian Institute of Architects, Bangalore
5	Ar. H.S. Anantharaman	Managing Director, Anantharam Associates, Visiting Faculty, MSRIT, Bangalore
6	Ar. Bindumadhav	Former Dean, School of Architecture, Mysore University, Mysore
7	Ar. VidyadharWodeyar	Managing Director, Arch Plan, Former Chairman, Indian Institute of Architects, Bangalore

BOARD OF STUDIES-ARCHITECTURE
Board of Studies members 2018-19 to 2020-21

	Name	Address	Contact No.	Email	
1	Dr. Vimala Swamy	Director, School of Architectrure, REVA University	9535836886	dir.arch@reva.edu.in	Chairperson
2	Dr. B.S. Bhooshan	656 B, Fifth Cross, Saraswathipuram, Mysore	0821 - 2510148 9845106500	Shashi.bhooshan@gmail.com	Member
3	Dr. H. N. Nagendra	Director, SPA, Manasagangotri, Mysore	9448957979	nagendrahnn@gmail.com	Member
4	Dr, Abhijit Natu	Professor, BKPS College of Architecture,Pune	9035015861	asnatu@bkps.edu	Member
5	Ar. Neeta Kembhavi	1872, S Building, 38 A Cross, 11th A Main, $th T Block, JayaNagar, Bengaluru-560041	080-22442734 080-22441557	Kaf.blr@kembhaviarchitects.com	Member
6	Ar. Rajesh. M.	Professor, School of Architecture, REVA University.	9845307887	rajesh.malik@reva.edu.in	Member
7	Ar. Vidya Srikanth	Associate Professor, School of Architecture, REVA University.	9972256670	vidya.srikanth@reva.edu.in	Member
8	Ar. Shubhi Sonal	Associate Professor, School of Architecture, REVA University.	9901777455	shubhi.sonal@reva.edu.in	Member
9	Ar. Neeraja Jayan	Associate Professor, School of Architecture, REVA University.	7026609149	neeraja.jayan@reva.edu.in	Member

Programme Overview
B.Arch.

Architecture is characterized by a symbiosis between creativity and technology. The vibrant, dynamic and all-encompassing nature of Architecture implies that the teaching-learning process in this area is very different from other domains of education. There are multidisciplinary challenges that influence architecture like Art, Technology, Environment, Society, Aesthetics and many more. Architecture is always dynamic. Hence the B.Arch. Program is designed keeping in view the current situation and possible future developments at global level. The Scheme of instructions and curriculum is designed with inputs from eminent architects and well qualified academicians with different specializations to meet the industry needs.

The architecture course intends to teach students the conceptualization of designs. The program aims to improve students' aesthetic judgments and facilitate this with exposure to a wide range of techniques and learning methods. The students choosing the B.Arch. program will enjoy their learning and update themselves with required skills. The student-centered teaching learning ambience combined with hands-on experience helps to develop their personality to become successful professionals. Greater emphasis is laid on studio practice, site visits and study trips. Students will have access to electives in various disciplines in art, digital design, sustainability and urban design. This flexibility is supported by a rigorous program of core courses in Design, History and Theory, Communication, Construction, Materials, Technology and skill development workshops. Students will be given an exposure to allied courses like photography, painting, sculpture, public art and more.

The program is structured as a CBCS and CAGP system where students will have opportunity to choose the subjects of their interest from a wide area of subjects as soft-core courses and open elective. Our well qualified, experienced and committed faculty will guide, monitor progress and make the architecture study interesting and fruitful. Exciting opportunities will be available for students to expand their studio experience, participate in design and build projects and leverage the knowledge and skills of proficient teachers. The facilities for curricular and co-curricular activities in REVA with dedicated supportive faculty provides a conducive ambiance for learning. The team of faculty members continually upgrade their knowledge base and course delivery techniques through Faculty development programs and by publishing and presenting their research at National and International conferences.

Architects must also be aware of the social context in which their designs are created, interpreted and understood. Teaching to students will not be limited to classrooms, instead we encourage them to be responsive and adaptive thinkers who can produce designs that meet clients' needs as well as cater to larger environmental concerns. Workshops, participation in competition designs, certification programs for enhanced learning, research through documentation and study trips are some of unique features of the program. The University fully understands that engagement with these professionally relevant aspects of the architectural profession is what will make our graduates highly sought-after and turn our alumni into industry leaders. We firmly believe that our students will find success in their career and will exceed expectations in the real world.

Program Educational Objectives (PEO's)

The programme educational objectives of the School of Architecture of REVA University is to prepare graduates

PEO-1	Demonstrate as successful professional architect with moral, ethical values and innovative ideas
PEO-2	Serve as a leader through consultancy, extension activities and adopt lifelong learning philosophy for continuous improvement.
PEO-3	Acquire higher degrees to lead in education, research and specialized professional service.

Program Outcomes (POs)

1. Assimilate the fundamental knowledge of history, culture, technical and legal aspects to address environmental and social needs.
2. Apply perceptive, aesthetic and creative abilities to design innovative solutions in the global context.
3. Identify and formulate a design problem by applying analytical reasoning and critical thinking.
4. Demonstrate the ability to deliver a project using contemporary techniques and tools.
5. Demonstrate effective visual, written and verbal communication skills.
6. Perform all professional responsibilities independently and as a team member with leadership skills and ethical values.
7. Develop an aptitude towards research and critical evaluation.
8. Develop the ability to choose appropriate online programmes and participate in conferences and seminars to be a life-long learner.

Programme Specific Outcomes (PSO)

After successful completion of the programme, the graduates shall be able to

PSO1- Assimilate the knowledge of Socio cultural, technical, environmental and legal aspects relevant to the design of human habitat.

PSO2-Analyse and design sustainable solutions for the built and unbuilt environment.

PSO3- Demonstrate the ability to use contemporary tools and techniques to solve real life problems

REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Graduate Degree Programing Architecture, 2020

(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 the **"REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Graduate Degree Programs, 2020 in Architecture".**

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

2. The Programs:

The Architecture program to be instituted and introduced in REVA University in coming years shall follow these regulations.

Architecture

3. Definitions:

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

(i) L= Lecture (ii) P= Tutoria/practical/practice (iii) D=Design Studio; where:

L stands for **Lecture** session consisting of classroom instruction.

P stands for session consisting Lab/ Seminar/Practice 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.

D stands for Design Studio Session and it consists of Hands on Experience / Field Studies / Case Studies that equip students to acquire the much required skill component.

4. Courses of study and Credits

4.1. The study of various subjects in B Arch degree program is grouped under various courses. Each of these courses carries credits which are based on the number of hours of teaching and learning.

4.1.1. In terms of credits, every **one hour session of L amounts to 1 credit per Semester** and a minimum of **two hour session of P amounts to 1 credit per Semester, 1 hour of Design session amounts to 1 ½ credit** over a period of one Semester of 16 weeks for teaching-learning process.

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

4.1.3. A course shall have either or all the four components. That means a course may have only lecture component, or only practical component, design or combination of any two or all the three components.

4.1.4. The concerned BoS will assign Credit Pattern for every course based on the requirement. However, generally, courses can be assigned with 1-16 Credits depending on the size of the course.

4.1.5. Different C**ourses of Study** are labeled and defined as follows:

4.1.6. Different C**ourses of Study** are labeled and defined as follows:

a. Professional Core Course (PC):

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The Professional Core Course is a Core Course in the main branch of study and related branches of study, if any that the candidates have to complete compulsorily. The CORE courses of Study are of THREE types, viz – (i) Professional Course, (ii) Building Science and Allied Engineering and (iii) Skill enhancement/professional elective Courses.

b. Foundation Course (FC):

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

c. Building Science & Allied Engineering Course (BSAE):

Th is a Core Course (**Building Science & Allied Engineering Course)** in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

d. Professional Elective (PE):

A Core course may be a elective course 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.

e. Open Elective Course:

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.**

f. Project Work / Dissertation:

Project work / Dissertation denoted as "D" is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Minor project normally will be assigned with 4-6 credits and a major project/dissertation will be assigned with 8-16 credits.

g. Elective Course: Generally a course which can be chosen from a pool of courses and are of 2 types

i) Professional Electives (PE): 10% of which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope.

ii) Open Electives (OE): 5% of which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill

h. Professional Ability Enhancement Course (PAEC):

i) Professional Ability Enhancement Courses (PAECC): (15%)

ii) Skill Enhancement Courses (SEC) :5%

PC= Professional Core (140-51.5%) BS= Building Services and Allied Engineering (58-21%) SE=Skill Enhancement Courses (11-4%)
PA= Professional ability courses (34-12%) PE= Professional elective (27-10%), Open Electives (4-1.5%)
Total credits – 274.

i. Open Elective Course:

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.**

5. Eligibility for Admission:

5.1 The candidates seeking admission to B.Arch Program shall have the following:

i) Pass in 12th standard/10+2/Pre University Course or equivalent with minimum 50% of marks in aggregate and has studied Maths and English compulsorily.

OR

10+3 Diploma (Architecture, Civil, Interior Design) or equivalent recognized by the Central/State Governments with minimum 50% aggregate marks.

OR

International Baccalaureate Diploma of 2 years, after 10 years of schooling with not less than 50% of marks in aggregate and with Mathematics as compulsory subject of examination.

ii) The candidate must possess Eligibility Certificate in National Aptitude Test in Architecture (NATA) conducted by Council of Architecture

OR

Passed the JEE Part 2 which is considered equivalent to NATA.

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

6. Scheme, Duration and Medium of Instructions:

6.1. B Arch degree program is of 10 semesters - 5years duration. A candidate can avail a maximum of 20 semesters - 10 years as per double duration norm, in one stretch to complete B. Arch 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.

6.2. The medium of instruction shall be English.

7. Credits and Credit Distribution

7.1. A candidate has to earn 274 credits for successful completion of B. Arch degree with the distribution of credits for different courses as given in **Table-1** below:

8. Credits and Credit Distribution

7.1. A candidate has to earn 274 credits for successful completion of B Arch degree with the distribution of credits for different courses as given in **Table-1** below:

Course Type	**Credits** **For B .ArchDegree (10 Semesters)**
Professional Core	**140**
Building Services and Allied Engineering	**58**
Skill enhancement	11
Professional Ability course	34

Professional Electives	27
Open Electives	4
Total	**274**

7.2. Every course including project work, practical work, field work, self study elective should be entitled as **Professional Course (PC), Building Science & Engineering(BSAE) or Professional Electives (PE) 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
1	English for Technical Communication	3
2	Environmental Studies	2
3	Indian Constitution and Professional Ethics	2

7.3. A candidate can enroll for a maximum of 32 credits and a minimum of 20 credits per Semester. However he / she may not successfully earn a maximum of 32 credits per semester. This maximum of 32 credits does not include the credits of courses carried forward by a candidate.

7.4. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to X semester and complete successfully 274 credits in 10 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. Assessment

b) Each course is assessed for a total weight of 100%. Out of the total 100% weight; 50% weight isfor Continuous Internal Assessment (CIA or IA) and the remaining 50% for the Semester End Examination (SEE). This applicable for theory, laboratory, workshop, studio and any such courses

c) Out of 50% weight earmarked for Internal Assessment (IA)- 10% is for Quizzes, 15% for test-1, 15% for test-2 and 10% for Assignments and this is applicable for theory based courses

d) The quizzes, tests and assignments are conducted as per the semester academic calendar provided by the University

The details as given in the table

Component	Description	Conduction	Weight Percentage
C1	Quizzess	At the end of each class	10
C2	Test-1: IA1	6th week from the starting date of semester	15
	Test-2: IA2	12th week from the starting date of semester	15
C3	1 Assignment	7th week	05
	2 Assignment	13 th week	05
C4	SEE including practical	between 17th Week-20th Week	50
Results to be Announced			By the end of 21st Week

Note: IA or CIA includes C1, C2, and C3

Each test must be conducted for a duration of 60 minutes, setting the test question paper for a maximum of 30 marks. The final examination must be conducted for a duration of 3 hours and the question paper must be set for a maximum of 100 marks. In case of Studio courses like Design, SSBC other studio course the reviews may be conducted by internal/external examiners. The same marks may be updated as Internal Assessment marks.

e) Students are required to complete courses like communication skills, technical English, Professional ethics and Indian Constitution, Environmental Sciences, technical skills, placement related courses, Open electives and any such value addition or specialized courses through online platforms like SWAYAM/NPTEL/Any other reputed online education aggregator. Students are required to choose the courses on the advice of their course coordinator/Director and required to submit the course completion certificate along with percentage of marks/grade scored in the assessment conducted by the online education aggregator. If the online education aggregator has issued a certificate along with the grade or marks scored to students, such courses will be considered for SGPA calculations, in case the aggregator has issued only a certificate and not marks scored, then such courses will be graded through an examination by concerned School, in case, if grading is not possible, students will be given a pass grade and award the credit and the credits will not be considered for SGPA calculations. The Online/MOOCs courses will not have continuous internal assessment component

f) Such of those students who would like to discontinue with the open elective course that they have already registered for earning required credits can do so, however, they need to complete the required credits by choosing an alternative open elective course.

9. Setting question paper and evaluation of answer scripts.

i. For SEE, three sets of question papers shall be set for each theory course out of which two sets will be by the internal examiners and one set will be by an external examiner. In subsequent years by carrying forward the unused question papers, an overall three sets of question papers should be managed and depending on the consumption of question ppaers either internal or external examiner be called for setting the question paper to maintain an overall tally of 3 papers with the conditioned mentioned earlier. The internal examiner who sets the question paper should have been course tutor.

ii. The Chairman of BoE shall get the question papers set by internal and external examiners.

iii. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation. It is the responsibility of the BoE to see that all questions contained in the question paper are within the prescribed syllabus of the concerned course.

iv. There shall be single valuation for all theory papers by internal examiners. However, there shall be moderation by the external examiner who has the subject background. In case no external examiner with subject background is available, a senior faculty member within the discipline shall be appointed as moderator.

v. The SEE examination for Practical work / Field work / Project work/Internship will be conducted jointly by internal and external examiners as detailed below: However, the BoE on its discretion can also permit two internal examiners.

vi. If a course is fully of (L=0):P:(P=0) type or a course is partly P type i.e, (L=3): (P=0) (D=1), then the examination for SEE component will be as decided by the BoS concerned.

10. Evaluation of studio based courses/Dissertation

10.3.1. A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

10.3.2. In case a course is fully of P type (L=0:P=4:D=0), the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a) Continuous Internal assessment (CIA) = 50 marks

b) ***Semester end practical examination (SEE) = 50 marks***

The 25 marks for continuous assessment shall further be allocated as under (IA or CIA):

i	*Conduction of regular practical throughout the semester*	*20 marks*
ii	*Maintenance of lab records*	*10 marks*
iii	*Laboratory test and viva*	*20 marks*
	Total	*50 marks*

The 50 marks meant for Semester End Examination, shall be allocated as under:

i	*Conduction 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*

10.3.3. The SEE for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

10.3.4. In case a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.

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

10.4. 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:

1	*First project presentation describing the problem definition*	*Should be done a semester before the project semester*	*Weightage: 0%*
2	*Project Progress presentation-1*	*7th week from the start date of project semester*	*Weightage: 25%*
3	*Project progress presentation-2*	*14th Week from the start date of project semester*	*Weightage -25%*
4	*Final project Viva and Project Report Submission*	*17th -20th Week of project Semester*	*Weightage: 30% for Project Report* *Weightage : 20% for Final Viva Voce*

11. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1,C2 and C3 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of 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 taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

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

- The Registrar (Evaluation) - 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.

12. Eligibility to Appear for Semester End Examination

12.1. 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 course(s), as provided in the succeeding sections, shall be eligible to appear for SEE examination.

12.2. Requirements to Pass a Course

Students are required to score a total minimum of 45% (Continuous Internal assessment and SEE) in each course offered by the University/ Department for a pass (other than online courses) with a minimum of 23 (45% of 50) marks in final examination

12.3. Requirements to Pass the Semester

To pass the semester, a candidate has to secure minimum of 45% marks in each subject / course of the study prescribed in that semester.

13. **Provision to Carry Forward the Failed Subjects / Courses:**

13.1. The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of immediate succeeding year of study. And he / she shall appear for C4 examination of failed courses of previous semesters concurrently with odd semester end examinations (C4) and / or even semester end examinations (C4) of current year of study. However, he / she shall have to clear all courses of both odd and even semesters of preceding year to register for next succeeding semester.

Examples:-

b. 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 C4 examination of 1 failed Course of First Semester concurrently with Third Semester C4 examination. Likewise, he / she is eligible to appear for C4 examination of 3 failed Courses of Second Semester concurrently with Fourth Semester C4 examination. However, he / she has to clear all the failed Courses of First and Second Semesters before seeking admission to Fifth Semester.

c. Student "B" has failed in 2 Courses in Third 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 C4 examination of 2 failed Courses of Third Semester concurrently with Fifth Semester C4 examination. Likewise he / she is eligible to appear for C4 examination of 2 failed Courses of Fourth Semester concurrently with Sixth Semester C4 examination. However, he / she is not eligible to seek admission to Seventh Semester unless he / she passes in all the failed courses of Third and Fourth Semesters.

d. Student "C" has failed in 4 Courses in Fifth Semester but has cleared all the courses in Sixth Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "C" is eligible to seek admission for Seventh Semester and appear for C4 examination of 4 failed

Courses of Fifth Semester concurrently with Seventh Semester C4 examination. However, he / she has to pass all the failed courses of Fifth Semester along with Seventh and Eighth Semesters courses to earn B Tech Degree.

e. Student "D" passed in 1to 4 semesters, but failed in 3 courses of 5th Semester and in 1 course of 6th Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "D" is also eligible to seek admission for 7th Semester and appear for C4 examination of 3 failed courses of 5th Semester concurrently with 7th Semester C4 examination and one failed course of 6th Semester concurrently with 8th Semester C4 examination. However, he / she has to pass all the 3 failed courses of Fifth Semester and 1 course Sixth Semester along with Seventh and Eighth Semester courses to earn B Tech Degree.

13.1. Re-Registration and Re-Admission:

a) 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 end semester examination (C4) and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b) 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.

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 (C4) examination and such student shall seek re-admission as provided in 7.8.4.

14.4. Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C4, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C4 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

15. Absence during Mid Semester Examination:

In case a student has been absent from a mid semester (C1, C2 and C3) examination 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 Head of the School, for make-up examination. The Head 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 test for such candidate(s) well in advance before the C4 examination of that respective semester. Under no circumstances C1,C2& C3 test shall be held after C4 examination.

16. Grade Card and Grade Point

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

16.2. **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 Registrar (Evaluation).

16.3. **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 > 90	9	v*9	A+
70 > 80	8	v*8	A
60 > 70	7	v*7	B+
55 > 60	6	v*6	B
50 > 55	5.5	V*5.5	C
45> 50	5	v*5	P
0-45	0	v*0	F
ABSENT			AB

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail

Here, P is the percentage of marks (P=[C1+C2+C3+C4] 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.

16.3.1. 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 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	4	A+	9	4X9=36
Course 2	4	A	8	4X8=32
Course 3	3	B+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	P	5	3X5=15
Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			188

Thus, **SGPA = 188 ÷ 24 = 7.83**

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	P	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**

16.4. Cumulative Grade Point Average (CGPA):

16.4.1. Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (192) 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.

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

Illustration:
CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	26	6.83	26 x 6.83 = 177.58
2	28	7.29	28 x 7.29 = 204.12
3	28	8.11	28 x 8.11 = 227.08
4	29	7.40	29 x 7.40 = 214.6
5	28	8.29	28 x 8.29 = 232.12
6	28	8.58	28 x 8.58 = 240.4
7	29	9.12	29x 9.12 = 264.48
8	26	9.25	26x 9.25 =240.5
9	26	9.0	26x9=234
10	26	9.14	26x9.14=237.64
Cumulative	274		2272.52

Thus, **CGPA** = $\frac{26x6.83+28x7.29+28x8.11+29x7.40+28x8.28+28x8.58+29x9.12+26x9.25+26x9+26x9.14}{240}$ = 9.4

16.4.2. *CONVERSION OF GRADES INTO PERCENTAGE:*

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10 (to be discussed)

its normally CGPA x 9.5

Illustration: CGPA Earned 8.10 x 10=81.0

16.5. 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/Pass
> 5 CGPA < 5.5	5.5	C	Average	
> 4 CGPA <5	5	P	Fail	Fail

Overall percentage=10*CGPA

17. **Challenge Valuation:**

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script 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 Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for C3 component.

b. The answer scripts 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.

c. No challenge valuation for Terwork/Viva Voce examination.

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

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR1010/ BDVA	CO1	3	0	3	1	1	2	0	1	2	2	2
	CO2	0	0	0	0	2	2	1	0	1	0	3
	CO3	0	1	3	2	1	2	0	0	1	2	3
	CO4	0	1	2	1	1	2	1	0	1	1	0
B19AR1020/ SSBC-I	CO1	1	2	2	3	2	2	0	3	2	2	1
	CO2	0	2	2	3	2	3	0	3	4	3	2
	CO3	0	0	0	0	0	0	0	0	0	0	0
	CO4	0	0	0	0	0	0	0	0	0	0	0
B19AR1030/ AR-I	CO1	0	2	2	2	1	2	1	1	1	1	2
	CO2	0	2	2	2	1	2	0	1	1	1	2
	CO3	0	2	1	2	1	2	0	1	1	1	2
	CO4	0	3	1	2	1	2	0	1	1	1	2
B19AR1040/ HOA-I	CO1	2	1	1	0	0	1	1	1	2	1	1
	CO2	3	1	1	0	0	1	1	1	3	1	1
	CO3	1	1	1	1	1	1	0	1	2	0	0
	CO4	0	0	0	1	2	2	0	1	1	1	1
B19AR1050/ EVS	CO1	2	0	2	0	0	2	0	2	3	0	3
	CO2	2	3	0	0	0	0	0	1	3	0	2
	CO3	1	0	2	1	0	2	0	1	3	3	2
	CO4	3	1	2	0	0	0	1	1	0	1	1
B19AR1060/ TE-I	CO1	0	0	0	3	3	3	0	3	0	0	3
	CO2	1	3	3	3	3	0	0	3	0	0	3
	CO3	0	3	0	3	3	0	0	3	0	0	3
	CO4	3	0	0	0	0	3	0	3	3	0	0
B19AR2010/ AD-I	CO1	0	2	2	1	1	0	1	1	1	2	1
	CO2	0	3	2	1	1	0	1	1	1	2	1
	CO3	1	2	2	0	0	0	0	1	2	2	1
	CO4	3	2	2	0	1	0	2	0	3	2	1
B19AR2020/ SSBC-II	CO1	2	3	2	2	1	2	1	1	2	3	1
	CO2	3	2	3	1	1	2	0	1	2	2	2
	CO3	1	0	3	1	1	1	0	1	1	2	2
	CO4	2	3	2	1	1	2	1	1	2	2	2
B19AR2030/ AR-II	CO1	0	2	1	2	1	2	0	1	1	1	2
	CO2	0	2	1	2	1	2	0	1	1	1	2
	CO3	1	2	1	2	1	2	0	1	1	1	2
	CO4	0	2	1	2	1	2	0	1	1	1	2
B19AR2040/ HOA-II	CO1	2	0	2	0	1	0	1	0	2	0	0
	CO2	2	0	3	1	2	0	2	0	3	1	0
	CO3	2	2	3	1	2	0	2	0	2	1	1
	CO4	1	1	2	0	2	0	1	0	1	1	0
B19AR2050/ Model Making	CO1	2	3	1	2	1	2	0	1	2	2	2
	CO2	3	3	1	2	1	2	0	1	3	3	2
	CO3	1	3	1	2	1	2	0	1	1	2	2
	CO4	2	3	2	2	1	2	0	1	1	3	2

B19AR2060/ TE-II	CO1	0	0	0	3	3	0	0	3	0	0	3
	CO2	0	1	3	3	3	0	0	0	0	0	3
	CO3	0	0	0	3	3	0	0	0	0	0	3
	CO4	0	3	0	0	0	3	0	0	0	0	3
B19AR2070/ C. I	CO1	2	0	3	0	1	0	1	1	3	0	3
	CO2	3	0	3	0	0	0	0	3	0	0	3
	CO3	0	0	3	0	0	3	0	0	3	0	3
	CO4	3	0	3	0	0	0	0	3	0	0	3
B19AR3010/ AD-II	CO1	0	0	2	1	0	2	2	1	2	2	3
	CO2	2	2	1	1	1	2	1	0	2	3	2
	CO3	2	2	2	1	1	2	1	0	1	3	2
	CO4	1	3	1	2	1	1	2	1	2	2	3
B19AR3020/ SSBC-III	CO1	3	2	2	1	1	2	0	1	2	2	2
	CO2	2	3	2	1	1	2	1	1	2	2	2
	CO3	3	2	3	1	1	2	0	1	2	2	2
	CO4	3	2	3	1	1	2	1	1	2	2	2
B19AR3031/ B19AR3032/ B19AR3033/ B19AR3034 RULO	CO1	0	2	1	1	0	1	0	1	3	0	1
	CO2	2	2	1	1	0	1	0	1	3	0	1
	CO3	3	2	0	1	0	1	0	1	3	0	2
	CO4	4	3	1	2	0	2	0	1	4	1	3
B19AR3040/ BS-I	CO1	3	2	2	2	2	2	1	2	3	3	3
	CO2	3	2	2	2	2	2	1	2	3	3	3
	CO3	3	1	1	1	2	2	1	2	3	3	3
	CO4	3	3	2	2	2	2	1	2	3	3	3
B19AR3050/ HOA-III	CO1	2	1	1	0	0	1	1	1	2	1	1
	CO2	3	1	1	0	0	1	1	1	2	1	1
	CO3	3	1	1	1	0	1	1	1	3	0	1
	CO4	0	0	0	2	2	2	1	1	2	1	2
B19AR3060/ SITE PLNG	CO1	2	3	3	1	2	2	1	1	1	3	2
	CO2	1	0	2	2	0	1	0	2	2	1	2
	CO3	0	1	3	2	0	1	1	2	2	2	3
	CO4	0	0	2	1	0	1	2	2	1	3	2
B19AR3070/ CAAD-I	CO1	1	2	0	2	1	1	0	2	2	1	3
	CO2	1	1	0	2	1	1	0	1	2	0	2
	CO3	1	2	0	2	1	1	0	1	2	1	3
	CO4	1	2	0	2	1	1	0	1	2	1	3
B19AR4010/ AD-III	CO1	3	0	3	2	1	1	2	1	3	2	3
	CO2	3	1	1	2	1	1	2	1	3	3	2
	CO3	1	2	1	1	1	1	1	1	2	2	2
	CO4	1	2	2	2	1	1	1	1	2	2	3
B19AR4020/ SSBC-IV	CO1	3	2	3	1	1	2	1	1	2	3	2
	CO2	3	3	3	1	1	2	0	1	2	3	2
	CO3	2	1	2	1	1	2	0	1	2	2	2
	CO4	2	3	2	1	1	2	1	1	2	2	2
B19AR4030/ CLIMATEOLOGY	CO1	2	1	3	0	0	0	2	2	3	2	0
	CO2	2	1	3	2	2	2	2	2	3	3	3
	CO3	3	3	3	2	2	2	2	2	3	3	3
	CO4	3	3	3	2	2	2	2	2	3	3	0

B19AR4040/ BS-II	CO1	3	3	2	1	2	1	2	3	3	3	3
	CO2	3	3	2	1	2	2	2	2	3	3	3
	CO3	2	3	2	1	1	1	2	3	3	3	3
	CO4	2	3	2	1	2	2	2	2	3	3	3
B19AR4050/ HOUSING	CO1	1	3	2	2	2	2	2	3	3	3	2
	CO2	1	3	1	1	2	2	1	3	1	3`	1
	CO3	3	2	2	2	2	2	1	3	2	3	1
	CO4	1	3	2	2	2	2	2	3	2	3	3
B19AR4060/ HOA-IV	CO1	2	1	1	0	0	1	1	1	2	1	1
	CO2	3	1	1	0	0	1	1	1	2	1	1
	CO3	3	1	1	1	0	1	1	1	3	0	1
	CO4	0	0	0	2	2	2	1	1	2	1	2
B19AR4070/ CAAD-II	CO1	3	0	2	1	1	0	1	2	1	3	1
	CO2	3	0	2	1	1	0	1	2	0	3	1
	CO3	3	0	2	1	1	0	1	2	1	3	1
	CO4	3	0	2	1	1	0	1	2	1	3	1
B19AR5010/ AD-IV	CO1	1	3	1	1	1	1	1	3	1	2	3
	CO2	3	3	2	1	2	2	1	3	3	2	2
	CO3	3	2	2	1	2	2	1	3	3	3	3
	CO4	3	2	2	2	2	3	1	3	2	3	3
B19AR5020/	CO1	1	1	1	0	0	0	0	3	3	2	3
	CO2	1	1	2	0	1	2	0	1	1	2	1
	CO3	0	2	0	0	2	2	2	3	1	3	3
	CO4	3	3	3	0	1	3	0	2	3	3	2
B19AR5030/ EEB	CO1	1	3	0	2	0	2	2	3	0	0	3
	CO2	3	3	2	2	2	2	2	3	3	3	3
	CO3	2	3	2	2	2	2	2	3	3	3	2
	CO4	3	3	2	2	2	2	2	3	3	3	2
B19AR5040/ BS-III	CO1	0	0	1	0	0	0	0	1	0	2	2
	CO2	1	3	0	2	2	0	0	0	0	1	1
	CO3	3	0	1	2	2	2	0	1	2	0	1
	CO4	1	3	0	2	2	0	0	1	2	1	0
B19AR5050/ TOA	CO1	2	1	2	2	0	2	0	3	2	2	3
	CO2	3	2	1	1	0	2	0	1	3	3	1
	CO3	3	3	2	3	0	2	0	1	3	3	1
	CO4	1	2	3	3	0	3	0	1	2	3	1
B19AR5060/ HOA V (CONT.ARCH)	CO1	1	1	0	2	2	2	1	2	0	0	3
	CO2	3	2	0	0	2	0	1	3	2	0	3
	CO3	1	2	1	0	0	1	1	3	0	1	3
	CO4	3	2	1	1	2	1	0	3	1	1	2
B19AR6010/ AD-V	CO1	1	3	2	1	1	1	1	1	1	1	3
	CO2	3	3	2	1	2	2	1	3	3	3	3
	CO3	3	2	2	1	2	2	1	3	3	3	3
	CO4	3	2	2	2	2	0	1	2	1	3	2
B19AR6020/ SSBC-VI	CO1	1	3	1	2	2	1	1	3	2	2	3
	CO2	1	3	2	2	2	2	1	3	3	3	3
	CO3	2	3	2	2	2	1	1	3	3	3	3
	CO4	2	1	1	2	2	1	1	3	2	2	3

B19AR6030/ WD	CO1	2	2	2	2	2	2	3	3	2	2	3
	CO2	2	2	2	2	2	2	2	2	2	3	2
	CO3	3	3	3	3	1	3	3	3	3	2	2
	CO4	3	3	2	3	2	2	2	3	3	2	2
B19AR6040/ BS-IV	CO1	0	3	1	2	2	2	1	2	1	2	1
	CO2	2	3	1	1	2	2	0	2	1	3	1
	CO3	2	3	2	1	2	2	1	2	2	3	1
	CO4	1	3	1	2	2	2	2	2	3	2	1
B19AR6051/ ARW	CO1	0	3	3	0	0	3	0	3	3	3	1
	CO2	3	3	3	0	0	3	3	1	3	3	1
	CO3	1	3	3	3	3	3	0	1	3	3	2
	CO4	0	3	3	3	3	3	3	0	2	3	0
B19AR6052/ DIGITAL ARCH	CO1	3	2	2	0	2	2	1	3	3	3	3
	CO2	3	3	1	0	2	0	1	3	0	2	1
	CO3	3	2	2	1	2	1	1	3	0	2	2
	CO4	3	3	2	0	2	0	1	3	1	2	1
B19AR6060/ UP	CO1	3	3	2	2	2	2	2	3	3	3	3
	CO2	2	3	2	2	2	2	2	3	3	3	2
	CO3	2	3	2	2	2	2	2	3	3	3	3
	CO4	3	3	2	2	2	2	2	3	3	3	3
B19AR6071/ 72/73 ADVANCED SOFTWARE	CO1	1	0	2	1	1	0	1	2	1	2	1
	CO2	3	1	2	1	1	0	1	2	3	2	1
	CO3	3	3	2	1	1	1	2	3	3	3	3
	CO4	2	3	2	1	2	2	2	2	3	2	3
B19AR7010/ AD-VI	CO1	1	2	0	1	1	1	1	2	2	2	2
	CO2	2	3	3	1	2	3	2	2	1	2	2
	CO3	2	1	1	0	1	1	1	3	1	1	3
	CO4	2	3	2	1	2	2	2	3	3	2	1
B19AR7020/ E&C	CO1	0	3	0	1	1	1	0	1	0	0	0
	CO2	1	3	0	1	1	0	0	1	0	1	0
	CO3	2	2	0	1	1	0	1	1	1	0	0
	CO4	1	3	1	1	1	0	0	3	1	0	1
B19AR7030/ PROF PRAC	CO1	0	3	1	2	2	0	1	2	0	3	2
	CO2	0	3	1	0	2	0	3	3	0	1	3
	CO3	0	3	2	2	2	0	1	2	1	3	3
	CO4	1	3	1	3	2	0	0	1	0	2	3
B19AR7041/ ID	CO1	2	2	2	2	3	2	2	2	2	2	2
	CO2	2	2	2	1	2	1	1	1	2	1	0
	CO3	2	3	2	2	2	3	3	2	3	2	2
	CO4	3	3	3	3	3	2	2	3	3	3	2
B19AR7042/ GD	CO1	3	3	0	1	0	1	3	3	2	2	3
	CO2	3	0	2	0	0	3	2	3	3	1	2
	CO3	3	1	2	3	3	2	3	2	3	1	3
	CO4	3	3	3	2	1	3	2	2	3	2	2
B19AR7043/ PD	CO1	3	3	0	1	0	1	3	3	2	2	3
	CO2	3	0	3	0	0	3	2	3	3	1	3
	CO3	3	1	2	3	3	3	3	3	3	2	3
	CO4	3	3	3	2	1	3	2	2	3	2	2

B19AR7051/ VERN ARCH	CO1	3	3	3	3	3	3	3	3	3	3	3
	CO2	2	2	2	2	2	2	2	2	2	2	2
	CO3	3	3	3	3	3	3	3	3	3	3	3
	CO4	3	3	3	3	3	3	3	3	3	3	3
B19AR7052/ BARRIER FREE ARCH	CO1	1	3	2	3	3	2	3	3	3	3	3
	CO2	2	2	2	2	2	2	2	2	2	2	2
	CO3	3	3	3	3	1	3	2	3	3	3	3
	CO4	3	3	1	3	3	2	3	3	3	3	3
B19AR7061/ IND.ART& HERITAGE (OPEN ELEC FOR OTHER STUDENTS)	CO1	2	1	3	2	2	3	3	3	0	3	2
	CO2	3	2	3	1	3	3	3	3	3	1	3
	CO3	2	3	2	1	2	1	3	2	1	2	2
	CO4	1	0	2	2	3	0	3	3	0	3	2
B19AR7062/ FINE ARTS (OPEN ELEC FOR OTHER STUDENTS)	CO1	2	1	3	2	2	3	3	3	0	3	2
	CO2	3	2	3	1	3	3	3	3	3	1	3
	CO3	2	3	2	1	2	1	3	2	1	2	2
	CO4	1	0	2	2	3	0	3	3	0	3	2
B19AR7063/ OPEN ELEC (FOR B. ARCH STUDENTS)	CO1	2	1	3	2	2	3	3	3	0	3	2
	CO2	3	2	3	1	3	3	3	3	3	1	3
	CO3	2	3	2	1	2	1	3	2	1	2	2
	CO4	1	0	2	2	3	0	3	3	0	3	2
B19AR7070/ ONLINE LEARNING (MOOC/SWAYAM)	CO1	3	2	3	1	0	0	0	3	1	3	3
	CO2	2	3	3	1	0	2	1	0	3	3	0
	CO3	1	3	2	3	0	0	0	0	0	1	0
	CO4	0	2	2	3	3	3	2	2	3	3	1
B19AR8010/ AD-VII	CO1	3	2	3	1	0	0	0	3	1	3	3
	CO2	2	3	3	1	0	2	1	0	3	3	0
	CO3	1	3	2	3	0	0	0	0	0	1	0
	CO4	0	2	2	3	3	3	2	2	3	3	1
B19AR8020/ PRE-THESIS	CO1	1	3	1	0	1	0	1	3	0	2	3
	CO2	2	3	3	3	3	3	3	3	2	3	3
	CO3	2	3	3	3	3	3	2	1	2	3	3
	CO4	2	3	3	3	3	3	1	3	1	3	3
B19AR8030/ LANDSCAPE DESIGN	CO1	3	1	2	2	0	1	2	1	2	1	1
	CO2	1	3	2	0	1	1	2	2	2	1	2
	CO3	3	3	2	1	2	1	1	3	2	2	2
	CO4	1	2	1	2	1	3	3	1	3	1	1
B19AR8041/ UD	CO1	0	2	2	2	2	2	2	3	1	2	3
	CO2	3	2	3	3	3	1	2	3	3	2	3
	CO3	3	3	3	3	3	3	2	3	3	3	3
	CO4	3	2	3	3	3	3	3	3	3	3	3
B19AR8042/ CONSERVATION STUDIES	CO1	0	2	0	0	3	0	3	3	0	3	3
	CO2	0	0	3	0	0	0	3	3	0	0	3
	CO3	0	0	3	0	3	0	0	3	0	3	0

	CO4	0	0	3	3	0	0	0	3	0	3	3
B19AR8051/ ADV BLDG MATERIALS	CO1	0	2	0	0	3	0	3	3	1	3	3
	CO2	0	0	2	0	0	0	3	3	0	0	2
	CO3	0	0	3	0	3	0	0	0	0	3	0
	CO4	0	0	3	3	0	0	0	3	0	3	3
B19AR8052/ REAL ESTATE &DEVELOP	CO1	1	2	0	0	3	2	3	3	1	3	3
	CO2	1	0	2	2	0	3	3	3	0	0	2
	CO3	3	0	3	0	3	1	0	0	0	3	0
	CO4	3	0	3	3	0	1	0	3	0	3	3
B19AR8060/ ENT. DEV CERT.COURSE	CO1	1	1	0	1	2	1	2	3	1	2	3
	CO2	3	2	1	1	3	2	2	2	1	1	0
	CO3	2	2	1	1	1	2	2	3	1	3	3
	CO4	2	2	1	1	2	1	1	1	2	2	3
B19AR9010/ PT	CO1	3	2	3	1	0	0	0	3	1	3	3
	CO2	3	3	3	1	0	3	1	0	3	3	0
	CO3	3	3	3	3	0	0	0	0	0	3	0
	CO4	0	2	2	3	3	3	2	2	3	3	1
B19ARX010/ THESIS	CO1	2	3	2	1	2	2	2	3	2	2	2
	CO2	2	3	2	1	2	1	2	3	2	2	2
	CO3	3	1	1	2	1	1	1	2	2	1	2
	CO4	2	1	3	2	4	2	1	2	2	2	0
B19ARX021/ ARCH JOURNALISM	CO1	0	3	2	0	2	0	2	1	0	3	0
	CO2	2	0	2	2	2	1	1	2	0	2	3
	CO3	0	3	2	2	2	1	1	2	2	2	0
	CO4	0	3	2	2	2	1	1	2	1	2	1
B19ARX022/ DISASTER MIT&MGT	CO1	0	0	0	0	0	0	3	3	0	1	3
	CO2	0	3	2	0	0	0	2	3	0	3	3
	CO3	0	3	0	3	2	0	3	0	0	3	0
	CO4	0	3	3	3	0	0	2	0	0	3	0
B19ARX030/ CONSTR MGT	CO1	0	1	2	0	3	3	2	2	3	2	1
	CO2	3	3	3	1	2	3	2	1	3	3	1
	CO3	1	3	3	0	3	3	1	1	3	3	1
	CO4	2	0	3	3	3	0	3	0	0	3	0
B19ARX040/ ONLINE LEARNING (MOOC/SWAYAM)	CO1	3	2	3	1	0	0	0	3	1	3	3
	CO2	2	3	3	1	0	2	1	0	3	3	0
	CO3	1	3	2	3	0	0	0	0	0	1	0
	CO4	0	2	2	3	3	3	2	2	3	3	1

Mapping of PEOS with Respect to PO's and PSO's

	PO1	P2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
PEO1	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√
PEO3	√	√	√	√	√	√	√	√	√	√	√

B ARCH DEGREE PROGRAM

SCHEME OF INSTRUCTION FOR 2019 BATCH (2019 to 2024) STUDENTS

FIRST SEMESTER							
No	**Course Code**	**Course Title**	**Type**	**L : P : D**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19AR1010	Basic Design and Visual Art	PC	2:2:4	9	8	VV
2	B19AR1020	Structural Systems and Building Construction-I	BS	3:3:1	6	7	VV
3	B19AR1030	Architectural Representation-I	PC	1:3:1	4	5	TW
4	B19AR1040	History of Architecture - I	PC	3:0:0	3	3	SEE
5	B19AR1050	Environmental Studies	BS	2:0:0	2	2	SEE
6	B19AR1060	Technical English I	SE	0:4:0	2	4	SEE
Total Credits					**26**	**29**	

SECOND SEMESTER							
No	**Course Code**	**Course Title**	**Type**	**L : P : D**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19AR2010	Architectural Design – I	PC	2:2:4	9	8	VV
2	B19AR2020	Structural Systems and Building Construction-II	BS	3:3:1	6	7	VV
3	B19AR2030	Architectural Representation-II	PC	1:3:1	4	5	TW
4	B19AR2040	History of Architecture – II	PC	3:0:0	3	3	SEE
5	B19AR2050	Model Making/art appreciation	PE	1:2:0	2	3	INT
6	B19AR2060	Technical English II	SE	0:4:0	2	4	SEE
7	B19AR2070	Constitution of India	PC	2:0:0	2	2	SEE
Total Credits					**28**	**32**	

THIRD SEMESTER							
No	**Course Code**	**Course Title**	**Type**	**L : P : D**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19AR3010	Architectural Design - II	PC	2:2:4	9	8	VV
2	B19AR3020	Structural Systems and Building Construction-III	BS	4:3:1	7	7	VV
3	MPA17F3910/ 20/30	Music/Dance/Theatre /Yoga /Sports	PE	2:0:0	2	2	SEE
4	B19AR3040	Building Services-I	BS	2:0:0	2	2	SEE
5	B19AR3050	History of Architecture- III -Hindu and Buddhist Architecture	PC	2:2:0	3	4	VV
6	B19AR3060	Site Survey and Planning	BS	2:1:0	2	3	SEE
7	B19AR3070	Computer Applications in Architectural design -I	SE	3:0:0	3	3	TW
Total Credits					**28**	**29**	
FOURTH SEMESTER							
No	**Course Code**	**Course Title**	**Type**	**L : P : D**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19AR4010	Architectural Design - III	PC	2:2:4	9	8	VV
2	B19AR4020	Structural Systems and Building Construction-IV	BS	4:3:1	7	7	VV
3	B19AR4030	Climatology	BS	3:0:0	3	3	SEE
4	B19AR4040	Building Services -II	BS	2:0:0	2	2	SEE
5	B19AR4050	Housing	PC	3:0:0	3	3	SEE
6	B19AR4060	History of Architecture – IV Islamic Architecture	PC	2:2:0	3	4	VV
7	B19AR4070	Computer applications in Architectural design -II	SE	2:1:0	2	3	TW
Total Credits					**29**	**30**	

FIFTH SEMESTER							
No	**Course Code**	**Course Title**	**Type**	**L : P : D**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19AR5010	Architectural Design - IV	PC	4:0:4	10	8	VV
2	B19AR5020	Structural systems and Building Construction-V	BS	3:4:2	8	8	VV
3	B19AR5030	Energy Efficient Design	BS	1:2:0	2	3	TW
4	B19AR5040	Building Services III	BS	2:0:0	2	2	SEE
5	B19AR5050	Theory of Architecture	PC	3:0:0	3	3	SEE
6	B19AR5060	History of Architecture IV-Contemporary Period	PC	3:0:0	3	3	VV
Total Credits					**28**	**27**	
SIXTH SEMESTER							
No	**Course Code**	**Course Title**	**Type**	**L : P : D**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19AR6010	Architectural Design - V	PC	3:1:4	10	8	VV
2	B19AR6020	Structural Systems and Building Construction-VI	BS	3:1:1	5	5	VV
3	B19AR6030	Working Drawings	PC	2:1:0	3	3	TW
4	B19AR6040	Building Services-IV	BS	2:1:0	2	3	SEE
5	B19AR6051	Research in Architecture	PE	3:0:0	3	3	VV
	B19AR6052	Digital Architecture					
6	B19AR6060	Urban Planning	PC	3:0:0	3	3	SEE
7	B19AR6070	Certification Course in Advanced Software	SE	0:4:0 (32 Hours Certification)	2	0	INT
Total Credits					**26**	**25**	

VII SEMESTER

No	Course Code	Course Title	Type	L : P : D	Total Credits	Contact Hours	Evaluation
1	B19AR7010	Architectural Design - VI	PC	3:0:6	12	9	VV
2	B19AR7020	Estimation & Costing	BS	3:0:0	3	3	SEE
3	B19AR7030	Professional Practice	PA	3:0:0	3	3	SEE
4	B19AR7040	Interior Design/graphic & Product Design	PE	2:1:0	3	3	VV
5	B19AR7051	Vernacular Architecture	PE	3:0:0	3	3	SEE
6	B19AR7052	Barrier free Architecture					
7	B19AR7061	Indian Art and Architectural Heritage	OE	3:0:0	3	3	SEE
8	B19AR7062	Fine arts	OE				
9	B19AR7063	Fundamentals of Interior Design	OE				
10	B19AR7070	SDL	PA	0:0:0	2	0	INT
Total Credits					**29**	**24**	

Open Electives offered by School of Architecture for students of other Schools/ Discipline: Indian Art and Heritage/ Fine arts/Interior Design; The students of Architecture shall have to choose one of the Open Elective offered by other Schools.

VIII SEMESTER

No	Course Code	Course Title	Type	L : P : D	Total Credits	Contact Hours	Evaluation
1	B19AR8010	Architectural Design - VII	PC	2:0:7	13	9	VV
2	B19AR8020	Pre-Thesis	PC	0:4:0	2	4	INT
3	B19AR8030	Landscape design	PC	2:2:0	3	4	SEE
4	B19AR8041	Urban Design	PE	3:0:0	3	3	SEE
	B19AR8042	Conservation studies					
5	B19AR8051	Advanced Building Materials	PE	3:0:0	3	3	SEE
	B19AR8052	Real Estate and Valuation					
6	B19AR8060	Certification Course in Advanced Software	PA	0:4:0	2	32 HOURS CERTIFICATION	INT
7	B19AR8070	SDL - Entrepreneurship Development	PA	2:0:0	2	0 (Online 4 to 6 weeks)	INT
Total Credits					**28**	**22**	

IX SEMESTER						
No	**Course Code**	**Course Title**	**Type**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19AR9010	Practical Training	PA	26	18 weeks	VV
Total Credits				**26**		

No	**Course Code**	**Course Title**	**Type**	**L-P-D**	**Total Credits**	**Contact Hours**	**Evaluation**
1	B19ARX010	Thesis	PC	6:0:8	18	14	VV
2	B19ARX021	Architectural Journalism	PE	3:0:0	3	2	SEE
3	B19ARX022	Disaster Mitigation and Management					
4	B19ARX030	Construction Management	PA	3:0:0	3	3	SEE
5	B19ARX040	SDL	PA	2:0:0	2	0 (online 4 to 6 weeks)	INT
Total Credits					**26**	**19**	
Total Credits from 1 to 10 Semesters					**274**		

i.L=lecture; P=Practice, Lab, Studio Exercise, Seminar; D=Design
ii.1 hour of L = 1 Credit; 1 hour of P-Lab/ Seminar/Practice=1/2 credit, 1 hour of D = 1.5 Credit
iii.SDL – Self Directed Learning

SEE = Semester end Theory Exam, VV=Viva voce, INT= Continuous Internal Evaluation
PC= Professional Core (140-51.5%), BS= Building Services and Allied Engineering (58-21%)
SE=Skill Enhancement Courses (11-4%), PA= Professional ability courses (34-12%)
PE= Professional elective (27-10%), Open Electives (4-1.5%)
Total credits – 274.

Semester wise Credits Distribution

Sl. No.	Semester	Credits	Contact Hours
1	Semester - 1	26	29
2	Semester - 2	28	32
3	Semester - 3	28	29
4	Semester - 4	29	30
5	Semester - 5	28	27
6	Semester - 6	26	25
7	Semester - 7	29	24
8	Semester - 8	26	16 to 18 weeks
9	Semester - 9	28	22
10	Semester - 10	26	19
	Total	274	237

Detailed Syllabus

Semester I:

B19AR1010	Basic Design and Visual Arts	L	P	D	C
Duration:14 Wks		2	2	4	9

Prerequisites:

Knowledge of basics drawing, sketching, use of colours in different medium, understanding of geometry and shapes

Course Objectives:

1. Explain the meaning and purpose of design through visual compositions.
2. Train the students in visual composition, architectural perception and representation through 2D and 3D
3. Translate elements and principles of Basic Design as the building blocks of creative design.
4. To apply abstract principles of design and anthropometric studies into architectural solutions.

Course Outcomes:

1. Recognize the grammar and language of Design.
2. Express the learnings through 2D and 3D compositions.
3. Apply anthropometry and principles of design to creation of spaces.
4. Represent through drawings and models, an architectural space of specific dimensions

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR1010/ BDVA	**CO1**	3	0	3	1	1	2	0	1	2	2	2
	CO2	0	0	0	0	2	2	1	0	1	0	3
	CO3	0	1	3	2	1	2	0	0	1	2	3
	CO4	0	1	2	1	1	2	1	0	1	1	0

Course Contents:

Unit-I: Elements and Principles of Design

Elements of design: properties, qualities and characteristics of point, line, plane, direction, shape, form, color and texture. Learning the importance of line types, characteristics and qualities of line types.

Introducing Principles of Design: Balance, proportion, scale, Unity, Variety, Emphasis, contrast, Pattern, Gradation, Dynamism, Positive and Negative. Work in small groups with variety in Materials

and mediums choosing between 2D and 3D methods of presenting the idea. Theory component for Scale, proportions will go parallel with studio.
Visual Art techniques in representation: Introduction to different mediums like pencil, pen, color pencils, pastels, watercolors and acrylic to be explored in the Basic design exercises of Elements and Principles.
Exercises can be done in groups or individually.

Unit-II: Anthropometry and Measured drawing

Introduction to Anthropometry and its importance as a tool in designing architectural spaces. Work with life size models and compare Indian adaptations and scale with Standards. Erecting a structure to Human scale to understand volume and its relation to anthropometry. Ideating and executing the design in Groups.
Exercises to demonstrate the relationship between Form, Space and enclosures. Introduction to Principles of Spatial organization
Visual art Techniques to be applied to developing conceptual design drawings.
Emphasis on transformation of conceptual drawings to the 2D drawing; Basics of preparation of plans, elevations, sections and views with an exercise in Measure drawing. Single function space in the immediate environment like Hostel room, kitchen and toilet or bedroom at their residence.

Unit-III: Architectural space design

Design of an architectural space having form and volume or additions/extensions to a built space; representing the same through Plan, Section, Elevation and Models. Students should learn to develop more than one solution to the design and learn the process of selection /elimination.

Unit-IV: Detailing and Presentation of design

Thought to be given to materials. Importance to be given to understand basics in the representations: Plinth, levels, Entrance porch, sill, lintels, parapets etc. that is learnt in Building construction.
Visual art techniques mastered to be applied in the presentation and model.

Reference Books

1. Archi-doodle- by Steve Browkett
2. Universal Principles of Design, William Lidwell, Kristina Holden, Jim Butler
3. Design Elements: A Graphic style Manual, Timothy Samara
4. Visual Grammar by Christian Leborg
5. Visual Thinking for Design, Colin Ware.
6. Design of everyday things, Donald Norman.

B19AR1020	Structural systems and building construction -I	L	P	D	C
Duration:14 Wks		3	3	1	6

Prerequisites:

Knowledge of Basic physics, mathematics, materials and drawing skills

Course Objectives:

The objectives of this course are:

1. Enumerate the basic building elements, materials used in Load bearing construction
2. Describe the basic forces of Tension and Compression and the system of distribution of loads with respect to Arches and Lintels
3. Discuss Earth as a material, its constituents and understanding its market ready forms, compressive quality and applications.
4. Trace evolution of structures through History, the techniques used, the two basic systems Trabeated and Framed, describe a typical wall section with all its different components.

Course Outcomes:

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

1. Acquire an exposure to the basic building materials like bricks, stone, earth, and cement, timber, steel and elaborate and compare brick and stone masonry
2. Identify and distinguish the nature of the basic forces of tension and compression and illustrate it through building systems like Arches and Lintels
3. Describe and comprehend earth as a building material, outline its constituents and identify its market forms and applications
4. Classify the two structural systems by understanding its evolution through History and explain the components of a simple Load bearing structure made of Masonry.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR1020/ SSBC-I	CO1	1	2	2	3	2	2	0	3	2	2	1
	CO2	0	2	2	3	2	3	0	3	3	3	2
	CO3	0	0	0	0	0	0	0	0	0	0	0
	CO4	0	0	0	0	0	0	0	0	0	0	0

Course Contents:

Unit- 1: Brick and Stone

Introduction to Brick as a building unit: Constituents of Brick, Physical and Chemical properties of Brick, Brick Masonry - Brick Wall in English bond, Flemish bond, rat trap bond and major types of bonds. Introduction to Tension and Compression forces through examples, Distribution of Compressive load in Brick Masonry.

Introduction to Stone as a building unit: Types of Stone, Physical and Chemical properties of Stone, Stone Masonry (Random Rubble, Dressed Masonry, Methods of Pointing)

Unit -2: Arches, Lintels and Forces

Introduction to the concept of Catenary and Arch (Forces of Tension and Compression)

Distribution of Horizontal and Vertical compression forces in an Arch, and formation of line of Thrust, with live examples

Basic components of an Arch. Major types of Arches and their method of construction.

Introduction to piers, lintels and Pilasters

Unit- 3: Introduction to Earth as a building unit:

Constituents of Earth

Physical and Chemical properties of Earth

Process of Stabilizing Earth

Compressed Earth Block Masonry

Introduction to the following techniques: Rammed Earth; Adobe Construction

Distribution of Compressive load in Compressed Earth Block Masonry. Live examples showing how CEB Masonry is weak in Tension and good in Compression.

Unit- 4: Basic structural systems

Evolution of Structures: Historical perspective and definition of structure as a device for channeling loads that result from the use or presence of the building in relation to ground. Built structure, components, forces, loads, types, different roofs.

Building system: Structural and enclosure system, Types of construction, Structural forces, Structural equilibrium, Foundations (brick and stone) Columns, beams and wall sections

Wall section through Load Bearing structure: Understanding typical brick and stone foundation, plinth, sill, window and door in section, lintel, roof slab, parapet and simple coping.

Self-learning component:

Experiment with Structures: Paper structure to withstand load, Bridge using sticks, simple examples for structural understanding.

Material Study: Mud, lime and Cement as mortar, Sand, Fly ash, cement, lime, aggregate.

Site Visits to Brick industry, Stone quarry to study the manufacturing process and related activities.

2 to 4 plates from each unit, sketch book, material portfolio and models to be prepared.

Reference Books:

1. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
2. Building Construction, Sushil Kumar, Standard Publishers Distributors, New Delhi
3. Building Construction, Punmia, Ashok K Jain, & Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi
4. Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York.

B19AR1030	Architectural Representation-I	L	P	D	C
Duration:14 Wks		2	1	1	4

Prerequisites:

Basics of geometry, drawing and understanding of 2D and 3 D forms

Course Objectives:

The objectives of this course are to:

1. To enhance drawing, visualization and representation skills and familiarize with drawing equipment like scales, set squares, pencils & its application and proportioning through free hand sketches
2. Explain orthographic projections in relation to architectural drawings & details
3. Introduce the technique of drawing different types of view of built elements and built form
4. Introduce the basic techniques of shading and material textures using pen and ink

Course Outcomes:

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

1. Explore the visual representation through drafting, lettering and use of concept of scale
2. Demonstrate techniques of orthographic projection.
3. Represent two dimensional objects in three dimensional forms through studio drafting and free hand sketching
4. Employ graphical presentation skills for effective communication in design.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR1030/ AR-I	**CO1**	0	2	2	2	1	2	1	1	1	1	2
	CO2	0	2	2	2	1	2	0	1	1	1	2
	CO3	0	2	1	2	1	2	0	1	1	1	2
	CO4	0	3	1	2	1	2	0	1	1	1	2

Course Contents:

Unit - 1: Introduction to visual representation and dimensioning systems

The basic principles of drawing and line conventions, BIS Conventions and drawing sheets. Introduction to types of dimensioning systems- linear, continuous and angular dimensions.

Architectural lettering and concept of scale and its application:

Introduction to lettering used in architectural drawings, practicing various font styles. Introduction to concept of scale, types of scale and its application in drawing.

Introduction to Euclidean Geometry:

Exercises in lines and angles, construction of quadrilaterals and regular polygons and tangents.

Unit - 2: Projection of solids

Construction of Conic Sections:

Construction of plane curves, ellipse, parabola, hyperbola and cycloids.

Orthographic projection (first angle projection)

Principles of orthographic projection: projections of points, lines, and planes – explore all combinations.

Orthographic Projection of Solids

Cube, Prism, Pyramid, Cylinder and Cone.

Orthographic Projection of Architectural Built Elements

Drawing Orthographic projection for simple furniture and interior spaces like living and bedroom or part of a classroom.

Unit – 3: 3D views

Introduction to Isometric view and axonometric views of solids and combination solids.

Exercise in Isometric views

Built elements and built forms. Example Furniture, Carpentry Joints, built environment.

Unit – 4: Architectural Rendering -1

Introducing Basic rendering techniques with pen and ink- shading and material textures. Visual presentation of plants, trees, objects, furniture, human beings etc. Study of objects in light and shade, sketching techniques. Drawing free hand Isometric view of built forms and elements, shading and texture with pencil and ink rendering.

Reference Books:

1. N.D. Bhat "Engineering Drawings"
2. I.H. Morris. "Geometrical Drawing for art students"
3. K.R. Gopalkrishna "Engineering Drawings (vol-1&2)"
4. "Architectural Graphics" by C. Leslie Martin
5. "Architectural Graphics" by Francis D K Ching

B19AR1040	History of Architecture-I	L	P	D	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Basics of World history, civilizations and drawing skills to represent

Course Objectives:

1. To familiarize the students with development of architecture in the Ancient times
2. To familiarize students with the cultural and contextual determinants that produced that architecture.
3. To describe architectural evolution as a product of cultural contexts including aspects of politics, society, religion and climate.
4. To explain the development of architectural form with reference to Technology, Style and Character in the prehistoric world and in Ancient Egypt, West Asia, Indus valley, Greece and Rome

Course Outcomes:

On completion of this course the student will be able to:

1. Trace the evolution of architecture in the prehistoric, ancient river valley civilizations and Classical period.
2. Demonstrate an understanding of socio-cultural context, climatic influences and technical advancement with reference to various styles of architecture
3. Illustrate construction techniques, architectural characteristics and structural forms of the period
4. Acquire skills and techniques to describe historical buildings through various media such as sketching, audio visual presentations, model making etc.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR1040/ HOA-I	CO1	2	1	1	0	0	1	1	1	2	1	1
	CO2	3	1	1	0	0	1	1	1	3	1	1
	CO3	1	1	1	1	1	1	0	1	2	0	0
	CO4	0	0	0	1	2	2	0	1	1	1	1

Unit -1: Prehistoric age & ancient river valley civilizations: Mesopotamia

Introducing concepts of culture and civilization – Paleolithic to Neolithic Culture – art forms and evolution of shelter – megaliths – agricultural revolution and its impact on culture and civilization

Examples such as dwellings from Paleolithic and Neolithic age, Stonehenge etc.

West Asian Architecture – Sumerian, Babylonian, Assyrian and Persian culture – evolution of city-states and their character and architecture – evolution of the ziggurat and palaces.

Examples such as White temple at Warka, Ziggurat of Ur, Urnamu, Ishtar Gate, Palace of Sargon at Khorsabad, Palace at Persepolis

Unit -2: Egyptian Civilization

Landscape and culture of Ancient Egypt – history – religious and funerary beliefs and practices – monumentality – tomb architecture: evolution of the pyramid, Mastaba, palaces, temple architecture: mortuary temples.

Examples such as Obelisk, sphinx, pylon, Mastaba-Aha at Sakkara, Step pyramid of Zoser, Bent pyramid, Great Pyramid of Cheops, Temple of Khons at Karnak, temple of Mentuhetep

Indus valley civilization: Harappa, Mohenjo-Daro, Great bath, Granary & town planning

Unit -3: Classical Period: Greece

Landscape and culture of Greece – Greek culture – Hellenic and Hellenistic cultures – Greek character – Greek city planning – architecture in classic periods; Public Buildings- Greek temple: evolution and classification- Greek Orders in architecture: Doric, lonic, Corinthian.

Examples such as The Acropolis, Theatre Epidaurus, Agora, Stoa, The Parthenon, The Erechthion

Unit -4: Classical Period: Rome

Roman history: Republic and Empire – Roman religion and the Roman temple – Roman urban planning – art and architecture as imperial propaganda: forums and basilicas- structural forms, materials and techniques of construction – Roman orders – Tuscan and Composite, Enclosure and manipulation of space- Public Structures

Examples such as Forum Romanum, Basilica of Trajan, The Pantheon, column of Trajan, Arch of Septemius Severus, Roman Colloseum, aqueduct, thermae

References:

1. ReSir Banister Fletcher, "A History of Architecture", CBS Publications (Indian Edition),1999.
2. Spiro Kostof, "A History of Architecture: Setting and Rituals, Oxford University Press, London, 1985.
3. Leland M Roth; "Understanding Architecture: Its Elements, History and Meaning"; Craftsman House; 1994.
4. Pier Luigi Nervi, General Editor, "History of World Architecture – Series", Harry N. Abrams, Inc. Pub., New York, 1972.
5. Lloyd S. and Muller H.W., "History of World Architecture – Series", Faber and Faber Ltd., London, 1986.

- Gosta, E. Samdstrp, "Man the Builder", Mc.Graw Hill Book Company, New York, 1970.
- Webb and Schaeffer; "Western Civilisation", Volume I; VNR: NY: 1962.

B19AR1050	Environmental Studies	L	P	D	C
Duration :14 Wks		2	0	0	2

Prerequisites:

Basics of Sciences, geography and immediate environment

Course Objectives:

The objectives of this course are to:

1. Emphasize the importance of environmental studies in the context of built & unbuilt environment shaped by architects
2. Enlist the various components of the environment including the various types of energy and natural resources.
3. Impart knowledge with respect to biodiversity, its threats and its conservation and appreciate the concept of ecosystem.
4. Familiarize students with threats to our environment & ways for protecting the environment.

Course Outcomes:

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

1. Comprehend the various components of the environments and its stakeholders
2. Enlist the Sources of energy with a focus towards innovative, renewable sources.
3. State the ecological imbalances and measures to protect it.
4. Assess the environmental conditions, causes of pollution and provide solutions towards its protection

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR1050/ EVS	CO1	2	0	2	0	0	2	0	2	3	0	3
	CO2	2	3	0	0	0	0	0	1	3	0	2
	CO3	1	0	2	1	0	2	0	1	3	3	2
	CO4	3	1	2	0	0	0	1	1	0	1	1

Course Contents:

UNIT I: Introduction

Basic definitions, Objectives and Guiding principles of Environmental Studies in relation to architecture, Components of Environment, Structures of atmosphere, Man-Environment relationship, Impact of Technology on the environment , Environmental Protection Acts and policies – Role of Government, Legal aspects, Initiatives by Non – Governmental Organizations (NGO), Community participation and awareness – through architectural examples

UNIT II: Energy & Natural Resources

Energy – Different types of energy- Conventional and Non-Conventional sources of energy, alternative source of Energy used through present day examples, conservation of natural resources.

UNIT III: Ecology & Ecosystems

Impact of human civilizations on the earth's major Ecosystem, Forests, Oceans & Atmosphere. Assessing the impacts and ways for its mitigation, Energy flow in eco-system, Land use matrix – Consumption, Carbon Footprint, Ecological Footprint, Bio-diversity

UNIT IV: Environmental Pollution

Environmental Degradation, Pollution, Sources of Pollution, Types of Environmental Pollution, Current Environmental Global issues, Global Warming & Green Houses, Effects, Understanding of environmental pollution and its impact through case-studies. Role of an individual in prevention of pollution. Disaster management: Floods, earthquake, cyclone and landslides.

REFERENCE BOOKS:

1. Raman Sivakumar, (2005), "Principles of Environmental Science and Engineering", Second Edition, Cengage learning, Singapore
2. Meenakshi P. (2006), "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi
3. Prakash S.M. (2007), "Environmental Studies", Elite Publishers, Mangalore
4. ErachBharucha (2005), "Text Book of Environmental Studies", for UGC, University Press
5. Tyler Miller Jr. G. (2006), "Environmental Science – Working with the Earth", Eleventh Edition, Thomson Brooks/Cole
6. "Text Book of Environmental and Ecology" by Dr. Pratibha Sing, Dr. Anoop Singh and Dr. Piyush Malaviya.

B19AR1060	Technical English-I	L	P	D	C
Duration :14 Wks		0	4	0	2

Prerequisites:

Basic knowledge of English, spoken and written

Course Objectives:

1. To prioritize listening, writing and reading skills among learners.
2. To introduce required speaking and communication for a professional working Environment.
3. To simplify writing skills needed for academic as well as workplace context.
4. To ascertain if learners utilise the electronic media such as the internet and supplement the learning materials used in the classroom.

Course Outcomes:

1. Communicate effectively in technical English through reading, writing and speaking
2. Demonstrate writing skills with proper usage of English language grammar
3. Illustrate nuances of critical thinking and report writing required for professional education.
4. Imbibe a professional attitude among peers for collaborative working through all of the soft skills

Unit 1: Functional English

Grammar:Prepositions; Modal Auxiliaries
Listening:Listening to audio (verbal & sounds)
Speaking:Debating Skills
Reading: Skimming a reading passage; Scanning for specific information
Writing:Email communication

Unit II: Interpersonal Skills

Grammar:Tenses; Wh-questions
Listening& Speaking:Listening and responding to video lectures / talks
Reading: Reading Comprehension; Critical Reading; Finding key information in a given text

Writing:Process descriptions (general/specific); Recommendations

Unit III: Multitasking Skills

Grammar:Conditional Sentences

Listening & Speaking:Listening to specific task; focused audio tracks and responding

Reading: Readingand interpreting visual material

Writing:Channel conversion (flowchart into process); Types of paragraph (cause and effect / compare andcontrast / narrative / analytical); Note Taking/ Note Making

Unit IV: Communication Skills

Grammar:Directand indirect speech

Listening & Speaking: Watching videos / documentaries and responding to questions based on them; Role plays

Reading:Making inference from the reading passage; predicting the content of a reading passage

Writing:Interpreting visual materials (line graphs, pie charts etc.); Different types of Essay Writing

Semester II:

B19AR2010	ARCHITECTURAL DESIGN - I	L	P	D	C
Duration:14 Wks		**2**	**2**	**4**	**9**

Prerequisites:

Grasp over concepts and content discussed in BDVA, AR-I and SSBC-I

Course Objectives:

- To explore relationship between form and function
- To understand abstraction of form and generation of concept for an architecturaldesign
- To Translate behavioral needs into an architectural project

To develop sensitivity towards site and surroundings

Course Outcomes:

On completion of the course, learners will be able to:

1. Infer the relationship between space & Activities.
2. Develop & express design concepts towards solving design problems
3. Interpret the design problem and propose solutions with sensitivity towards site, context and space efficiency.
4. Acquire skills in accurate architectural representations through 2D and 3D media.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR2010/ AD-I	**CO1**	0	2	2	1	1	0	1	1	1	2	1
	CO2	0	3	2	1	1	0	1	1	1	2	1
	CO3	1	2	2	0	0	0	0	1	2	2	1
	CO4	3	2	2	0	1	0	2	0	3	2	1

Course Contents:

UNIT 1: INTRODUCTION TO FORM GENERATION

Abstraction and Form Generation

Basics of form and function symbiosis. Studio exercises linked to form exploration in architectural design applying model making techniques of working with multiple media.

Introduction to Design of simple uni-functional spaces. Introduction to the problem, Requirement finalization, concept development.

Unit 2: DESIGN OF HABITABLE SPACE

Exercises relating personal experiences to behavioral needs and translating them into architectural program requirements.

Introduction to design of a simple building within the immediate observable environment. Basic introduction to the design of human habitat, its components and space standards.

Explore the relationship between human feelings and architectural form – observe aspects of design like aesthetics, light, circulation, form guidelines for design

Unit 3: FORMULATION OF DESIGN AND RESPONSE TO SITE

Case studies, case study documentation and presentation. Introduction to Site, site analysis, Concept, Single line plan, translating between 2D and 3D to resolve the plan using study models.

Unit 4: DESIGN DEVELOPMENT AND PRESENTATION

Double line plans, 3D visualization through models, elevations, sections, site plan, application of rendering and presentation technique to all drawings.

Students shall explore different materials for making models.

References:

1. Wucius Wong “Principles of two-dimensional designs”
2. Francis D.K. Ching “Architecture-form space and order”.
3. Robertson Howard “The principles of architecture composition”
4. Leon Baptista Alberti “The Ten Books of Architecture”
5. John Hanock “Time Saver Standards for Architectural Design Data”
6. Ramsay and Sleeper “Architectural Graphic Standards”

B19AR2020	STRUCTURAL SYSTEMS & BUILDING CONSTRUCTION & MATERIALS - II	L	P	D	C
Duration:14 Wks		**3**	**3**	**1**	**6**

Prerequisites:

Basic knowledge of contents discussed in SSBC-I, AR-I and BDVA

Course Objectives:

1. Outline the basic structural loads, support systems and equilibrium of forces and describe the properties of timber in carpentry and Joinery, its usage in Doors and window
2. Demonstrate the structural behavior of timber through concept of triangulation load transfer
3. Introduce Graphic vector analysis, Modulus of Elasticity, Stress strain relation
4. Illustrate through drawings the principles of staircase design and details of Timber staircases.

Course Outcomes:

On completion of the course, learners will be able to:

1. Interpret the concept of loads, support systems and equilibrium of forces through problem solving and apply knowledge of Joinery in design of Timber doors and windows.
2. Explore different types of roof trusses based on the spans in timber
3. Describe the different vector forces, Modulus of Elasticity, Stress strain relation graphically, and through problem solving.
4. Apply the knowledge in designing and detailing of timber staircases.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR2020/ SSBC-II	CO1	2	3	2	2	1	2	1	1	2	3	1
	CO2	3	2	3	1	1	2	0	1	2	2	2
	CO3	1	0	3	1	1	1	0	1	1	2	2
	CO4	2	3	2	1	1	2	1	1	2	2	2

Course Contents:

UNIT-I

- **Loads on Structures:** Dead load (DL), live load (LL).
- **Principle of transmissibility of forces:** Understanding load flow by tributary load and load path (slab, beam, and girder) and vertical members (post, wall, and footing); load path. Force and stress
- **Equilibrium of Forces:** Force, Reaction, Moment and Principle of Support conditions and their significance in resistance to forces and to maintain equilibrium.
- **Application of Timber as a Structural material:** Study of structural system using timber posts and rafters, typical junction details and joinery in timber
- **Doors**- Introduction to basic doors types frames, parts of door, types of doors, detail study of panel doors with glass, flush doors, and louvered door.
- **Windows:** Basic Casement windows in timber with fixed and openable shutters. Introduction to fanlights, top hung ventilators, fixed window, horizontal and vertical pivot windows, and louvered windows, double glazing, fixed and sash windows, Bay windows in Timber.
- **Materials:** Timber and its frame sections and beading details

UNIT-II

- **Introduction to Pitched Roofs and Truss:** Truss concept of triangulation, common timber truss configurations like Lean- to Couple, couple close, collar, collar with tie etc with detail, King post truss and Queen Post truss and typical junction details
- **Truss loads and reactions**: For a given configuration of the trusses and center to center spacing, calculations of the dead weight of the truss and the dead weight of the roof cover and support reaction loads.
- **Materials:** Types of roof covering for Pitched roofs

UNIT-III

- **Basic principles of mechanics:** Tension, compression
- **Stress/strain relations (Hooke's Law):** Modulus of Elasticity, linear and non-linear materials, elastic, plastic, and elastic-plastic materials; Poisson's Ratio; Thermal stress and strain.
- **Graphic vector analysis:** Resultant and equilibrant of coplanar, concurrent and non-concurrent force systems. Parallelogram, force polygon, resultant, equilibrant, components; numeric method

UNIT-IV

- Staircase terminology, design, calculations, and types and basic rule and design of riser and tread. Different Staircase typologies- Masonry, Dog-legged, Open well, staggered, spiral, geometric, etc. Qualities of good staircase design in Public and private buildings.
- Detailing of Timber staircase for Dog-legged staircase.

Site / field visit: Regular site visits to construction sites and buildings to understand the practical implication of classroom learning.
2 to 4 plate from each unit, sketch books and material portfolio to be prepared

References:

1. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
2. Building Construction, Sushik Kumar, Standard Publishers Distributors, New Delhi
3. Building Construction, Punmia, Ashok K Jain, &Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi
4. Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York.

B19AR2030	Architectural Representation-II	L	P	D	C
Duration:14 Wks		2	1	1	4

Prerequisites:

Basic knowledge of contents deliberated in BDVA,AR-I, SSBC-I on drafting skills and rendering.

Course Objectives:

1. Demonstrate skills in technical representation of geometric forms and development of lateral surfaces and sections of solids
2. Introduce the techniques of perspective drawings-one point perspective and 2point perspective
3. Introduce the techniques of perspective drawings of built environment
4. Explain the techniques of light and shadow in a built environment.

Course Outcomes:

On completion of the course, learners will be able to:

1. Explore the skills in technical representation of geometric forms

2. Draw perspective views of interior elements of a building
3. Draw perspective views of the exterior of a built environment
4. Explore the techniques of light and shadow using sciography

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR2030/ AR-II	**CO1**	0	2	1	2	1	2	0	1	1	1	2
	CO2	0	2	1	2	1	2	0	1	1	1	2
	CO3	1	2	1	2	1	2	0	1	1	1	2
	CO4	0	3	1	2	1	2	0	1	1	1	2

Course Contents:

UNIT-1

Section of solids

Exercise -True shapes of sections for simple geometric forms (Prism, Pyramid, & cone).

Development of surfaces

Development of lateral surfaces of Solids - Polyhedral (Cube – Tetrahedron – Prisms, Pyramids cone and Cylinder), its application to built forms, Suggested examples: Domes.

UNIT-2

Perspective drawings

Introduction to perspective drawings and understanding of picture plane, station point, vanishing point, eye level, ground level, their variation and their resultant effects.

One-point perspective drawings

Generate multiple perspective drawings by altering the VP and PP, and by keeping SP fixed for the simple geometric objects. Perspective drawings of everyday objects like chair and table. Perspective drawings of simple built form -interior or exterior of building.

UNIT-3

2-point perspective drawings

Exercise-Perspective drawings of simple geometrical objects and their combinations. Perspective drawings of simple everyday objects. Sketching Perspective view of built forms-Interior or exterior of building.

UNIT-4
Architectural Rendering-2

Introduction to Sociography: Learning about light, shade and shadow on built forms. Introducing to rendering techniques of plans, elevations, sections with ink and colour Basics of colour theory, free hand rendering of landscapes & built scapes including human Figures and street elements for the perspective view of buildings. Understanding the importance of colour schemes in design presentation as well as its application on built form.

References:

1. N.D. Bhat "Engineering Drawings"
2. I.H. Morris. "Geometrical Drawing for art students"
3. K.R. Gopalkrishna "Engineering Drawings (vol-1&2)"
4. "Architectural Graphics" by C. Leslie Martin
5. "Architectural Graphics" by Francis D K Ching

B19AR2040	HISTORY OF ARCHITECTURE - II	L	P	D	C
Duration:14 Wks		3	0	0	3

Prerequisites:

Sketching skills, knowledge on world history, SSBC-I

Course Objectives:

1. To outline the evolution of architecture in the Western World from early Christian period till late renaissance.
2. To describe architectural evolution as a product of socio cultural contexts including aspects of politics, society, religion and climate.
3. To explain the development of architectural form with reference to Technology, Style and Character.
4. To familiarize the students with different stylistic variations as seen in architectural styles from early christian to late medieval period.

Course Outcomes:

On completion of the course, learners will be able to:

1. Trace the evolution of architecture in the west from the early Christian to late medieval period.
2. Demonstrate an understanding of socio cultural context, climatic influences and technical advancement with reference to various styles of architecture.
3. Illustrate construction techniques and architectural characteristics of the period
4. Acquire skills to describe historical buildings through various media such as sketching, audio visual presentations, model making etc.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR2040/ HOA-II	CO1	2	0	2	0	1	0	1	0	2	0	0
	CO2	2	0	3	1	2	0	2	0	3	1	0
	CO3	2	2	3	1	2	0	2	0	2	1	1
	CO4	1	1	2	0	2	0	1	0	1	1	0

Course Contents:

UNIT-I

EARLY CHRISTIAN &BYZANTINE -

Architectural Character and various influences over Early Christian architecture in Italy
Church planning – Basilican concept: St. Peters Rome (old), St. Clemente
Tombs- tomb of Gala Placidia, Baptisteries – Baptistery of Constantine
Architectural Character and various influences over architecture in Byzantine
Centralized plan concept: S. Hagia Sophia, Constantinople; St. Marks, Venice

UNIT-II

EARLY MEDIEVAL PERIOD -

Introduction to Romanesque architecture, Architectural character, influences etc
Architectural Character & building techniques of Romanesque architecture of
Italian Romanesque churches, development of vaulting, building techniques, Pisa Group
French Romanesque architecture with examples such as Abbey aux Hommes
British Romanesque architecture with examples such as Peterborough cathedral

UNIT-III

LATE MEDIEVAL PERIOD -

Introduction to Gothic Architecture, influences and Architectural Character
Development of Gothic architecture Church plan, structural developments, building techniques with examples –
France – Gothic Character with examples such as Cathedral of Notre Dame
England - Gothic Character with examples such as Salisbury Cathedral
Italy - Gothic Character with examples such as Milan cathedral

UNIT-IV
RENAISSANCE AND BAROQUE –
Introduction to Renaissance architecture, Renaissance architectural character and building technique Italy –Contribution of Brunelleschi, Palladio and Michelangelo with examples; Palazzos; St.Peter's Rome
France –Renaissance architectural character with examples such as Soufflot's Pantheon Paris
England – Renaissance architectural character with examples such as Christopher Wren's St. Paul's Cathedral
Brief Introduction to Baroque & Rococo Architecture

Examples are indicative in nature and are subject to changes.

References:

1. Toman, Rolf ,History of Architecture From Classic to Contemporary. Parragon
2. Sir Banister Fletcher, A History of Architecture, CBS Publishers
3. Ching, Franicis D K A Visual Dictionary of Architecture Van Nostrand Reinhold
4. Rodgers, Nigel The Rise & Fall of Ancient Rome Anness
5. Thomary EdithA History of Fine Arts in India and West Orient Longman
6. Yatin Pandya Elements of Space Making

B19AR2050	ARCHITECTURAL MODEL MAKING	L	P	D	C
Duration:14 Wks		1	2	0	2

Prerequisites:

Material properties, AR-I, knowledge on geometry, sense of color and composition

Course Objectives:

- Introduction to basic technique of surface development using lightweight materials
- Train in basic skills and creative use of various materials for model making
- Demonstrate techniques of making models to scale

- Explain the usage of conventional model making materials such as mount board, paper, foam board, balsa wood for architectural models

Course Outcomes:

On completion of the course, learners will be able to:

1. Make models of desired texture and form
2. Explore the different types of materials and its feasibility in model making.
3. Use suitable materials for Architectural models
4. Prepare scaled models using innovative techniques for the corresponding architecture studio design

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR2050/ ARCH MODEL MAKING	CO1	2	3	1	2	1	2	0	1	2	2	2
	CO2	3	3	1	2	1	2	0	1	3	3	2
	CO3	1	3	1	2	1	2	0	1	1	2	2
	CO4	2	3	2	2	1	2	0	1	1	3	2

Course Contents:

UNIT-I

Introduction to different materials, Surface development using paper, making basic shapes out of different materials to explore the nature & texture of the material, Choose from Plaster of Paris, cement, wire mesh etc.

UNIT-II

Geometrical shapes in varied materials. Choose from materials such as clay, Pottery and papier Mache etc.

UNIT-III

Exercises involving creating small study models for architectural projects, understanding of scale, material usage for various elements such as building components (walls/ openings /staircase/ roofing), furniture etc. Usage of conventional model making materials such as mount board, paper, foam board, balsa wood etc.

UNIT-IV

Exercises involving creating large scale study models for architectural projects including buildings, site detailing on model, landscape elements, street furniture etc. Color scheme and textures for large scale architectural models. Innovative use of various model making materials to achieve the desired texture and form.

Architectural model making must be in tandem with the studio projects of architectural design-I

References:

1. Gill, Rober W   Rendering with Pen + Ink   Thames & Hudson
2. Ching, Franicis D K   Architectural Graphics   John Wiley
3. Ching, Franicis D K   A Visual Dictionary of Architecture Van Nostrand Reinhold

B19AR2060	TECHNICAL ENGLISH- II	L	P	D	C
Duration:14 Wks		0	4	0	2

Prerequisites:

Knowledge on English, written and spoke, current events and use of devices for communication

Course Objectives:

1. To Illustrate application of language skills effectively in real-life scenarios.
2. To develop the learners' competence to ensure employability.
3. To improve the habit of writing, leading to effective and efficient communication.
4. To prioritize specially on the development of technical reading and speaking skills among the learners.

Course Outcomes:

On completion of the course, learners will be able to:

1. 1 Organize their opinions clearly and meaningfully.
2. Demonstrate the ability to speak appropriately in social and professional contexts.
3. Build inferences from the text.

4. Participate in interviews confidently and develop accurate writing skills using different components of academic writing.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR2060/ TE-II	CO1	0	0	0	3	3	0	0	3	0	0	3
	CO2	0	1	3	3	3	0	0	0	0	0	3
	CO3	0	0	0	3	3	0	0	0	0	0	3
	CO4	0	3	0	0	0	3	0	0	0	0	3

Course Contents:

UNIT-I
UNIT I: Language Acquisition

Grammar: Active and passive voice
Listening & Speaking: Listening to informal conversations and interacting
Reading: Developing analytical skills; Deductive and inductive reasoning
Writing: Giving Instructions; Dialogue Writing

UNIT II : Persuasive Skills

Grammar: Compound words; Phrasal verbs
Listening: Listening to situation based dialogues
Speaking: Group Discussions
Reading: Reading a short story or an article from newspaper; Critical reading
Writing: Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives)

UNIT III: Cognitive Skills

Grammar: Homonyms; homophones
Listening: Listening to conversations; Understanding the structure of conversations
Speaking: Presentation Skills
Reading: Extensive reading
Writing: Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions - interpretation of data using charts, PPT); Precis Writing

UNIT IV: Employability Skills

Grammar: Idioms; Single Word Substitutes
Listening: Listening to a telephone conversation; Viewing model interviews (face-to-face, telephonic and video conferencing)
Speaking: Interview Skills, Mock Interviews
Reading: Reading job advertisements and the profile of the company concerned
Writing: Applying for a job; Writing a cover letter with résumé / CV.

References:

1. Taylor, Grant English Conversation Practice TMH
2. Mudambadithaya, G S Communicative English Made Easy Sapna
3. Thomson, A J & Martinet, A VA Practical English Grammar Oxford

B19AR2070	CONSTITUTION OF INDIA	L	P	D	C
Duration:14 Wks		2	0	0	2

Prerequisites:

Knowledge on Civics, structure of Government, law

Course Objectives:

1. Discuss the constitution of India and evolution of constitutional law
2. Enumerate the scope and extent of fundamental rights and duties.
3. Describe the roles and duties of the leaders of the country
4. Define the term amendment and describe the various amendments

Course Outcomes:

On completion of the course, learners will be able to:

1. Outline the constitution of India
2. Cite the fundamental rights and duties
3. Outline the roles and duties of the leaders of the country
4. Examine and interpret the amendments

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR2070/ C.I	**CO1**	2	0	3	0	1	0	1	1	3	0	3
	CO2	3	0	3	0	0	0	0	3	0	0	3
	CO3	0	0	3	0	0	3	0	0	3	0	3
	CO4	3	0	3	0	0	0	0	3	0	0	3

Course Contents:

UNIT I

Preamble to Constitution of India – Evolution of Constitutional Law, Citizenship under constitution
Indian Tricolour Flag: its features and significance.
Scope and Extent of Fundamental Rights under Part III – Details of Exercises of Rights, Limitations and Important Cases

UNIT II

Relevance of Directive Principles of State Policy under Part IV
Significance of Fundamental Duties under part IV (a)

UNIT III

Union Executive President, Vice-President, Prime Minister, Council of Ministers, Parliament and Supreme Court of India
State Executive, Governor, Chief Minister, Council of Ministers, Legislature and High Courts
Electoral Process and special provisions: Electoral process in India.

UNIT IV

Amendment procedures: 42nd, 44th, 74th, 76th, 86th and 91st Amendments
Constitutional provisions for scheduled castes and tribes; special provisions for Women andChildren and Backward Classes
Emergency Powers

References:

1. Basu, Durga Das Introduction to the Constitution of India V K Publishers
2. Pylee, M V Constitution of India Vikas Publication, New Delhi, 2007

Semester III:

B19AR3010	ARCHITECTURAL DESIGN – II	L	P	D	C
Duration:14 Wks		2	2	4	9

Prerequisites:

Space understanding, anthropometry, knowledge gained in AD-I, AR-II, SSBC-II, Model Making and other foundation courses

Course Objectives:

1. To identify the relation between site, building and user requirements.
2. To Understand horizontal and vertical circulation patterns
3. To Recognize the role of fenestrations in building design
4. To express through design the articulation of interior volumes, light and movement

Course Outcomes:

On completion of the course, learners will be able to:

1. Apply suitable design philosophy for public use spaces.
2. Extend the knowledge gained in Building construction and Structures to the Architectural design project.
3. Demonstrate an ability to design a space using anthropometrics.
4. Explore the relation of built to unbuilt spaces.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR3010/ AD-II	CO1	0	0	2	1	0	2	2	1	2	2	3
	CO2	2	2	1	1	1	2	1	0	2	3	2
	CO3	2	2	2	1	1	2	1	0	1	3	2
	CO4	1	3	1	2	1	1	2	1	2	2	3

Course Contents:

Studio Theme- *Site and Context*

Unit 1: INTRODUCTION TO DESIGN FOR PUBLIC USE
Design of a building for public activity spread over more than one level.
Introduction to the design, Case studies, case study documentation and presentation, anthropometry studies

Unit 2: FORMULATION OF DESIGN PROBLEM

Requirement finalization, Site study, site analysis, concept development, bubble diagram, User Space matrix, Proximity matrix and Site zoning.
Single line development of floor plans based on function and concept.

Unit 3: DESIGN DEVELOPEMENT
Development of site plan, double line plans, basics of parking and standards, study models, roof plan, massing, elevations, sections, site plan.

Unit 4: DETAILING THE DESIGN AND PRESENTATION
Detailing of one component of the built- space within the whole design (Special study) with emphasis on openings, façade treatments, structural framework, materials etc
Development of the design with furniture layout, treatment of open spaces, detailed sections, perspectives and models. Students are encouraged to try software knowledge gained for some part of the presentations.

References:

1. Neufurt, Ernst architect's data. Crosby LockWood and Sons
2. Time Saver Standards for Architectural Design Data. McGraw Hill.
3. An Introduction to predesign. Naresh Shah, NIASA publication.

B19AR3020	STRUCTURAL SYSTEMS & BUILDING CONSTRUCTION & MATERIALS - III	L	P	D	C
Duration:14 Wks		4	3	1	7

Prerequisites:

Understanding gained in SSBC-I, II, Architectural Design will be required to comprehend and apply the knowledge in the course

Course Objectives:

1. Acquire the knowledge of different types of Door and openings with UPVC and Aluminum
2. Outline the special opening in buildings and plastics in construction industry
3. Explain the RCC mechanics with respect to building components and introduce traditional roofing methods
4. Describe the different type of beams and design of slabs in RCC

Course Outcomes:

On completion of the course, learners will be able to:

1. Illustrate knowledge gained on types of Non-Timber doors
2. Describe graphically windows, special openings and roof openings and gain material knowledge on plastics and other market varieties
3. Discuss the mechanical property and behaviour of RCC on elements of building and acquire knowledge on traditional roofing systems.
4. Describe structural behaviour of RCC in terms of slabs and beams

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR3020/ SSBC-III	CO1	3	2	2	1	1	2	0	1	2	2	2
	CO2	2	3	2	1	1	2	1	1	2	2	2
	CO3	3	2	3	1	1	2	0	1	2	2	2
	CO4	3	2	3	1	1	2	1	1	2	2	2

Course Contents:

UNIT I

- **Doors:** Introduction to Sliding door, folding door, sliding and folding door, (UPVC and aluminum)
- **Materials:** Timber and beading details, Aluminum, UPVC frame sections
- **Market study**- rolling shutters, collapsible gates

UNIT 2

- Special openings: sliding window, dormer windows with UPVC and Aluminum
- Skylights-Study and details of different types of skylights.
- Materials Study: Plastics as a building material, types, properties and uses of plastics such as polycarbonates, acrylics, PVC polymer films, and fiber reinforced plastic, glass reinforced plastics. Application and details.

UNIT 3

- **Bending moment and shear force diagrams:** concept of bending moment and shear force. BMD and SFD for different types of beams subjected to loads.
- **Deflection of beams:** concept of deflection of different types of beams and different loading condition
- **Mechanics of Reinforced Concrete:** Properties of Concrete, Compression and tension in Concrete and Structural behavior under load and the need for reinforcement.
- RCC Materials: Basic Characteristics of Concrete & Reinforcing Steel Materials including specifications and testing.
- Study of Roof / Floor: Brick jack arch, flagstone floors, Jack arch floor, madras terrace, ordinary flat brick floor.

UNIT 4:

- Detailing of singly reinforced beams and Doubly reinforced beams
- Structural principles and design of one way and Two-way Concrete slab system,
- Principles of temporary works such as shuttering, centering and scaffolding, Form work, Centering and scaffolding materials used for these temporary structures - timber & steel.

  Site / field visit: Regular site visits to construction sites and buildings in order to understand the practical implication of theoretical inputs.

References:

1. Strength of materials by Ramamrutham, Dhanpat Rai publications
2. Strength of materials by S SBhavikatti, C CHAND publications
3. Design of structural elements (RCC vol-1) by SS Bhavikatti New age international publication.
4. Design of reinforced concrete structures III edition by Krishnaraju

B19AR3031/ B19AR3032/ B19AR3033/ B19AR3034/	Carnatic music/ Elements of visual representation/ Film appreciation/ Post modernism in literature	L	P	D	C
Duration:14 Wks		2	0	0	2

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR3031/ B19AR3032/ B19AR3033/ B19AR3034/ RULO	**CO1**	0	2	1	1	0	1	0	1	3	0	1
	CO2	2	2	1	1	0	1	0	1	3	0	1
	CO3	3	2	0	1	0	1	0	1	3	0	2
	CO4	4	3	1	2	0	2	0	1	4	1	3

Course code:	B19AR3031
Semester:	**III**
Course title:	CARNATIC MUSIC
Credits:	**2**
Course Duration:	8 Weeks

5.

6. **Instruction Details**

7. WEEKLY 2 CLASSES ON EVERY SATURDAY
8. STARTING OF SESSION 14 SEP 2020
9. END OF SESSION 06 NOV 2020
10. EXAM DATE 19 DEC 2020 MS: 9:00 AM – 12:00 AM AS: 2:00 PM – 05:00 PM
11.
12. COURSE LAYOUT
13. Music in India
14. Variety of Music in India – Folk, popular, religious and classical music.
15. Musical material
16. The 12 pitches or swara sthana-s
17. The scale - natural or just tempered scale as opposed to the equal or even tempered scale.
18. Raga - the basic melodic facet of Indian music
19. What makes for a raga – swara (note/tone), gamaka (embellishment), pidi (phrase), graha, nyasa, jeeva swaras.
20. Variety of raga-s and their classification. The 72 melakarta schema
21. Tala - the rhythmic facet
22. Concepts of the avartanam, samam, and eduppu
23. Suladi sapta tala schema
24. Composition
25. Composers - the Carnatic trinity and their contribution; before them and after them
26. Kinds of composition: Varnam, Kriti, Padam, Javali.
27. Bhakti and Carnatic Music

28. Improvisation
29. What is the nature of improvisation in Carnatic music; various kinds of improvisation - alapana, neraval, swara prastara and tanam. The RTP - Ragam, Tanam, Pallavi.
30. Presentation of a Carnatic concert - the meshing of the compositional and improvisational aspects.
31. Accompaniment - its unique nature in Carnatic music.
32. Percussive and melodic instruments
33. Listening to a Carnatic concert - aesthetic and technical aspects.
34.
35.
36. BOOKS AND REFERENCES
37. Nil
38.
39. INSTRUCTOR BIO
40.
41. Prof. Lakshmi Sreeram
42. IIT Madras
43. Trained in Carnatic music since her childhood, Lakshmi has been a performer for over 25 years. She also performs Khayal, a north Indian tradition of classical music. She has a Ph.D in Philosophy from the University of Bombay focusing on the idea of dhvani in Anandavardhana's Dhvanyaloka, a 9th century Sanskrit text in the tradition of Alankarasastra (literary theory). She has been teaching introductory courses on Carnatic and Hindustani music at the prestigious Indian Institute of Technology, Madras. She is also a freelance journalist. For more details and music clips, please visit www.lakshmisreeram.com.
44. 44.
45. COURSE CERTIFICATE
46. · The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
47. · The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
48. · Date and Time of Exams: 19 December 2020 ,Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
49. · Registration url: Announcements will be made when the registration form is open for registrations.
50. · The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
51. · Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.
52. 52.
53. CRITERIA TO GET A CERTIFICATE
54. · Average assignment score = 25% of average of best 6 assignments out of the total 8 assignments given in the course.
55. · Exam score = 75% of the proctored certification exam score out of 100
56. · Final score = Average assignment score + Exam score
57. YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75.

58. · If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

59.

60.

Course code:	B19AR3032
Semester:	III
Course title:	ELEMENTS OF VISUAL REPRESENTATION
Credits:	2
Course Duration:	8 Weeks

61.

62. Instruction Details

63. WEEKLY 2 CLASSES ON EVERY SATURDAY
64. STARTING OF SESSION 14 SEP 2020
65. END OF SESSION 06 NOV 2020
66. EXAM DATE 20 DEC 2020 MS: 9:00 AM – 12:00 AM AS: 2:00 PM – 05:00 PM
67.

68. COURSE LAYOUT
69. Week 1: Introduction to Art and visual language
70. Week 2: Composition and Space
71. Week 3: Perception of motion
72. Week 4: Scale and Proportion
73. Week 5: Line as a visual element
74. Week 6: Visual harmony and balance as a rule
75. Week 7: Color combination, value and texture
76. Week 8: Visual analysis and conclusion
77.
78. BOOKS AND REFERENCES
79. NIL
80.
81. INSTRUCTOR BIO
82. Prof. Shatarupa Thakurta Roy
83. IIT Kanpur
84. Dr. Shatarupa Thakurta Roy is an assistant Professor at the Indian Institute of technology Kanpur, in the discipline of Fine Arts, under the Department of Humanities and Social Sciences. She has done her BFA and MFA in Fine Arts from Kala Bhavana, Visva Bharati University, Santiniketan and PhD from the Department of Design, Indian Institute of Technology Guwahati. Her area of specialization is Graphic Art and Design Culture. She is involved in teaching art history, criticism and appreciation, design theory, drawing and painting.

85. 85.
86. COURSE CERTIFICATE
87. • The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
88. • The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
89. • Date and Time of Exams: 20 December 2020, Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
90. • Registration url: Announcements will be made when the registration form is open for registrations.
91. • The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
92. • Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.
93. 93.
94. CRITERIA TO GET A CERTIFICATE:
95. • Average assignment score = 25% of average of best 6 assignments out of the total 8 assignments given in the course.
96. • Exam score = 75% of the proctored certification exam score out of 100
97. • Final score = Average assignment score + Exam score
98. YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75.
99. • If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
100. • Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Kanpur. It will be e-verifiable at nptel.ac.in/noc
101. • Only the e-certificate will be made available. Hard copies will not be dispatched.
102.

Course code:	B19AR3033
Semester:	III
Course title:	FILM APPRECIATION
Credits:	2
Course Duration:	8 Weeks

103.

104. Instruction Details

105. WEEKLY 2 CLASSES ON EVERY SATURDAY
106. STARTING OF SESSION 14 SEP 2020
107. END OF SESSION 06 NOV 2020
108. EXAM DATE MS: 18 DEC 2020 9:00 AM – 12:00 AM AS: 2:00 PM – 05:00 PM

109.
110. COURSE LAYOUT
111. WEEK 1 :
112. · Introduction
113. · Key concepts-Part 1
114. · Key Concepts-Part 2
115. · Film Theory
116. · Genre Theory
117. WEEK 2 :
118. · Traditions in World Cinema-Lecture: German Expressionism
119. · Lecture: Italian New-Realism
120. · Lecture: French New Wave
121. · Lecture: Spanish Cinema
122. · Lecture: British New Wave
123. · Lecture: Chinese Cinema
124. WEEK 3 :
125. · Action Cinema
126. · Lecture: Deewar
127. · Aspects of Cinema: Melodrama
128. · Formalism in Cinema
129. · The Language of Cinema
130. · Devdas
131. · City Cinema
132. WEEK 4 :
133. · The Semiotics of Cinema
134. · Raging Bull
135. · Robert Bresson
136. · Studio Cinema: Part -1
137. · Studio Cinema: Part 2
138. WEEK 5 :
139. · New Hollywood Cinema: Part 1
140. · New Hollywood Cinema: Part 2
141. · History of Hindi Cinema Part 1
142. · History of Hindi Cinema Part 2
143. · History of Hindi Cinema: Part 3
144. WEEK 6 :
145. · Aspects of cinema:
146. · Ideology in Cinema
147. · Character in Cinema
148. Cinema in India :
149. · Mythological Cinema in India
150. · The Cinema of Satyajit Ray
151. · Hindi Film Music
152. WEEK 7 :
153. · WORLD CINEMA : The Hollywood musicals
154. · WORLD CINEMA : African cinema

155. · WORLD CINEMA : Iranian cinema
156. · WORLD CINEMA : Canadian Cinema
157. · WORLD CINEMA : Eastern European Cinema
158. · WORLD CINEMA : European Cinema Hungary, Sweden, Greece
159. WEEK 8 :
160. · Postmodernism and cinema
161. · Small towns in cinema
162. · Film sequels, remakes and cult films
163. · Parallel Cinema from India
164.
165. BOOKS AND REFERENCES
166. NILL
167.
168. INSTRUCTOR BIO
169. Prof. Aysha Iqbal
170. IIT Madras
171. Aysha Iqbal Viswamohan is professor of film studies, drama and popular culture in the Department of Humanities and Social Sciences, IIT Madras. Among her several books are Behind the Scenes: Contemporary Bollywood Directors(ed.) Sage: New Delhi, 2017, Post-liberalization Indian Novels in English: Global Reception & Politics of Award London: ANTHEM, 2013. Her books on communication include English for Technical Communication, and English for Nurses and English for the Hotel Industry
172.172.
173. COURSE CERTIFICATE
174. • The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
175. • The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
176. • Date and Time of Exams: 18 December 2020, Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
177. • Registration url: Announcements will be made when the registration form is open for registrations.
178. • The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
179. • Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.
180.180.
181. CRITERIA TO GET A CERTIFICATE:
182. • Average assignment score = 25% of average of best 6 assignments out of the total 8 assignments given in the course.
183. • Exam score = 75% of the proctored certification exam score out of 100
184. • Final score = Average assignment score + Exam score
185. YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75.
186. • If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

187. • Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Madras. It will be e-verifiable at nptel.ac.in/noc
188. • Only the e-certificate will be made available. Hard copies will not be dispatched.
189.

Course code:	B19AR3034
Semester:	III
Course title:	POST MODERNISM IN LITERATURE
Credits:	2
Course Duration:	8 Weeks

190.

191. Instruction Details

192. WEEKLY 2 CLASSES ON EVERY SATURDAY
193. STARTING OF SESSION 14 SEP 2020
194. END OF SESSION 06 NOV 2020
195. EXAM DATE MS: 20 DEC 2020 9:00 AM – 12:00 AM AS: 2:00 PM – 05:00 PM
196.
197. COURSE LAYOUT
198. WEEK 1: Introducing Postmodernism -Definitions, Concepts, General Online background
199. WEEK 2: Reading the seminal texts and events which define Postmodernism-Online Lyotard,Barthes
200. WEEK 3: Locating the Postmodern in the contemporary
201. WEEK 4: Postmodernism in literature and historical survey
202. WEEK 5: Postmodernism as a literary critical approach
203. WEEK 6: Detailed study of selected texts - Prose
204. WEEK 7: Detailed study of selected texts, Poetry and drama
205. WEEK 8: Detailed study of selected texts – miscellaneous
206.
207. BOOKS AND REFERENCES
208. NILL
209.
210. INSTRUCTOR BIO
211. Prof. Merin Simi Raj
212. IIT Madras
213. Dr.Merin Simi Raj is an Assistant Professor in the Dept. of Humanities and Social Sciences at IIT Madras. She specializes in Postcolonial Writing, Modernity Studies and Historiography Studies. Her teaches History of English Language and Literature, Indian fiction in English, Literary Criticism, World Literature and Feminist Writings.
214.214.
215. COURSE CERTIFICATE

216. • The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
217. • The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
218. • Date and Time of Exams: 20 December 2020, Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
219. • Registration url: Announcements will be made when the registration form is open for registrations.
220. • The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
221. • Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc
222. .
223. CRITERIA TO GET A CERTIFICATE:
224. • Average assignment score = 25% of average of best 6 assignments out of the total 8 assignments given in the course.
225. • Exam score = 75% of the proctored certification exam score out of 100
226. • Final score = Average assignment score + Exam score
227. YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75.
228. • If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
229. • Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Madras. It will be e-verifiable at nptel.ac.in/noc
230. • Only the e-certificate will be made available. Hard copies will not be dispatched.

B19AR3040	BUILDING SERVICES I (WATER SUPPLY, PLUMBING & SANITATION)	L	P	D	C
Duration:14 Wks		2	0	0	2

Prerequisites:

Understanding of the environment (EVS) and sources of water for consumption

Course Objectives:

1. To explain the basic aspects of environment and health and illustrate the process of water supply from source to consumer and consumption patterns
2. To describe the sewage system from collection to treatment.
3. To explain the importance of stormwater collection systems and solid waste management.
4. To demonstrate how all three systems: water supply, plumbing and sanitation are incorporated in a building design.

Course Outcomes:

On completion of the course, learners will be able to:

1. Trace the evolution of the water supply, health and sanitation systems through history to current day practices.
2. Illustrate the process of water supply, from source to consumer and tabulate per capita water requirement
3. Describe the sanitary system, stormwater management and solid waste management.
4. Explore various plumbing systems applications in architectural design by drawing neat layouts.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR3040/ BS-I	**CO1**	3	2	2	2	2	2	1	2	3	3	3
	CO2	3	2	2	2	2	2	1	2	3	3	3
	CO3	3	1	1	1	2	2	1	2	3	3	3
	CO4	3	3	2	2	2	2	1	2	3	3	3

Course Contents:

UNIT I:

Introduction to Environment and Health Aspects:

History of Sanitation with respect to human civilization.

Importance of Health, Hygiene Cleanliness.

Water borne, Water related, Water based, Epidemic diseases.

Conservancy to water carriage system. Urban and Rural sanitation.

Water Supply:

Source of Water supply.

Quantity of water for different usages like Domestic, Commercial, Industrial Applications.

Rate of demand and Assessment of requirement for different users.

Quality of supply for different users as per national and international standards.

Treatment of water for different uses.

Storage and pumping – gravity system, hydro-pneumatic system.

Distribution of water to fixture and fittings, schematic diagrams.

Swimming pool, water bodies.

Efficient usage of water for firefighting.

Sump and OHT calculation design.

UNIT II:

Sewerage System:

Assessment of sewage generated.

Collection of sewage/ wastewater from all sources. Different systems of sewerage - schematic diagrams.

Conveyance of sewage, sewer appurtenances – gully trap, chamber, manhole, intercepting trap, grease traps, backflow preventer.

Materials of construction of sewerage network. Ventilation of sewers.
Objective of Sewage treatment, type of treatment, aerobic, anaerobic.
Stormwater Management:
Assessment, quantification of rainfall, flood control measures.
Drainage system–piped drains, open drains.
Recharging of storm water, Harvesting of roof top water.
Drainage of basements, podium, paved areas.
Collection, Reuse of water within the project, reduction of the load on the municipal system.
Landscape drainages and Rainwater harvesting. Recharging ground water table.
Terrace plan with Rainwater downtake pipes.

UNIT III:
Plumbing:
Water supply piping–hot, cold and flushing water.
Piping in sunken areas and false ceiling areas.
Shaft sizes. Drainage – floor traps, drains, P-trap, bottle traps.
Systems of house drainage: One pipe system, two pipe system, single stack, two stack, cross venting, fixture venting.
Material of construction like GI, PPR, PB, CPVC, Composite pipes, Copper.
Flow control Valves – Gate valve, Globe valves, butterfly valves, Pressure Reducing valves.
Plumbing of small houses: Layout of Water supply and Sanitation with all fixtures in Kitchen, Bath and Utility for a small Residence with Plan and Section.
Special requirements: Central LPG Supply System, Central Waste Collection.

UNIT IV:
Sanitary Fixtures, Fittings & Wellness:
Soil appliances: Water closets, Bidet, urinals, Cisterns, Flush valve.
Waste appliances: Wash basin, sink, dishwasher, washing machine.
Hot water system: Geysers, boilers, heat pump, Solar Hot Water Generation.
Bath & water fixtures: Taps, mixers, single lever, quarter turn, bathtub, multi-jet bath, rain showers, health faucets.
Wellness products: Sauna bath, steam bath, Jacuzzi, single and double stack system.
Solid Waste Management:
Assessment of waste, Waste to wealth concept.
Types of waste: Municipal waste, garden waste, organic & inorganic, Commercial waste, Medical waste & Industrial waste,
Process: Collection, segregation, treatment, disposal,
Organic waste treatment processes– Bio-methanation, Vermi-composting, Organic waste converter.

Site Visits:
Water/ Sewage Treatment Plants. Small Residential Building: to observe water supply, sanitary system & plumbing. Organic waste treatment center.

References:

1	Rangwala	Water Supply & Sanitary Engineering	Charotar
2	McGhee, Terence	Water Supply & Sewerage	TMH
3	Husain, S K	Text book of Water Supply & Sanitary Engineering	Oxford
4	Deolalikar, S G	Plumbing Desing& Practice	TMH
5	Gahlot P S & Sharma, Sanjay	Building Repair and Maintenance Management	CBS
6	Mohan, C R &AnandVivek	Design and Practical hand Book on Plumbing	Standard Publishers
7	Kumara Swamy, N &Kameswara Rao, A	Building Planning & Drawing	Charotor
8	Bureau of Indian Standards	Special IS Code: SP- 35 – 1996	
9	Bureau of Indian Standards	Uniform Plumbing Code India 2012	
10	Karnataka Pollution Control Board	Pollution Control Board Norms	

B19AR3050	HISTORY OF ARCHITECTURE-III- BUDDHIST AND HINDU	L	P	D	C
Duration:14 Wks		3	0	0	3

Prerequisites:

Indian History, HOA-I and II, sketching skills, writing and presentation skills

Course Objectives:

1. To articulate a broad overview of the evolution of religious architecture (Buddhist and Hindu)
2. To describe the characteristics ,influences and distinguishing features of Buddhist and Hindu architecture
3. To facilitate an analytical approach towards study of historical buildings and styles.
4. To inculcate skills in describing historical buildings through various media such as drawing, model making, audio video documentation etc.

Course Outcomes:

On completion of the course, learners will be able to:

1. Identify the general characteristics of religious Architecture in the Indian subcontinent

2. Explore the evolution and development of architecture styles under various dynasties/regions
3. Demonstrate an understanding of sociocultural context, climatic influences and technical advancements and construction techniques with reference to various styles of architecture.
4. Acquire skills to describe historical buildings through various media such as sketching, audio visual presentations, model making etc.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR3050/ HOA-III	CO1	2	1	1	0	0	1	1	1	2	1	1
	CO2	3	1	1	0	0	1	1	1	2	1	1
	CO3	3	1	1	1	0	1	1	1	3	0	1
	CO4	0	0	0	2	2	2	1	1	2	1	2

Course Contents:

Detailed study & analysis of architectural styles in Buddhist and Hindu through significant examples; Socio-political background, Climatic & geographic influence; Construction technology & material; Design principles; Typology; Evolution; Spatial organization; Form & Detailing.

UNIT I

Ancient India: Vedic village architecture

Introduction to Buddhist architecture in India- Establishment of Buddhist school, its significance & contribution; Forms of worship, building typologies, symbolism; Stupas, Viharas, Chaitya halls, stambhas

Hindu forms of worship – evolution of temple form - meaning, symbolism, ritual and social importance of temple - categories of temple - elements of temple architecture –

Development of the Hindu temple form –

- Gupta Period- Udaygiri caves, temples at Deogarh & Bhittargaon;
- Early Chalukyan- Temple form at Aihole - e.g. Lad Khan & Durga temples
- Pallava Dynasty: Rock cut Architecture- mandapas, monolithic temples (Rathas); Pancharathas & Shore temple at Mamallapuram; Kailasanatha temple/ Vaikuntha Perumal Temple at Kanchipuram.

Characteristics and differences between Dravidian, Aryan/ Nagara and Vesara styles

UNIT II

Dravidian style –

- Chola Dynasty : Development of Chola style & capital, Influence from Chalukyan style; Brihadeshwara Temple at Tanjore
- Development under Pandya Dynasty- Development of Temple Citadel & Gopuram; e.g at

Tiruvannamalai / Chidambaram.
- Temple Architecture under Madurai Dynasty: development of Prakaarams & spaces in Temple, example of Madurai Meenakshi Temple.
- Relation between Bhakti period and temple architecture - Temple towns of Kumbakonam/ Kanchipuram/ Srirangam/ Madurai / Rameshwaram.

Vesara style:
- Hoysala: Examples such as Chennakeshwara Temple at Belur/Hoysaleshwara Temple at Halebeedu/ Keshava temple at Somnathapur;

Vijaynagara dynasty: Vittala Temple / Virupaksha temple at Hampi, Settlement pattern of Hampi

UNIT III

Documentation/ Case study of any examples of Hindu / Buddhist architecture.

UNIT IV

Nagara style –
- Nagara Temples of Kalinga (Odisha) Dynasty: Types of Deulas - e.g. Lingraj/ Mukteswara/Jagannath Temples & Sun temple at Konark;
- Nagara Temples of Chandela Dynasty - Principles of shikhara & urushringa; Overview of Khajuraho group of temples; Kandariya Mahadev at Khajuraho
- Temple architecture of Gujarat- Sun temple at Modhera
- Jain Temple architecture-Planning aspects, Examples such as Dilwara temple at Mt. Abu/ Adinatha temple at Ranakpur

The examples to represent the historical styles are suggestive & students are encouraged to explore additional examples for a comprehensive understanding of the respective styles.

References:

1	Ram, Vikramajit	Elephant Kingdom Soulpture form Indian Arch	Mapin
2	Ching, Franicis D K	A Visual Dictionary of Architecture	Van Nostrand Reinhold
3	George Michel	Temple Towns of Tamilnadu	Marg
4	Sir Banister Fletcher	History of Architecture	
5	Brown Percy	Indian Architecture – Buddhist & Hindu	
6	Grover Satish	Architecture of India – Buddhist & Hindu	
7	Thomory Edith	A History of fine arts in India & the West	Orient Longman

B19AR3060	**SITE SURVEY AND PLANNING**	**L**	**P**	**D**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Basic knowledge of Site, Environment and representation skills

Course Objectives:

1. To introduce the concept of landscape, its importance & its basic elements
2. To impart knowledge and skills related to surveying and levelling principles
3. To familiarize students with survey plans and their integration in the design process
4. To familiarize the students with the process of site analysis and various steps for site planning.

Course Outcomes:

On completion of the course, learners will be able to:

1. Define and describe basic elements of landscape and landform.
2. Acquire skills for guiding and carrying out surveys for medium complexity sites.
3. Acquire knowledge and skills in levelling methods and site contours
4. Apply knowledge gained to conduct site analysis for design projects.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR3060/ SITE SURVEY& PLANNING	CO1	2	3	3	1	2	2	1	1	1	3	2
	CO2	1	0	2	2	0	1	0	2	2	1	2
	CO3	0	1	3	2	0	1	1	2	2	2	3
	CO4	0	0	2	1	0	1	2	2	1	3	2

Course Contents:

Stage 1: 2 to 3 weeks

An Introduction to Landscape

Introduction of Landscape basic terminology. Various Landscape elements. Various types of vegetation and their impact on land. Water body as a landscape element. Land and types of Landform.

Stage 2: 2 to 3 weeks

Site Survey / Site Analysis

Importance of surveying to Architects. Types and classification of survey. Principles of surveying character of work, shrunk scale. Definition of maps and understanding topographical maps of

survey of India. Shrunk scale problems.
Chain Survey: Instruments used, Types of chain, Instruments for ranging, Setting out angles, erecting perpendiculars.
Plane table survey: Accessories, Advantages and disadvantages of plane table survey, basic definitions, principles of plane tabling, setting up and orientation, methods of plane tabling: radiation and intersection, plane table traversing.

Stage 3: 2 to 3 weeks
Leveling
Basic definitions, classification of leveling methods, types of levels- dumpy level, temporary adjustments of dumpy level, reduction of levels, plane of collimation method, problems, profile leveling- methods and application, fly leveling
Contouring: Characteristics of contours, direct and indirect methods of contouring, interpolation, and uses of contours.

Stage 4: 2 to 3 weeks
Site Planning
Site Planning: Things to consider and three phases for the site planning process. Steps involved in site planning from Site analysis of identifying the landform and landscape features to commence site planning in accordance with the site and requirement

References:

1. Colise Brenda, Land and Landscape.
2. Punmia, B C, Jain, Ashok K & Jain, Arun K, Surveying Vol I
3. Punmia, B C, Jain, Ashok K & Jain, Arun K, Surveying Vol II
4. Roy, S K, Fundamentals of Surveying, PHI Learning Pvt. Ltd.
5. Bhavikatti S S, Surveying Thoery& Practice, I K International
6. Lynch, Kevin, Site Planning, IT Press, Massachusetts, 1962.
7. Trivedi, P. Pratibha, Beautiful Shrubs. Indian Council of Agricultural Research, Delhi, 1990.

B19AR3070	CAAD–I	L	P	D	C
Duration:14 Wks		1	1	1	3

Prerequisites:

Familiarity with computers and software, representation skills gained from AR-I,AR-II and Architectural Design I and II

Course Objectives:

1. To familiarize students with the digital interface in architectural representation

2.ToIntroduce the students to digital media as a tool for architectural representation

3. To equip students with skills to explain and showcase their design through digital media.

4. Familiarize students with a range of digital tools and techniques in drafting and 3D modelling.

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquire necessary skills and knowledge to use the computer and digital media as a tool.

2. Gain familiarity with the use of digital media for architectural representation

3. Draft and present architectural ideas through 2D CAD drawings.

4.Acquire skills to employ digital tools and techniques in three dimensional representation of their design.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR3070/ CAAD -I	CO1	1	2	0	2	1	1	0	2	2	1	3
	CO2	1	1	0	2	1	1	0	1	2	0	2
	CO3	1	2	0	2	1	1	0	1	2	1	3
	CO4	1	2	0	2	1	1	0	1	2	1	3

Course Contents:

Unit-1
INTRODUCTION TO CAD
Introduction to CAD:2D commands, viewports, dimensions, annotations. Time problem introduction; Classroom exercises such as measured drawing of studio (windows, doors and staircases included), architecture department (windows, doors and staircases included) etc.
Understanding layers, paper space Vs model space, line weights, print set up and Modelling of Wall, Doors, Windows, Stairs etc. Single line plan of building.

Unit-2
INTRODUCTION TO 2D PRESENTATION
2D drafting: Presentation of time problem; plan, sections, elevations of a building, of single storied

building, of previous semester architectural design studio project.
2D drafting: Presentation of time problem; floor plan with furniture layout, enlarged construction details.

Unit-3
ISOMETRIC VIEWS
Presentation of time problem; drawing quickly with basic shapes, isometric view, Adding detail to view in 3D space, use of cameras, material applications. Presenting models - to jury or clients. Preparation of drawings and details drafted in Building construction studio in to Auto cad.

Unit-4
INTRODUCTION TO 3D MODELLING
Google Sketch Up or relevant 3D modelling software–Introduction to 3Dmodelling software interface, demonstration of 3D modelling commands required to convert 2D project into 3D.
3D massing of built forms studied in History of Architecture and Theory of Architecture

Reference Books:
1. Auto CAD 2016 tutorials SDC Publications.
2. Auto CAD for Engineers and designers by TickooBhaat.
3. CAD in Civil Engineering.

Semester IV

B19AR4010	ARCHITECTURE DESIGN-III	L	P	D	C
Duration:14 Wks		2	2	4	9

Prerequisites:

Drawing and documentation skills gained in AD-II, HOA-III, SSBC-II and III , material knowledge, report writing and presentation skills

Course Objectives:

1. To introduce the techniques and methods of a documentation study
2. To understand the urban context and its implication on a design for commercial use.
3. To explain how architectural design can foster better interaction and activity in the public realm.
4. To develop a design considering the structural factors and incorporating building services

Course Outcomes:

On completion of the course, learners will be able to:

1. Relate architecture to built form, climate, materials, culture and occupation in a rural or urban setting
2. Design a space for retail/ commercial considering structural factors
3. Apply urban regulations in project planning.
4. Use the knowledge of building services while designing a commercial or retail space.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR4010/ AD-III	CO1	3	0	3	2	1	1	2	1	3	2	3
	CO2	3	1	1	2	1	1	2	1	3	3	2
	CO3	1	2	1	1	1	1	1	1	2	2	2
	CO4	1	2	2	2	1	1	1	1	2	2	3

Course Contents:

Theme : Documentation studio

Unit 1: Rural or Urban setting Documentation

Documentation study of vernacular architecture in rural or urban settings; Visit to site, socio-economic survey, Measured drawing, socio cultural study, activity mapping and study of street elevations, land use, infrastructure, vegetation etc.

Unit2: Identification of issues and Design proposals

Conducting SWOT analysis and identifying issues that need design interventions. Detailing of the proposals and presentation in the form of report and drawings

Unit 3: Design of Commercial or Public use building in Urban Context:

Introduction to urban regulatory controls and barrier free design, Case studies, case study documentation and presentation, arriving at Design requirements, Site study, site analysis, concept development, zoning.

Unit 4: Detailing of the design

Design development, relating the system of horizontal and vertical circulation, concept of a service core, Resolution of structural grid, open spaces and parking design.Double line plans, 3D visualization, Roof plan, roofing, massing, elevations, sections, site plan, application of rendering and presentation technique using manual/ software.

References:

1. Neufert, Ernst architect's data. Crosby LockWood and Sons
2. Time Saver Standards for Architectural Design Data. McGraw Hill.
3. Rural Documentation studio, NIAS publication.

B19AR4020	STRUCTURAL SYSTEMS & BUILDING CONSTRUCTION & MATERIALS - IV	L	P	D	C
Duration:14 Wks		4	3	1	7

Prerequisites:

Drafting and representation skills gained in SSBC-III, AD-III, material studies in earlier semesters

Course Objectives:

1. Acquaint students with alternative methods of slab for column free construction
2. Appraise the students with methods of steel construction for spanning small to medium spans and introduce RCC columns
3. Extend knowledge on various types of Foundations in RCC and their applications.
4. Describe various types of RCC staircases, Plastering, waterproofing and waterproofing compounds

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquire the knowledge of alternative slabs systems for medium to large Flat spans
2. Infer the principles and behavior of Steel structures for roofing, illustrate types of medium span trusses and attain the ability to design a single storied building in R.C.C
3. Identify different of types of Foundations and illustrate typical details
4. Explore different types of staircase design in RCC and waterproofing materials

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR4020/ SSBC-IV	**CO1**	3	2	3	1	1	2	1	1	2	3	2
	CO2	3	3	3	1	1	2	0	1	2	3	2
	CO3	2	1	2	1	1	2	0	1	2	2	2
	CO4	2	3	2	1	1	2	1	1	2	2	2

Course Contents:

UNIT I:

- Filler slab, various materials used in filler slab. Detailing of filler slab with various materials for a particular span. Applications of filler slabs, advantages and disadvantages of filler slabs.
- Waffle slabs- Detailing of waffle slab, applications, advantages and disadvantages.
- Flat Slabs - Detailing of Flat slab, applications, advantages and disadvantages

UNIT II :

- Steel trusses: Introduction to steel sections, welding and riveting. Buildings with small, medium span trusses, (Fink Warren, Howe, Pratt trusses) placing of trusses in key plan, typical sectional elevation of truss (tube and angle), details at ridge, eave, purlin fixing etc. Roof covering with GI sheets and other materials.
- Structural principles of columns, design and various types of columns, loads and forces acting on columns and structural failures in columns, design of columns placement and basic thumb rules.
- General framing arrangement and Structural design for a single storey building using SP 16: Design Aids for Reinforced Concrete to IS 456:2000 and calculation of total concrete volume, reinforcement tonnage

UNIT III

- RCC foundation: shallow foundations– Definition, purpose, site exploration, preliminary investigation, methods, trial pits, bore holes, Bearing capacity of soil, plate load method, penetration test method, SBC based on IS code, methods to improve SBC
- Types of shallow foundations – Isolated foundation, Grillage foundation, Combined and Trapezoidal foundations, Raft foundation and types of Raft foundations, foundation for black cotton soil, pier foundation, foundation on sloping ground, timbering of trenches, excavation for water logged sites, concrete used for foundation

- Deep foundation- Types of deep foundations, pile foundations, type of pile foundations including R.C.C and Precast piles, pile driving, structural implications, Caissons, types, Shoring, types of shoring, underpinning and scaffolding, types of scaffoldings.
- Concept Design of Retaining walls and Shear walls.

UNIT IV

- Staircase terminology, design, calculations, and types in R.C.C and basic rule of relationship and design of riser and tread. Concept of waist slab and folded plate staircase, Construction details of stairs with composite materials, Design of handrail and balusters using different materials. Various methods of fixing them.
- Plastering: Preparation, types, finishes, tools used, pointing, white washing and color washing
- Weather and water proofing elements: Water and waterproofing of flat terraces, sloping roofs, in different materials, finishes in bathrooms, basics of waterproofing, bitumen felts method. Water proofing compounds: Flexible, Semi-Rigid, Rigid and Grout materials –market survey.
- Materials Study: Types, manufacture, use. Paints for interiors and exterior, oil bound cement-based Distemper, Varnishes, Plastic Emulsion, Epoxy and Their Uses.

Textbooks:

- Building Construction, Sushil Kumar, Standard Publishers Distributors, New Delhi.
- Building Construction, B C Punmia 10th and 11th edition, Laxmi Publications (P) ltd, New Delhi.
- Building Construction Handbook, 10th and 11th edition, Roy Chudley and Roger Greeno, Routledge, London.

References:

- STRUCTURES - Martin Bechthold, Daniel L Schodek, PHI Learning Private limited
- Soil mechanics and foundations by Dr B C Punmia, Ashok kumarjain, Arun K Jain, laxmi publications.
- Advance RCC Design by S SBhavikatti, New age international publishers.
- Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
- Building Construction, Sushik Kumar, Standard Publishers Distributors, New Delhi.

B19AR4030	CLIMATOLOGY	L	P	D	C
Duration:14 Wks		4	3	1	7

Prerequisites:

Basic knowledge of Physics, environment and site understanding, geography and topography.

Course Objectives:

1. To discuss the impact of climate on architecture and vice versa.
2. To enumerate the different climatic zones and their influence on building materials and construction techniques.
3. To explain the concept of human thermal comfort.
4. To illustrate the design process for designing in response to climate.

Course Outcomes:

On completion of the course, learners will be able to:

1. Interpret the influence of climate and architecture on each other.
2. Describe thermal comfort and explain the effect of climate and architecture on human comfort.
3. Outline the design process for climatic response at various levels.
4. Analyze through case studies the design considerations for different climatic zones.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR4030/ CLIMATOLOGY	CO1	2	1	3	0	0	0	2	2	3	2	0
	CO2	2	1	3	2	2	2	2	2	3	3	3
	CO3	5	3	3	2	2	2	2	2	3	3	3
	CO4	5	3	3	2	2	2	2	2	3	3	0

Course Contents:

UNIT I:

Introduction to Climate:

Effect of climate on man, shelter and environment.
Elements of climate, measurement and representation of climatic data.
Classification and Characteristics of tropical climates, major climatic zones of India.

Thermal Comfort:
Thermal balance of the human body. Effect of climatic elements on the thermal comfort of the environment. Psychrometric chart & Bioclimatic chart.
Introduction to Climate Consultant software for systematic analysis of weather data, interpreting psychrometric charts and translating outdoor conditions to indoor comfort through the design process.

UNIT II:

Design process for climate response 1:
Site level: Effect of landscape elements on site/ micro climate. Landform, vegetation, water bodies, streets, open and built spaces, ground character.
Building level: Orientation with respect to sun path, plan form, solid void ratio, roof form.

UNIT III:

Design process for climate response 2:
Fenestration (Natural Ventilation, Day Lighting & Shading Devices): pattern, configuration, orientation and controls/ shading devices with emphasis on design of shading devices with respect to sun path, using solar charts.
Material finishes: Roof materials, wall materials, external colors & textures, external finishes.

UNIT IV:

Climatic Design considerations:
Design considerations for buildings in tropical climates with special reference to hot-dry, warm humid and cold climates
Literature study of relevant traditional and contemporary building examples.

References:

1. Koenigsberger, O H & others,
2. Manual of Tropical Housing & Building Climatic Design, University press
3. Shah, M G, Kal , C M &Patki, S Y
4. Building Drawing with an Integrated Approach to Built Environment
5. Arvind Kishan, Nick Baker, Simos Yannas & Steve Szokolay
6. Climate Responsive Architecture: A Design Handbook for Energy Efficient Buildings
7. Johan Van Lengen,
8. Barefoot Architect, A handbook for Green Building
9. Mark Dekay& G.Z. Brown,
10. Sun, Wind & Light: Architectural Design Strategies
11. Richard Hyde,
12. Climatic Responsive Design: A study of buildings in moderate & hot humid climates

B19AR4040	BUILDING SERVICES –II (ELECTRICITY, ILLUMINATION & FIRE SAFETY.	L	P	D	C
Duration:14 Wks		2	0	0	2

Prerequisites:

Basic knowledge of Physics, Architectural design-II and III, CAAD-I

Course Objectives:

1. Achieve proficiency in application of electrical services in design & construction.
2. Study the current and prospective materials used in electrical services for buildings.
3. Impart practical knowledge of electricity and illumination applications used in current architectural practice.
4. Train the students to comprehensively plan and design the electrical and illumination requirements of building design.

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquire knowledge on Planning and design of electrical services for simple spaces and Illustrate graphically the electrical layout plan for a simple residential building
2. Compute required illumination levels for different tasks.
3. Elaborate on Fire safety measures and methods adopted
4. Describe various components involved in planning the Fire fighting and protection system

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR4040/ BS-II	CO1	3	3	3	2	1	2	1	2	3	3	3
	CO2	3	3	3	2	1	2	2	2	2	3	3
	CO3	3	2	3	2	1	1	1	2	3	3	3
	CO4	3	2	3	2	1	2	2	2	2	3	3

Course Contents:

UNIT – I

Electricity

Introduction to electrical services. Transmission and Distribution of electricity to different categories of buildings, various devices and processes involved in it. Different types of service connections.

Protection systems against electrical threats to buildings. Fuses-Rewirable Fuse, Cartridge Fuses, HRC Fuses (High rupturing capacity fuses), MCB's, Earthing, Types of Earthing, Lightning Protection. Different types of distribution systems in buildings. Various materials involved in it. Power requirement for different categories of buildings. Preparation of electrical drawing using correct graphical representation for a residence plan.

UNIT – II

Illumination

Quality and quantity of light; Factors influencing quality of light. Methods of lighting – Ambient, task and accent lighting. Lighting aspects for various categories like street lighting, factory lighting.

Systems of luminaries, direct, indirect, etc.

Various types of electrical lamps for different usages – incandescent, fluorescent/CFL, HID's, neon, LED lamps and their lighting characteristics, application criteria; Design considerations for different types of occupancies and tasks and calculation of lighting requirement

UNIT – III

Fire safety in buildings

Fire hazards. Fire load. Fire resisting properties of materials like timber, brick, stone, steel, concrete, glass, asbestos, plaster/ mortar.

Standards adopted: Fire norms by National Building Code of India.

Architectural considerations for passive fire protection of buildings:

Classification of buildings, Types of construction, building setbacks, Fire driveway, Refuge area, Occupant load, Egress components, Exits- widths, types and planning, Travel distance, Staircase requirements, Pressurization of staircase and lift lobby.

UNIT IV

Active fire fighting/ protection systems

Difference between fire prevention and firefighting.

Active fire fighting/ protection systems: Down comer, Wet riser, Dry riser, Firefighting shaft. Fire lifts and Fire staircases. Fire pumps, Fire hydrant systems, Automatic sprinkler system, Fire detection system, Public address system, Fire extinguishers for different Classes of fire, Fire signages and Fire order.

Case studies of fire protection and firefighting systems adopted in various buildings against fire and incorporating the same into architectural designs.

References:

1. H Cotton, Electrical Technology
2. L. Uppal, Electrical wiring, Estimating & Costing
3. Anwari., ElectricalEngg.
4. M.S.N. Swamy, Lighting, MSN Marketing, Bangalore.
5. TorquilBarker, Concepts in Practice lighting, 1997, B.T. Batsford Ltd, 583, fullham Road, London.
6. Dr. Frith Abnwos and others. Electrical Engineering handbook.

B19AR4050	HOUSING	L	P	D	C
Duration:14 Wks		3	0	0	3

Prerequisites:

Knowledge of works of different architects, Architetcural design II,Site planning, open spaces

Course Objectives:

1. To articulate a broad overview of housing and important concepts related to description, categorization and appraisal of housing.
2. To facilitate an understanding of the concept and approach of social housing and related policies in India.
3. To facilitate an analytical approach towards study of various housing typologies, layouts for cluster planning and other guidelines towards design of housing communities.
4. To expose the students to various innovative solutions proposed by architects of national and international repute in the field of housing to tackle various issues such as social housing, disaster rehabilitation, climate sensitive housing, participatory housing etc.

Course Outcomes:

On completion of the course, learners will be able to:

1. Demonstrate a firm grasp of housing related concepts for description and characterization of housing

2. Acquire familiarization with housing policies and the significance of social housing
3. Employ concepts learnt to arrive at design solutions in Housing
4. Acquire knowledge of modern concepts and innovative ideas to address housing issues.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR4050/ HOUSING	**CO1**	3	1	3	1	1	1	2	1	3	2	2
	CO2	2	0	3	2	1	1	2	1	3	2	2
	CO3	5	0	2	2	1	1	2	1	3	2	2
	CO4	2	2	2	2	1	1	2	1	3	2	3

Course Contents:

Unit – I

Basic concepts in housing- density, dwelling units size, household size, housing quality
Importance of housing, Stakeholders in housing- users, housing agencies, policy makers
Brief review of the historical development of housing in various contexts.

Unit – II

Evolution of Housing policy and perspective at the national level from 1950s to present.
Brief introduction to the problem of slums in urban areas and strategies for slum upgradation
Concepts of Social housing, housing affordability, inclusiveness
Case studies of social housing from India and abroad

Unit – III

Housing design-Traditional pattern of housing design Row Housing, Cluster Housing layout of concepts, low rise versus high rise housing with examples ; Housing standards for rural and urban areas; Housing stock, Housing need and Demand, housing shortage

Relevance of Residents' Satisfaction in housing, Factors that affect residents' satisfaction in housing, psychosocial considerations, preparation of questionnaire and mock survey in different housing typologies

Unit – IV

Case studies of innovative housing projects from around the world covering concepts such as flexible/modular housing, Disaster resilient housing, innovative usage of materials, Climate sensitive housing, participatory housing etc.

References:

1. Chattopadhyay Subrata, New Essays on Inclusive housing, Macmillan Publications.
2. Chiara, De Joseph, and Others. Timesavers standard for Housing and Residential development, 2" ed. McGraw Hill, Inc, New York.
3. Desai, A.R. and Pillai, Devadas. Slums and Urbanization. Popular Prakashan Pvt. Ltd.
4. HUDCO. Housing for the Low Income. HUDCO.
5. Poulose, K. Thomas. Reading Material on Housing. Institute of Town Planners. New Delhi.

B19AR4060	HISTORY OF ARCHITECTURE-IV-ISLAMIC PERIOD	L	P	D	C
Duration:14 Wks		3	0	0	3

Prerequisites:

Drawing, documentation skills of HOA-III, AD-II, report writing and presentation skills

Course Objectives:

1. To articulate a broad overview of the evolution of religious architecture (Islamic) and colonial style in the Indian subcontinent
2. To describe the characteristics, influences and distinguishing features of Islamic and colonial architecture
3. To facilitate an analytical approach towards study of historical buildings and styles.
4. To inculcate skills in describing historical buildings through various media such as drawing, model making, audio video documentation etc.

Course Outcomes:

On completion of the course, learners will be able to:

1. Identify the general characteristics of Islamic and colonial Architecture in the Indian subcontinent
2. Explore the evolution and development of architecture styles under various dynasties/regions

3. Demonstrate an understanding of sociocultural context, climatic influences and technical advancements and construction techniques with reference to various styles of architecture.
4. Acquire skills to describe historical buildings through various media such as sketching, audio visual presentations, model making etc.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR4060/ HOA-IV	**CO1**	2	1	1	0	0	1	1	1	2	1	1
	CO2	3	1	1	0	0	1	1	1	2	1	1
	CO3	3	1	1	1	0	1	1	1	3	0	1
	CO4	0	0	0	2	2	2	1	1	2	1	2

Course Contents:

UNIT I-

- Islamic Architecture in India: Overview; Development of various building typologies & incorporation of indigenous elements, development of construction systems & elements;
- Various dynasties & their influence: Slave, Khilji, Tughlaq, Sayyid & Lodi; Significant examples for each dynasty.

UNIT II-

- Provincial Islamic Style: Development of provinces & evolution of regional architecture; Geographic, social, cultural, political influences; Significant examples for - Bengal, Gujarat, Jaunpur, Deccan (Gulbarga/Bidar/Golconda/Bijapur)
- Mughal Architecture: Development of Mughal Architecture -Geographic, social, cultural, political influences; Incorporation of local styles, skills, materials & elements; Development of Settlements, Building typologies & Gardens; Study of significant examples at Delhi, Agra, Fatehpur Sikri

UNIT III-

Documentation/ Case study of any examples ofIslamic/ Colonial architecture

UNIT IV-

Colonial Architecture- British: Overview, Evolution of Indo-Saracenic style of Architecture, fusion of Indian regional architecture with European styles; Development of various typologies like Forts, Bungalows, Cantonments, Public buildings, Institution, Industries & Commercial buildings; Architectural examples from prime British settlements of Calcutta, Madras, Bombay & New Delhi.

The examples to represent the historical styles are suggestive & students are encouraged to explore additional examples for a comprehensive understanding of the respective styles

References:

1	Bhalla, A S	Royal Tombs of India 13th to 18th Century	Mapin
2	Sir Banister Fletcher	History of Architecture	
3	Brown Percy	Indian Architecture – Islamic period	
4	Grover Satish	Islamic Architecture in India	
5	Thomory Edith	A History of fine arts in India & the West	Orient Longman

B19AR4070	CAAD –II	L	P	D	C
Duration:14 Wks		1	2	0	2

Prerequisites:

Knowledge of CAAD-I, AD-II and presentation techniques, familiarity with software

Course Objectives:

1. To deliver the working knowledge of advanced software
2. To demonstrate building of 3D models and conceptual architectural masses
3. To Illustrate rendering of photo-realistic images
4. To develop their skills in editing and rendering of architectural drawings

Course Outcomes:

On completion of the course, learners will be able to:

1. Explore any advanced software as a 3D modeling tool
2. Acquire skills to Convert 2D drawings into 3D drawings using advanced software.
3. Visualize the Materials & Lighting aspects of Design & create realistic renderings.
4. Explore Photoshop as a rendering tool and Acquire skills to Develop good design presentations & Compositions with the help of advanced software.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR4070/ CAAD-II	**CO1**	1	2	0	2	1	1	0	1	2	1	3
	CO2	1	2	0	2	1	1	0	1	2	0	3
	CO3	1	2	0	2	1	1	0	1	2	1	3
	CO4	1	2	0	2	1	1	0	1	2	1	3

Course Contents:

UNIT 1

3D modeling: Use of Sketch up or any 3D software. Conversion of previous semester AD project(2D) into 3D model, adding detail to Models in 3D space, use of cameras, material applications.

UNIT 2

Rendering & Visualization: Introduction to concepts of visualization using rendering engines.

UNIT 3

Introduction to graphics editing tools: Adobe Photoshop. Concepts of image editing, image scanning, effects, filters.

UNIT 4

Graphics editing software: – Classroom exercise to demonstrate use of Adobe Photoshop in simple projects. For e.g., rendering of 2D drawings, adding nature to 3D visualizations of architecture design project.

References:

1. Modeling with SketchUp for 3D Printing by Bonnie Roskes
2. Modeling with SketchUp for Interior Design by Bonnie Roskes
3. SketchUp Pro 2013 step by step by Joao Gaspar
4. An introduction Adobe Photoshop by Steve Bark
5. Adobe Photoshop 7.0 for photographers: A professional image editor's guide by Martin Evening

Semester V

B19AR5010	**ARCHITECTURE DESIGN-IV**	**L**	**P**	**D**	**C**
Duration:14 Wks		**4**	**0**	**4**	**10**

Course Objectives:

1. To describe agglomerations of multiple building units (eg Multi storied Apartments with club house, play areas etc. or Campus Housing)
2. To Introduce and develop different Habitation types in an urban setting, implementing Building bye laws pertaining to Set backs, achieving F.A.R and Parking norms within a larger MasterPlan
3. To provide an insight into modular housing units, prefabricated housing as alternatives for traditional methods.
4. To facilitate integration of building services like water supply, drainage, rainwater harvesting, uninterrupted power supply, SWD into the design.

Course Outcomes:

On completion of the course, learners will be able to:

1. Formulate the design problem to address mass housing needs in an Urban context through literature study, Case study, site study and Context study.
2. Characterize agglomeration of buildings in a layout and develop road networks, junctions, parking needs and common areas
3. Demonstrate space planning principles for efficient unit plans and integrate open spaces, incorporate basic services like water supply, sanitation, rain water harvesting, electrical services and fire safety.
4. Communicate the design using latest software tools, models or through manual drawings.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR5010/ AD-IV	CO1	3	1	3	1	1	1	1	1	3	1	2
	CO2	2	3	3	2	1	2	2	1	3	3	2
	CO3	3	3	2	2	1	2	2	1	3	3	3
	CO4	3	3	2	2	2	2	0	1	3	2	3

Course Contents:

UNIT – I
Case study and literature study of selected Design type. Site selection and Site study in urban location

UNIT - II
Drawing up specific design requirements that are site specific. Zoning and Development of Form, splitting of units with Vehicular and Pedestrian circulation resolved.
Continuous emphasis on controls, codes and bye-laws.

UNIT – III
Development of drawings for detailed units (Habitation and others). Adopting norms, structural aspects (grid planning) , exploratory study on modular and prefabrication models in Housing as alternatives

UNIT -IV
Detailed Design of housing units, integration of services. Presentation and Models using computer aided software or Manual drawings.

STUDIO PROJECTS:
Indicative Projects:
Group housing with added infrastructure like clubhouse, shopping, interactive open spaces etc, Campus housing, rehabilitation housing, resort type hotels with multiple units and landscaped areas for public interaction, Serviced apartments for student housing in City Centers with added infrastructure like clubs, shopping, offices etc.
Time bound problems:
Detailing of a unit within the larger design can be taken up for this.

References:

1. Time savers standards for architectural design data – by John Callender (Editor)
2. Architectural design data – by Ernst Neufert.
3. High-density housing for mixed income groups – Ranjana Mittal, Aneesh Nandi Copal Publishing
4. Life between Buildings- Using Public space: Jan Gehl , Island Press
5. Hotel and Resort Design- Anne M Schmid and Mar Scoviak – Lerner

B19AR5020	STRUCTURAL SYSTEMS & BUILDING CONSTRUCTION & MATERIALS - V	L	P	D	C
Duration:14 Wks		3	4	2	8

Course Objectives:

1. Acquaint the students with different types of partitions and ceilings using the latest materials and technologies
2. Describe advanced building materials and application of advanced concrete
3. Acquaint students with the structural principles of Vaults and Domes
4. Describe different methods of Curtain glazing and Structural glazing,

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquire the knowledge of Partitions with different materials and illustrate suitable types
2. Recognize advanced materials and advanced concrete usages in the building industry.
3. Acquire the knowledge of Structural concepts behind Shell structures and Tensile structures and illustrate with details for open spaces, courtyards and similar situations.
4. Illustrate the detailing for false ceiling, Curtain and Structural Glazing of various types.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR5020/ SSBC-V	CO1	3	1	1	1	0	0	0	0	3	3	2
	CO2	1	1	1	2	0	1	2	0	1	1	2
	CO3	3	0	2	0	0	2	2	2	3	1	3
	CO4	2	3	3	3	0	1	3	0	2	3	3

Course Contents:

UNIT I:

Partitions:

- Single skin and Double skin partitions, full height, low height and glazed partitions
- Typical fixing details at Floor level, Ceiling level, sill level, lintel level, in respect of

- Gypsum partitions and Particle Board partitions
- Substitutes to Timber - Bamboo wood, Rubber wood, MDF, FRP, A.C.P, Laminates, Veneers.

Market study encouraged for material understanding of alternatives to Timber.

UNIT II

- **Advanced concrete** – foam concrete, ferro cement, Ferro Crete, Fiber reinforced concrete, Castrate, megacrete, thermocrete, translucent concrete, Glass fiber reinforced concrete.
- **Advanced Building Materials**: Plastic, PVC, Synthetic boards, fireproof/ resistant boards/tiles, acoustic materials, composite panels and their applications, non- load bearing gypsum blocks

Concepts may be introduced through examples and Literature studies

UNIT III:

Shells, Vaults and Domes, Folded plate structures:

- Structural principles of types of Shell structures, Vaults and Domes, Geodesic Dome with detailing and folded plate systems and details.
- Structural concepts of Tensile structures & Pneumatic structures and typical Construction details

Students may be exposed to a Hands-on workshop for installing a simple tensile structure or dome.

UNIT IV

False ceilings:

- Types of ceilings- Gypsum, Aluminium, etc. and types of framework generally used
- Typical fixing details at Partition junctions, Ceiling drops, junction with curtain glazing, external masonry
- Curtain and Structural Glazing, Types of Curtain glazing, Difference between Curtain and Structural glazing, important terminologies- Spandrel panel, Vision panel.

Learnings to be enhanced through site visits to view glazing and False ceilings types

References:

1. STRUCTURES - Martin Bechthold, Daniel L Schodek, PHI Learning Private limited
2. Prestressed concrete by N krishnaraju Mc graw hill education
3. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
4. Building Construction, Sushik Kumar, Standard Publishers Distributors, New Delhi
5. BARRY's The Construction of Buildings (Vol. 1-5).
6. BARRY's Introduction to Construction of Buildings 3rd edition, Stephen Emmitt, Christopher A Gorn.

Textbooks:

- Building Construction, B C Punmia 10th and 11th edition, Laxmi Publications (P) ltd, New Delhi.
- Building Construction Handbook, 10th and 11th edition Roy Chudley and Roger Greeno, Routledge, London.

B19AR5030	ENERGY EFFICIENCY IN BUILDINGS	L	P	D	C
Duration:14 Wks		1	2	0	3

Course Objectives:

1. To inform the need of energy management and conservation in building design and construction
2. To familiarize the students with passive design considerations and strategies
3. To explain the various strategies adopted to design a green building through case studies
4. To inform about the various rating systems for Green building design

Course Outcomes:

On completion of the course, learners will be able to:

1. Outline the principles of sustainable and energy efficient building design
2. Attain an ability to apply passive design strategies in design.
3. Describe green building rating systems and their significance.
4. Apply the techniques learnt through software into design.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
BR17AR5030/ EEB	CO1	3	1	3	0	2	0	2	2	3	0	0
	CO2	3	3	3	2	2	2	2	2	3	3	3
	CO3	2	2	3	2	2	2	2	2	3	3	3
	CO4	2	3	3	2	2	2	2	2	3	3	3

Course Contents:

UNIT I

Introduction to Energy Efficiency in the contemporary context, Concept of embodied energy of material, Ecological footprint of a building, Concept of carbon neutrality, Green buildings. Direct Gain Thermal Storage of Wall and Roof, thermal properties of building materials (u value, thermal mass and time lag) - Roof Radiation Trap - Solarium - Isolated Gain-Evaporative Cooling - Nocturnal Radiation cooling - Passive Desiccant Cooling – InducedVentilation - Earth Sheltering - Wind Tower - Earth Air Tunnels

UNIT II

Energy management and rating systems

Introduction to Energy Management of Buildings and Energy Audit of Buildings; Energy Conservation Building Code (ECBC). Rating systems for green building- LEED, IGBC, GRIHA etc. Case study of LEED rated buildings.

Areas for innovation in improving energy efficiency such as Photo Voltaic Cells, Battery Technology, Thermal Energy Storage, Recycled and Reusable Building materials, Nanotechnology, smart materials and the future of built environment

UNIT III

Case study:

Case study of an energy efficient building. Analyzing different techniques adopted in a building. Formulating strategies of energy efficiency.

Different software's available to analyze the energy efficiency (in design, eco-tech etc).

UNIT IV:

Application

Applying different strategies to the studio design project demonstrating with different software and analysis of findings.

References:

1. "Housing climate comfort" by Martin Evans.
2. "Green Architecture"-Design for a sustainable future by Brende and Robert vale.
3. "Green Architecture"-A guide for sustainable design by Michael J Crosbie.
4. Energy efficient buildings of India, TERI

B19AR5040	BUILDING SERVICES – III	L	P	D	C
Duration:14 Wks		2	0	0	2

Course Objectives:

1. Introduce mechanical ventilation and air conditioning of various types and usages
2. Describe and discuss the latest methods and materials in HVAC and understand Heating load calculations and thumb rules
3. Introduce the mechanics of Vertical and horizontal Transportation, both standard models and catering to special needs
4. Extend learnings of the services into an architectural project through case studies and design

Course Outcomes:

On completion of the course, learners will be able to:

1. Describe Mechanical services and air conditioning systems, including current trends.
2. Elaborate on mechanical services in a building and demonstrate knowledge on energy conservation techniques.
3. Describe the vertical transportation in a building.
4. Integrate & coordinate the services knowledge in architectural design to provide a service plan for a building.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR5040/ BS-III	CO1	2	0	0	1	0	0	0	0	1	0	2
	CO2	1	1	3	0	2	2	0	0	0	0	1
	CO3	1	3	0	1	2	2	2	0	1	2	0
	CO4	0	1	3	0	2	2	0	0	1	2	1

Course Contents:

UNIT – I

Unit -1 – Heating Ventilation and Air conditioning Systems

Introduction to Mechanical ventilation & air-conditioning systems. Human Comfort and definitions, Air cycle and distribution, ducts, grilles and diffuser, Dust control and filters. Classification and application air-conditioning, Refrigeration cycle and components, Window unit, Split units without ducts, ductable splits, Package unit with ducts. Direct expansion system, Chilled water system, Humidifiers & dehumidifiers

Mechanical ventilation, air-conditioning for human comfort & definitions, Dust control and filters, Air cycle, Refrigeration cycle, components, Air distribution - ducts, grilles etc, Classification and application air-conditioning

UNIT – II

Indoor air quality, Moist air properties and Conditioning processes, thermal comfort and weather data. Heat transmission in building structures, effects of Solar radiation, Infiltration and ventilation, Heat load estimation & thumb rules, Building energy calculations and Energy efficiency compliances for HVAC.

UNIT – III

Introduction to vertical circulation, Lift well, pit, doors, car, machine room etc. Typical section through lift, quality & quantity of service, Types of lifts Lift bank, lobby and lift interiors, Hydraulic & traction lift, Escalator &travelator, Lift act, Architect's role, Double Decker lift, sky lobby, current scenario.

UNIT –IV

Design aspects and limitations involved in location and design of service core in a multi-storied building (Low and High-rise Public or commercial building). Graphical representation of advanced services for a project carried out in the previous semester may be of public or commercial building, like air conditioning details, fire escape routes, firefighting facilities like portable and non-portable systems.

Site visit recommended to a large scale mall or Hotel to understand all the services like air conditioning, vertical transportation and others.

References:

1. Principles of Air-conditioning by Paul Lang, D B Taraporevala Sons & company Limited
2. Building Service Engineering – by David V Chadderton, E & FN SPON – an Imprint of Chapman & Hall
3. Building Construction illustrated by Francis D K ching, CBS Publishers & Distributors
4. Building Environment – By Dr. AjithaSimha, Tata Mc-Graw Hill Publisher Co Ltd, ND
5. Mechanical System for Architects by Aly S Dadras, Mc-Graw Hill, Inc.
6. Lifts – company manuals / Brochures
7. Blue star comfort guide to air conditioning

B19AR5050	THEORY OF ARCHITECTURE	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. Introduce a broad overview of the evolution of thought and trends in architecture practice, across timeline
2. To acquaint the students with architectural theory from antiquity to present.
3. To identify issues that shaped the approach to architectural design in a particular context & age.
4. To familiarize students with various theories related to design process in architecture

Course Outcomes:

On completion of the course, learners will be able to:

1. Comprehend and apply the theories of form, proportion and the evolution of architectural theory from antiquity to renaissance period.
2. Identify and illustrate the development of architectural theory from the 18^{th} to 20^{th} century including the development of the modernist movement.
3. Describe and comprehend the postmodernist & deconstructivist theories in architecture as aprecursor to contemporary architecture.
4. Appreciate the various theories related to design process in architecture and develop skills in fundamentals of architectural criticism

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR5050/ TOA	CO1	3	2	1	2	2	0	2	0	3	2	2
	CO2	1	3	2	1	1	0	2	0	1	3	3
	CO3	1	3	3	2	3	0	2	0	1	3	3
	CO4	1	1	2	3	3	0	3	0	1	2	3

Course Contents:

UNIT I

a) Introduction to theories in form & proportions: - Theory of Proportions, Proportioning system- Golden Section, Modular, Generation of forms- Pragmatic, Analogic, Canonic and Iconic, Properties & Transformation of form.

b) Theories in Architecture- Antiquity Period- Concepts of Vitruvius

c) Theories in Architecture- Renaissance Period- Leon Alberti, Andrea Palladio, French Academic Tradition

UNIT II

d) Theories in Architecture- 18th and 19th Century Theory: Ideas of Laugier, Boullee, Ledoux, Quatramere de Quincy and Gottfried Semper.

e) Modern Movement- The principles and philosophy of modernism, structuralism in architecture ; Philosophy & theories of Louis Sullivan, Walter Gropius, Alvar Alto, Le Corbusier

Elective Study- Pablo Picasso, Immanuel Kant, Friedrich Nietzsche, Max Weber.

UNIT III

f) Post Modern Theories and Deconstruction: Ideas on Post-Modern Classicism by Robert Venturi and Charles Jencks. Fundamental beliefs and philosophy of de – constructivism, Ideas of Peter Eisemann

g) Biomimicry/biomimetics: The principles, philosophy and Examples. Discussions on Works /Philosophies of Antoni Gaudi, Norman Foster, Michael Pawlyn.

Elective Study-Jacques Derrida, Peter Eisenman, Bernard Tschumi, Henri LeFebvre, Merleau-Ponty, Juhani Pallasmaa,

UNIT IV

h) Theories on Design process in Architecture- Kenneth Frampton, Christopher Alexander, Amos Rapoport and Geoffrey Broadbent.

i) Architectural Criticism: Meaning and Definition of criticism, Types of Criticism, Wayne Attoe, John Lang – Positive and Normative Theories in Architecture.

Note- Elective study themes have been mentioned to facilitate group discussions and seminars.

References:

1. Ching, F.D.K. (1979). Architecture – Form, Space and Order. Van Nostrand Reinhold Company.
2. Deleuze, G. and Hand, S. (1988). Foucault. Minneapolis : University of Minnesota Press.
3. Eisenman, P. (1999). Diagram Diaries. New York : Universe.

4. Heidegger, M. (1993). Building Dwelling Thinking. Basic Writings. HarperCollins. Johnson, P. and Wigley, M. (1988). Deconstructivist Architecture. New York : Museum of Modern Art.
5. Lefebvre, H. (1991). The production of space. Oxford: Cambridge.
6. Merleau-Ponty, M., and InEdie, J.M. (1964). The primacy of perception. North Western University Press.
7. Pallasmaa, J. (2005). The eyes of the skin: Architecture and the senses. Chichester : Wiley-Academy.
8. Pawlyn, M. (2011). Bio-mimicry in Architecture. London : RIBA Publishing.
9. Tschumi, B. (1994). Architecture and disjunction. Cambridge, Massachusetts : MIT
10. Venturi, R. (1966). Complexity and Contradiction in Architecture. New York : The Museum of Modern Art.
11. Vitruvius, P. and Morgan, M. H. (1960). Vitruvius: The ten books on architecture. New York : Dover Publications.

B19AR5060	HISTORY OF ARCHITECTURE- IV: CONTEMPORARY ARCHITECTURE	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. Describe through examples the emergence of Modernism in Europe and America
2. Provide an overview and understanding of Contemporary Architecture in Indian and World Architecture through the works of outstanding architects
3. Discuss developments in the West in terms of styles and movements and their influence on India
4. Trace the development in Architecture through the period of Modernism to Postmodernism upto the period of Deconstructivism

Course Outcomes:

On completion of the course, learners will be able to:

1. Review through examples the emergence of modernism in Europe and America
2. Interpret the evolution of Contemporary Architecture in Indian and World Architecture through the works of outstanding architects
3. Identify various styles and movements and their influence on India

4. Demonstrate the development in Architecture through the period of Modernism to Postmodernism upto the period of Deconstructivism

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR5060/ HOA-V (CONTEMPORARY)	**CO1**	3	1	1	0	2	2	2	1	2	0	0
	CO2	3	3	2	0	0	2	0	1	3	2	0
	CO3	3	1	2	1	0	0	1	1	3	0	1
	CO4	2	3	2	1	1	2	1	0	3	1	1

Course Contents:

UNIT 1

World Architecture- Early 20th Century

Arts &Crafts Movement- William Morris(Red House), Art Nouveau- Works of Victor Horta & Otto Wagner, Introduction to Art Deco, De Stijl movement. Chicago School of thought; Development of skyscraper–works of Louis Sullivan. Organic architecture –Frank Lloyd Wright (Falling Waters, Prairie School) Expressionism-Gaudi (Casa Mila, Sagrada familia)

World Architecture-Late 20th Century

Modernist Architecture- works of Richard Meier (Smith House, Connecticut and Getty Centre, Los Angeles) , Le Corbusier (Villa Savoye, Unite D'habitation&Ronchamp Chapel), Mies Van der Rohe (Barcelona Pavilion, Seagram Building)

UNIT-2

Architecture in India -Post Independence and advent of Modernism

An Introduction to Indian Architectural scene during the time of Independence. Planning of New Delhi. Necessity to create different Building typologies like Industry, Institutions, offices, Mass Housing. Understanding the need for an Indian Identity and the new Modernism. Introduction to the need for designing New Capital Cities; Nehruvian theories, Chandigarh Capitol complex and other Planned Cities.

Selected works of Architects like Habib Rehman, Otto Koeingsberger, Piloo Modi, JA Stein, Le Corbusier, Louis I Kahn, Achyut Kanvinde, Geoffrey Bawa, and many more.

UNIT-3

Post-Modernism in the West- Its characteristics and influence on the rest of the world. Rejection of the idea of Modernism and embracing classicism in a new form. Early ideas of De-constructivism by Peter Eisenham, Jacques Derrida, Bernard Tschumi and its influence on World architecture. Rejection of Fundamental ideologies like Functionalism and structural rationalism. Characterised by Juxtaposition, Non-rectilinear shapes, and manipulation of surfaces.

Selected works of Micahel Graves, Robert Venturi, Charles Moore, Philip Johnson and early works of Frank O Gehry

Contemporary architecture of the West- Eero Sarinen (TWA Terminal, Gateway Arch , St. Louis), I M pei(Louvre, Paris), Norman Foster (HongKong Shanghai Bank and Renault Distribution Centre, Swindon, England)

UNIT-4

Post-Modernism in India- Trends in Indian architecture like Regionalism, Monumentality, New-Age Religious architecture, Experimental buildings, Neo-traditionalist, Neo-Vernacular styles.

Selected works of Charles Correa, RajRewal, AchyutKanvinde, B.V Doshi, Uttam Jain, Laurie Baker and Anant Raje who's works can be categorized into the above styles.

Late Deconstructivism of the West- Selected works of Daniel Liebeskind, Zaha Hadid, Frank Gehry

References:

1. A concise History of Modern Architecture in India/Jon Lang Permanent Black
2. Architecture Guide-Delhi/ Anupam Bansal/Malini Kochupillai Adom
3. Chandigarh Revealed-Le Corbusier's city today/ Shaun Fynn Mapin
4. Venturi, R. (1966). Complexity and Contradiction in Architecture. New York: The Museum of Modern Art.
5. An emancipated place, a unique collection of essays presenting the contemporary works of women architects in South Asia/Brinda Somaya and Urvashi Mehta
6. Modern, postmodern architecture & Pioneer architects/ VVLN Murthy
7. Architecture of Auroville/ Anupama Kundoo and Poppo pingel
8. Modern Architecture – A Critical History/ Kenneth Frampton

Semester VI

B19AR6010	ARCHITECTURE DESIGN-V	L	P	D	C
Duration:14 Wks		4	0	4	10

Course Objectives:

1. To outline the design principles of large scale projects preferably on chosen sites with contoured terrain
2. To Illustrate that designs must respond to climate, environment and ecological factors.
3. To Integrate master plan with landscape details, circulation and services.
4. To facilitate the use of contemporary presentation techniques and tools to deliver the design

Course Outcomes:

On completion of the course, learners will be able to:

1. Extrapolate Contour analysis , context study, Climate responsiveness, regulations and universal design principles into formulating the project brief
2. Demonstrate an ability for space planning and develop detailing of individual blocks while integrating with the Master plan development
3. Extend the knowledge of all the services like water supply and sanitation, Electrical, HVAC, Fire safety and acoustics to be incorporated in design.
4. Apply the knowledge of contemporary software presentation tools to the delivery of the design

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR6010/ AD-V	CO1	3	1	3	2	1	1	1	1	1	1	1
	CO2	3	3	3	2	1	2	2	1	3	3	3
	CO3	3	3	2	2	1	2	2	1	3	3	3
	CO4	2	3	2	2	2	2	0	1	2	1	3

Course Contents:

UNIT -I

Projects shall be large scale with multiple functions and complexity. Design emphasis shall be on response to climate, environment and ecological factors. Understanding, exploration & development of design programme concept and drawing up the detailed design requirements with focus on climate, environment and ecological factors. The literature study and case studies are part of this phase.

UNIT -II

The design issues to be addressed for the design project pertaining to larger projects are
Issues in Preparation of Master Plan for the project undertaken.
Phases of development and scope for expansion.
Comfortable Vehicular and pedestrian movement.
Landscaping and Services.
Details pertaining to universal design

UNIT –III

Identify hierarchy of spaces, public and private scales of space. To continually ensure that the design is sensitive to climate, environment, and ecology. Detailing of a common major block or a public space of larger project. Integrate usage of materials, construction technique, structural system.

UNIT –IV

Exploration, analysis, integration of services, detailed design of units within the larger project in response to environmental aspects. Special focus on presentation using software.

Indicative projects: Large scale Institutional Design (Campus Planning) / Commercial / Industrial / Housing / Public use project of diversified activities with focus on horizontal & / or verticalcirculation & grid planning. Site extent: Upto 20000 m2.

References:

1. Time Saver Standards for building Types- Joseph De Chiara & John Callender
2. Time Saver Standards for Architectural Design Data-John Hancock Callender
3. Neuferts's Standards
4. Hotel and Resort Design- Anne M Schmid and Mar Scoviak– Lerner

B19AR6020	STRUCTURAL SYSTEMS & BUILDING CONSTRUCTION & MATERIALS - VI	L	P	D	C
Duration:14 Wks		3	1	1	5

Course Objectives:

1. Acquaint the students with knowledge of Earthquake resistant structures.

2. Explain the theory behind Tall structures
3. Describe the design of steel structures and advanced usage of steel for Large plan span buildings.
4. Introduce advance construction techniques and expansion joints in buildings

Course Outcomes:

On completion of the course, learners will be able to:

1. Explain the structural principles related to Earthquake Resistant Design
2. Discuss the principles of structural design for Tall buildings
3. Demonstrate through drawings the design of steel structures and advanced usage of steel for Large pan structures
4. Acquire working knowledge on current practices and contemporary construction techniques in building industry

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR6020/ SSBC VI	**CO1**	3	1	3	1	2	2	1	1	3	2	2
	CO2	3	1	3	2	2	2	2	1	3	3	3
	CO3	3	2	3	2	2	2	1	1	3	3	3
	CO4	3	2	1	1	2	2	1	1	3	2	2

Course Contents:

UNIT I

- Introduction to earthquake resistant structures, types of waves, earthquake zones according to IS code.
- Causes of earthquakes, seismic waves, magnitude, intensity, characteristics of strong earthquake ground motions.

UNIT II

- Introduction to tall buildings, development & uses. Load calculations for different structural elements – Load distribution methods – Code recommendations.
- Loads & forces on buildings. Vertical forces, Horizontal forces, internal force
- Material study: Metals and Alloys: Properties, sustainable design character Architectural usage or application in construction industry. Galvanizing and Chromium plating process.

UNIT III

- Structural behavior of Large Span Steel trusses, lattice girder, tubular trusses and north light glazing, space frames, and self-supported roofing systems
- Pre-Engineered Buildings in steel, assembling process of Pre-Engineered Structures, Advantages & disadvantages of PEB's, Castellated beams. Different types, applications, advantages & disadvantages.

UNIT IV

- Basic concepts of Prestressed concrete, prestressing materials and pre tensioning and post tensioning
- Behavior of prestressed concrete beams, columns, footings, slabs, Introduction to precast and assembling of pre- cast members. Adopting of precast members in bridges and modular building units, typical Construction details.
- Purpose and functions of joints in Building construction, types of joints that occur in Buildings. Expansion joints in Brick walls and R.C.C. framed structures and its construction details and materials involved in the construction. Study of relevant IS codes
- Advanced construction methods: Concept of mivan constructions RCC, lift slab construction, multi-storied building frames, circular slabs and beams, uses of rapid-hardening cement, ready mix concrete, light weight concrete and translucent concrete.

References:

1. Krishna Raju N " structural design and drawing" (RCC & steel).
2. Dongre A P "Structural engineering for architects".
3. Pankaj Agarwal, Manish shrikhande" Earthquake resistant structures".
4. David J dowrick" Earthquake resistant design"

B19AR6030	WORKING DRAWINGS	L	P	D	C
Duration:14 Wks		2	2	0	3

Course Objectives:

1. To make the students familiar with the concept of working drawings
2. To expose the students to examples of good working drawings
3. To acquaint them with the knowledge required for converting a design into working drawings
4. To impart them the necessary skills for the preparation of working drawings of a project

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquire a grasp of the working drawings process
2. Obtain exposure to good standard of working drawings
3. Master the knowledge required to convert their designs into working drawings
4. Acquire the necessary skills required to prepare a complete set of working drawings

Mapping of Course 0s with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR6030/ WD	**CO1**	3	2	2	2	2	2	2	3	3	2	2
	CO2	2	2	2	2	2	2	2	2	2	2	3
	CO3	2	3	3	3	3	1	3	3	3	3	2
	CO4	2	3	3	2	3	2	2	2	3	3	2

Course Contents:

UNIT 1: Basic Working Drawings

Prepare working drawings of a Design project consisting of the following:

- Setting out plans
- Site plan
- Cluster plans
- Unit plans
- Sections & Elevations

UNIT 2: Detailed Working Drawings

- Toilet Details
- Kitchen Details

- Staircase Details
- Joinery Details

UNIT 3: Detailed Working Drawings

- Wall Sections including details at Plinth level, Openings, Intermediate slab level and Terrace level

UNIT 4: Detailed Working Drawings

- Terrace plan including Lift Machine room, Staircase room, roof slopes
- Wall Section through Lift Machine room
- Electrical drgs
- Plumbing drgs
- Roof plan including roof drainage, stair room plan.

References:

1. Building Construction" by W.B Mckay
2. Building Construction" by Punmia
3. Text Book of Building Construction" By Arora &Bhindra

B19AR6040	BUILDING SERVICES-IV (ACOUSTICS)	L	P	D	C
Duration:14 Wks		1	2	0	2

Course Objectives:

1. Describe the properties and characteristics of Sound and outline the science of Acoustics and acoustical principles of Open Air Theatres and auditoriums in History
2. Extend knowledge on Calculations and formulae required in Acoustical Design.
3. Elaborate on Methods of Achieving Noise control – Natural and Manmade.

4. Illustrate Methods and Materials in Acoustical Insulation.

Course Outcomes:

On completion of the course, learners will be able to:

1. Define the properties and characteristics of Sound and elaborate on the working principles of open air theatres and auditoriums of the past.
2. Identify the need of acoustical treatment at various places for absorption, reflection and diffusion and acquire the formulae and calculations required in Acoustical Design.
3. Adapt the methods of Achieving Noise control by using both Natural and Manmade.
4. Apply Methods and Materials with different NRC in Acoustical Insulation.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR6040/ BS-IV	CO1	1	0	3	1	2	2	2	1	2	1	2
	CO2	1	2	3	1	1	2	2	0	2	1	3
	CO3	1	2	3	2	1	2	2	1	2	2	3
	CO4	1	1	3	1	2	2	2	2	2	3	2

Course Contents:

UNIT I

Introduction to architectural Acoustics - Characteristics and measurements of sound, frequency, intensity, decibel scale, effect of sound on man - design criteria of sound for various architectural spaces, acoustical problems. History behind Theatres and amphitheaters.

UNIT II

Acoustics in built environment - Behavior of sound in enclosed spaces, reverberation and reverberation time, Sabine's formula and its interpretation, dead and live rooms, sound field of classrooms, offices and studios.

Auditorium acoustics - design criteria

UNIT III

Noise Control - Classification of Noise, Environmental impact of noise and acceptable noiselevels. Principles of noise control - noise sources, airborne and structure borne sound.

Vibration isolation - damping of noise, noise barriers, noise transmission through ducts, Design criteria for industrial noise control, planning considerations, use of unit absorbers, treatment of floor & wall

UNIT IV

Acoustic materials and applications

General description on properties of acoustical materials – tile, boards, fibers, carpets, resonator absorbers, unit absorbers, composite materials and acoustic plaster, panel absorbers.
Construction details of acoustic treatment on walls, ceiling and floors, floating floor construction acoustic panels and screens, maintenance of acoustic treatment.

References:

1. “Architectural Acoustics Principles and Design”By David R. Johnson and Madan L. Mehta.
2. “Auditorium Acoustics and Architectural Design”By Michael Barron.
3. “McDavid Egan (1988)-Architectural Acoustics” McGraw hill book co., NY.
4. Parich, Peter (1979) Acoustics: Noise and Buildings, Faber and Faber, London
5.

B19AR6051	**RESEARCH IN ARCHITECTURE**	**L**	**P**	**D**	**C**
Duration:14 Wks		**3**	**0**	**0**	**3**

Course Objectives:

1. To expose the students to basic research methods in architecture
2. To facilitate the selection, formulation and conduct of a small research exercise related to architecture
3. To familiarize students with basics of academic writing and referencing
4. To cultivate communication skills required to communicate the research outcomes in form of research paper, audio visual/verbal presentations.

Course Outcomes:

On completion of the course, learners will be able to:

1. Demonstrate an understanding of research methods in architecture
2. Explore the realms of their selected topics using primary and secondary research techniques.
3. Acquire skills in academic writing and referencing
4. Cultivate effective skills to communicate the outcome of the research study

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR6051/ ARW	**CO1**	1	0	3	3	0	0	3	0	3	3	3
	CO2	1	3	3	3	0	0	3	3	1	3	3
	CO3	2	1	3	3	3	3	3	0	1	3	3
	CO4	0	0	3	3	3	3	3	3	0	2	3

Course Contents:

UNIT 1

Meaning of research, objectives of research, types of research, research approaches, significance of research, research process, criteria of a good research, problems in research

Defining the research problem-Title, aim, objectives, scope, limitations, need for study, Preparation of research abstract

UNIT 2

Basics of literature survey and referencing styles, Research strategies in architecture historical, qualitative, co relational, experimental, simulation, logical argumentation, case studies and combined strategies, secondary case studies and analysis

Formulation of research methodology, literature survey, Secondary case studies, identification of Primary case study

UNIT 3

Primary case study, data collection, analysis. Formulation of research conclusions based on Primary and secondary studies.

Preliminary draft of the paper.

UNIT 4

Presenting a seminar on the selected topic. Paper to be written on a selected topic.

References:

1. C R Kothari, Gaurav Garg, Research Methodology: methods and Techniques, New age International Publishers, 2014
2. Groat, Linda N., and David Wang. Architectural research methods. John Wiley & Sons, 2013.
3.

B19AR6052	DIGITAL ARCHITECTURE	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To sensitize students in digital technology and architecture
2. To orient the students towards contemporary process in architectural design
3. To impart concepts of geometries and surface, media and architecture
4. To familiarize students with Fractal geometries and their applications in architecture

Course Outcomes:

On completion of the course, learners will be able to:

1. Comprehend the relationship between digital technology, media and architecture
2. Acquire knowledge about various aspects of the digital architecture process
3. Infer the contemporary design processes and their relation with computation
4. Acquire skills to approach spatial design problems with help of diagrams, geometry and surface parameters.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR6052/ DA	**CO1**	3	3	2	2	0	2	2	1	3	3	3
	CO2	1	3	3	1	0	2	0	1	3	0	2
	CO3	2	3	2	2	1	2	1	1	3	0	2
	CO4	1	3	3	2	0	2	0	1	3	1	2

Course Contents:

UNIT 1

INTRODUCTION

Investigation of contemporary theories of media and their influence on the perception of space and architecture. Technology and Art –Technology and Architecture –Technology as Rhetoric – Digital Technology and Architecture

UNIT II

ASPECT OF DIGITAL ARCHITECTURE

Aspects of Digital Architecture –Design and Computation –Difference between Digital Process and Non-Digital Process –Architecture and Cyber Space –Qualities of the new space –Issues of

Aesthetics and Authorship of Design –Increased Automation and its influence on Architectural Form and Space

UNIT III

CONTEMPORARY PROCESS

Overview of various Contemporary design process and it relation to computation: Diagrams –Diagrammatic Reasoning –Diagrams and Design Process –Animation and Design –Digital Hybrid Design Protocols –Concept of Emergence -Introduction to Cellular Automata and Architectural applications –Genetic algorithms and Design Computation

UNIT IV

GEOMETRIES AND SURFACES

Fractal Geometry and their properties –Architectural applications -Works of Zevi Hecker–-Shape Grammar -Shapes, rules and Label -Shape Grammar as analytical and synthetic tools-Combining Shape grammar and Genetic algorithm to optimise architectural solutions -Hyper Surface–Introduction to Hyper surface and concepts of Liquid architecture.

References:

1. The Phaidon Atlas of Contemporary World Architecture, 2008

2. Dennis Sharp Twentieth Century Architecture –A visual History, Images Publishing 2006

3. Dimitris Kottas, Contemporary Digital Architecture: Design and Techniques, Links International, 2010

4. Antoine Picon, Digital Culture in Architecture, Birkhäuser Architecture, 2010

5. Nick Dunn, Digital Fabrication in Architecture, Laurence King Publishing, 2012

6. Rivka Oxman, and Robert Oxman,Theories of the Digital in Architecture, Routledge, 2014

B19AR6060	**URBAN PLANNING**	**L**	**P**	**D**	**C**
Duration:14 Wks		**3**	**0**	**0**	**3**

Course Objectives:

1. civilizations up until the concept of New Towns.
2. To elaborate on the importance of planning principles and to describe various aspects in planning like Land use, Infrastructure, Transportation, Housing, and integrating them at a Town or City level.
3. To give an overview of the Process of Planning and the implementation mechanism.

4. To Discuss strategies and implementation mechanisms for Cities of the Future

Course Outcomes:

On completion of the course, learners will be able to:

1. Describe different planning principles of ancient towns and early models of planning new towns
2. Discuss Land Use planning, understand roles of planning authorities and different levels of Planning.
3. Elaborate on the Planning process and its implementation and recognise relevant issues affecting Planning in Urban scenario
4. Identify planning methods and solutions for future cities through case studies.

CERTIFICATION COURSES- ADVANCED ARCHITECTURAL MODELLING TOOLS

Course Code	Course Title	TYPE/Evaluation	L	P	D	C	Hrs
B19AR6070	Certification Course Advanced Software	SE/ INT	0	4	0	2	0

COURSE OBJECTIVES:

1. To give an overview of 3D modelling software as a tool for basic understanding of design representation and techniques
2. To illustrate and develop the techniques for generating creative forms.
3. To create a design that respond to the visualization using advanced software
4. To integrate the outputs by simulation, evaluation and animation using advanced software

1. COURSE CONTENTS:

2. UNIT I: Introduction to modeling Interface

Understanding the drafting interface by learning selection methods, modify command, drawing objects and essential software tools. Fundamentals application of the software to transform 2D to 3D model. Exercise to understand navigation, groups, parameters, printing, the import and export of drawings.

UNIT II: Forms and Modelling

Application of surface modeling: – Introduction to concepts of BIM (Building Information Modeling) and other modeling software's. Exercise to understand 3D modeling techniques and to create generative and dynamic forms, use of mesh tool, surfaces transform through to nurbs, Boolean solid operations and manipulating properties.

3. UNIT III: Simulation and Energy analysis

4. Conceptual energy analysis and evaluating the project by performance, BIM material substitution, object library, project phase and project lifecycle management. Integrate the BIM model with virtual reality as 3D interactive models.

UNIT IV: Rendering and Animation

Classroom exercises to generate a 3d Model using the software's learnt and the application of the different work sets by material mapping, light setting, real-time rendering, walkthrough videos and 3d printing techniques.

COURSE OUTCOMES:

On completion of the course the student will be able to:

1. Acquire knowledge of advanced drawing techniques, editing object, exploded assemblies to modify.
2. Understand the methods and application to create Surface modeling, Generative and parametric forms to represent their designs skills.
3. Visualize their designs through advanced software tools like BIM analysis evaluation and Simulation.
4. Comprehend in totality the complex nature of 3d printing and photorealistic rendered video presentation of their designs.

REFERENCES:

1. http://docs.mcneel.com/rhino/6/usersguide/en-us/index.htm
2. http://bimscape.com/beginners-guide-to-revit-architecture/
3. https://www.sdcpublications.com/pdfsample/978-1-58503-812-1-2.pdf
4. User's Guide
5. https://www.ace-hellas.gr/wp-content/uploads/2014/10/978-1-58503-973-9-7.pdf
6. http://digitaltoolbox.info/grasshopper-basic/interface/

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR6060/ UP	CO1	3	3	3	2	2	2	2	2	3	3	3
	CO2	2	2	3	2	2	2	2	2	3	3	3
	CO3	3	2	3	2	2	2	2	2	3	3	3
	CO4	3	3	3	2	2	2	2	2	3	3	3

Course Contents:

UNIT I:
History of Town Planning - Ancient town patterns, Impact of industrialization and technology, Evolution of modern town planning concepts, their Characteristics and classification. Model towns, garden cities, satellite towns, suburbia, green belts. Case studies of New Towns.

UNIT II
Planning Principles- National planning, regional planning, and town planning
Principles of land use planning, Principles of environmental planning control of land, water and air pollution, building byelaws and importance in planning,
Planning for Environmental conservation- Ekistics units and grids.

UNIT III
Planning Process and Implementation - Process of preparation of Master plans and developments and development plans - structure plans. Causes for urban blight-remedial planning measures. Housing- concept of L.I.G/ H.I.G and slum clearance boards.

UNIT IV
Planning For Future - Urban Renewal, Re- Planning, Urban Conservation, Concept of Decentralization and Recentralization, Resilient Cities, Smart cities and Transit Oriented development in Cities
Case studies to be discussed from the above approaches for the future of cities

References:

1. "The urban pattern" Arthur Gallion
2. "Garden cities of Tomorrow" Ebenezer Howard
3. "Design of cities" Edmund Bacon
4. "An Introduction to Town and Country Planning", John Ratcliffe, Hutchinson 1981
5. Urban Planning- theory and practice, Pratap Rao, CBS Publishers.
6. Urban Planning- Anthony J. Catanese, James C. Snyder. McGraw Hill.

Semester VII

B19AR7010	ARCHITECTURE DESIGN-VI	L	P	D	C
Duration:14 Wks		3	0	6	12

Studio Theme: Services & Structures for complex building typologies

Course Objectives:

1. 1. To brief on various parameters of context including site, history, culture, tradition, Climate etc.
2. 2. Identify the design approach at the start of the project, for e.g. sustainable design, Energy Efficient Design, Structural, or any other.
3. 3. Interpret the un-built environment of Landscape and apply knowledge of Place making in planning the Public spaces as required.
4. 4. Demonstrate abilities to resolve large projects of higher complexities with integration of knowledge gained in Construction, Structures, Landscape, Services, Bye laws and codes.

Course Outcomes:

On completion of the course, learners will be able to:

1. Explore the possibilities in contextual design through context reading
2. Relate the Design with Sustainability, Energy Efficiency, Structure competency etc.
3. Elaborate Space Planning for un-built environment of Landscape and public spaces
4. Explore the advanced architectural design by including building services and other added infrastructure

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7010/ AD-VI	CO1	2	1	2	0	1	1	1	1	2	2	2
	CO2	2	2	3	3	1	2	3	2	2	1	2
	CO3	3	2	1	1	0	1	1	1	3	1	1
	CO4	1	2	3	2	1	2	2	2	3	3	2

Course Contents:

UNIT – I

Literature Study and Case Study

Identifying a suitable case study in the City which fits the project brief and doing the study. May be broken up into different components to facilitate group work. Individual Literature studies

from available Internet sources and Books to be done.
Site Selection, analysis and Concept development.

UNIT – II

Development of Design

Design developments through study Models, Plans, Sections, area analysis, Mapping with City Bye law's and Zoning. Resolving Vertical services, Firefighting, HVAC and structural systems. Continuous emphasis on controls, codes and bye-laws.

UNIT – III

Delivery of the Design

Detailed double line Plans, elevations, Sections and models using computer aided software or Manual drawings.

UNIT -IV

Time Problem - Detailed Design of taking one component for ancillary block/ Open space - e.g. Cafetaria, Out patientUnit, Public plaza etc.

STUDIO PROJECTS:

Major Project:

Complex building typologies such as mixed-use development, Hospitals, 5-star hotel & convention centre, high rise office buildings etc may be taken up as problem statements. The project should have sufficient scope for integration of large span structural systems and services such as plumbings and sanitation, vertical circulation, HVAC, electrical services and Acoustics.

Time bound problems:

Detailing of a unit within the larger design can be taken up for this.
For eg: Interior design of Out -Patient Unit in a hospital;Office cafeteria design with detailed kitchen services and spill out spaces; Public plaza and recreation centre in a mixed use development.

References:

1. Time savers standards for architectural design data – by John Callender (Editor)
2. Architectural design data – by Ernst Neufert.

B19AR7020	ESTIMATION AND COSTING	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To provide the student sufficient knowledge of estimation in order that he can advise

prospective clients on project viability and monitor/ control project cost.

2. To provide the student adequate knowledge to write the specifications for a given item of work, to work out the unit cost of individual items based on their specifications and arrive at the overall cost of the project.
3. To enable the student to write specifications for diverse items of civil works with a view of controlling quality of work executed at site.
4. To enable students to prepare entire estimation of one project.

Course Outcomes:

On completion of the course, learners will be able to:

1. Enumerate the detailed list of items for preparation of an estimate for a simple building.
2. Derive detailed specifications for items enumerated for construction.
3. Compute the rate analysis for simple residential buildings.
4. To prepare complete estimation of load bearing/ frame structure.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7020/ E&C	CO1	0	0	3	0	1	1	1	0	1	0	0
	CO2	0	1	3	0	1	1	0	0	1	0	1
	CO3	0	2	2	0	1	1	0	1	1	1	0
	CO4	1	1	3	1	1	1	0	0	3	1	0

Course Contents:

UNIT 1

INTRODUCTION TO ESTIMATION

Estimation– definition; purpose; types of estimate; various methods of approximate estimate of buildings study of various drawing with estimate, abstract method of taking out quantities and cost-center line method, long wall and short method or crossing method.

UNIT 2

RATE ANALYSIS

Rate analysis– definition; method of preparation; quantity and labor estimate for unit work; task or outturn work; rate analysis for: earth work, concrete works, first class brick work, cement plastering, DPC with cement mortar/ concrete, finishing (cement paint, distemper, acrylic emulsion, enamel paint) to walls & ceiling.

UNIT 3

INTRODUCTION TO SPECIFICATION

Specification- Definition, purpose, procedure for writing specifications for calling tenders, typesof specification. General specifications for 1st, 2nd, 3rd and 4th class buildings.

SPECIFICATION FOR DIFFERENT ITEMS

Specifications for the following items – Bricks; sand; cement; coarse aggregate; water; reinforcement; Earth work in foundation; PCC; RCC; First class brick work in cement mortar; half brick thick partition in cement mortar; DPC; glazed tiles in skirting and dado, cement plaster; joinery in wood, steel & aluminum; painting to walls – cement paint, oil bound distemper, acrylic emulsion, enamel paint; painting to joinery; varnishing; French polishing

UNIT 4

DETAILED ESTIMATE

Detailed estimate– data required, factors to be considered, methodology of preparation, abstract of estimate, contingencies, work-charged establishment, bill of quantities, different methods for estimating building works, methods of measurement of works.

References:

1. M. Chakraborti,Estimation, Costing, Specification and Valuation in Civil engineering.
2. Dutta, Estimating and Costing, S. Dutta and Co., Lucknow 1983
3. PWD Specifications of Karnataka State Government
4. CPWD Specifications of Government of India

B19AR7030	PROFESSIONAL PRACTICE	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. Outline the Professional responsibilities within the ambit of the laws of the land, building codes, contract documents and ethics.
2. Describe the different aspects of contracts, tenders and project management
3. Introduce the different aspects of running an Architectural practice/office.
4. Orient to the legal aspects, legislation having a direct impact on Architectural practice and also the current trends in practice

Course Outcomes:

On completion of the course, learners will be able to:

1.Describe the various aspects of Architectural Practice such as the types of services offered, the scale of fees and stages of payment, types of Architectural firms, types of tenders etc.

3.Outline the guiding principles of Professional Practice, including Professional ethics.

3. Acquire the knowledge on process of architectural practice.

4. Acquire knowledge on architect's liabilities, legal aspects and current trends in practice

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7030/ PP	CO1	2	0	3	1	2	2	0	1	2	0	3
	CO2	3	0	3	1	0	2	0	3	3	0	1
	CO3	3	0	3	2	2	2	0	1	2	1	3
	CO4	3	1	3	1	3	2	0	0	1	0	2

Course Contents:

UNIT I:

Introduction to Profession Practice-Idea of profession and essential differences among profession, trade and business. Profession of Architecture-Types and extent of services offered by architects, scale of fees, stages of payment, and contract between client and architect. Code of Professional Conduct-Council of Architecture’s guidelines on competitions, types and classifications of competitions. Building Industry-Overview of the industry, Finance, statutory controls, construction procedures and enforcement issues related to building industry and the role of architect, employer, and contractor.

UNIT II:

Architectural Practice1- Types of Architectural firms, proprietorship, partnership, associate ship.

Architectural Practice-2: Various means of building client base and gaining projects.

Tender1& 2 - Procedure of calling for tender, documents necessary, Types of tenders, process of selection and award. Architect’s role in tender process, Earnest Money Deposit, Security Deposit, Retention Amount, Mobilization Amount and Bonus & Penalty Clauses.

UNIT III:

Introduction to Contract Administration & Issues of Contract- Bill checking, quality auditing, handover procedures and final certification. Termination of contract, Certificates of value and quality, Defects liability period, Liquidated and un-liquidated damages, Extension of time, delays and penalty, Non tendered items, additional works, variations, rate analysis and architect’s role in certification of variations, Types of insurance necessary during contract including fire insurance for safeguarding client’s interest. Project formulation - BOT, DBOT, BOLT, BOO. Understand the process - Expression of Interest, Request for proposal, Mode of evaluation, evaluation of Bid, Award of work. Site Supervision, meeting, co-ordination, instructions etc.

UNIT IV:

Architect's liability, Legislations and current Trends- Liabilities - Safeguards in construction industry such as performance bonds, insurance warranties, retention, indemnities, and estoppels and liquidated damages. Legislations - DCR, Factories acts, Heritage Act, TDR, Barrier free environment, CRZ and others

References:

1. "Professional Practice for Architects & Engineers" By Roshan Namavathi
2. "Legal and Contractual Procedures for Architects" By Bob Greenstreet
3. "Professional Practice" by KG Krishnamurthy and SV Ravindra

B19AR7041	**INTERIOR DESIGN**	**L**	**P**	**D**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Course Objectives:

1. To familiarize the students with an overview of interior and furniture design and design movements through history.
2. To inform the various components of interior space and treatment and finishes for the same.
3. To enable students to design an interior project applying all knowledge gained.
4. To illustrate graphically the interior design through plan, sections, elevations and 3D views by using software's

Course Outcomes:

On completion of the course, learners will be able to:

1. Characterize the guiding principles of Interior Design.
2. Enumerate the different components of Interior Design
3. Articulate the integration of lighting, services and landscaping into Interior

4. Enumerate the latest finishes and products available in the field of Interior Design and integrate all the above into the final outcome in the form of drawings.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7041/ ID	**CO1**	2	2	2	2	2	3	2	2	2	2	2
	CO2	0	2	2	2	1	2	1	1	1	2	1
	CO3	2	2	3	2	2	2	3	3	2	3	2
	CO4	2	3	3	3	3	3	2	2	3	3	3

Course Contents:

UNIT – I

History and Introduction - Definition and process of interior design - vocabulary of interior design in terms of principles and elements. Understanding interior spaces using activity analysis and anthropometrics. Effect of enclosure, fenestration, color, lighting on perception of interior space. Psychological effects of space.

Designing for Comfort- natural and artificial lighting, air conditioning and acoustics.

UNIT – II

Components of Interior Spaces

Interior Treatment and Finishes: floors, ceilings, walls, partitions, window treatments, accessories

Furniture Design: Importance of furniture, Ergonomics, Materials, matching Furniture to Themes.

Furniture for specific types of interiors: office furniture, children's furniture, residential furniture.

UNIT – III

Integration into Design - Interior lighting - types of lighting fixtures, Interior landscaping elements: rocks, plants, water, flowers, fountains, paving, artefacts, etc., their physical properties and effects on spaces

Integrating Services into Interior Design: Water supply and drainage, Electrical, Air-conditioning.

UNIT IV

Design of Interiors (Office, Restaurant, Hotel etc.,) - Drawing Plan, Sections, Elevations specifying Materials, methods of construction, detailing showing furniture Layout etc. Should be represented using Manual or Digital software.

References:

1. "Construction and Detailing for Interior Design" By Drew Plunket
2. " Interior Architecture From Brief to Build" By Jennifer Hudson
3. " Key Interiors Since 1900" By Graeme Brooker

4. “Time Saver’s Standards for Interior Design”, Joseph DeChiara, Julius Panero, Martin Zelnik, McGraw-Hill Professional 2001
5. “Interior Design”, John F.Pile, John Wiley and Sons 2004
6. “The Impulse to adorn - Studies in traditional Indian Architecture”, Dr.Saranya Doshi, Editor, Marg Publications 1982
7. “Introduction to Interior Design”, Steport - De - Van Kness, Logan and Szebely, Macmillan Publishing Co NY 1980.
8. “ Human Dimensions and Interior space”, Julius Penero and Martin Zelnik, Whitney Library of Design NY 1979

B19AR7042	**GRAPHIC DESIGN**	**L**	**P**	**D**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Course Objectives:

1. To introduce to the basics of graphic design
2. To introduce to the tools of graphic design
3. To introduce to the importance of computer graphics through software’s and typography design
4. To introduce to the different fields of graphic design

Course Outcomes:

On completion of the course, learners will be able to:

1. Use digital graphics as a tool for presentation.
2. Explore the different tools related to graphic design
3. Explore the typography design.
4. Develop signage boards, logos and website designs.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7042/ GD	**CO1**	3	3	3	0	1	0	1	3	3	2	2
	CO2	2	3	0	2	0	0	3	2	3	3	1
	CO3	3	3	1	2	3	3	2	3	2	3	1
	CO4	2	3	3	3	2	1	3	2	2	3	2

Course Contents:

UNIT 1:

Introduction to Graphic Design

This module will cover the history of graphic design, uncover what graphic designers do and review the design process.

- ·Course Introduction
- ·Historical Overview of Graphic Design
- ·What Do Graphic Designers Actually Do?
- ·Design Process

UNIT 2:

Elements of Design

This module will introduce the design principles of balance, alignment, proximity, space, repetition and contrast.

- ·Overview of Design Principles
- ·Balance and Alignment
- ·Proximity and Space
- ·Repetition and Consistency
- ·Contrast and Color

UNIT 3:

Basic Concepts of Design and textural elements of design: fonts, typography and spacing

This module will go over the expectations of projects in this specialization, how to apply the design principles to the projects, and software needed to product course projects.

- ·Online and Adobe Products Overview and Uses
- ·From the history of typography, the difference between type, fonts and text as well as exposure to typography spacing, students will learn the value of selecting the best kind of type and combinations of fonts to get their message across in a visually pleasing manner.

UNIT 4:

Print and digital elements of design: Branding and User Experience

In this module the students will be introduced to the print and digital media

- · Textual and color elements, as well as tips on fixing design issues.
- · Printing terms and paper options, as well as print-specific features in computer design programs.
- · Online elements of graphic design such as designing for online mediums and converting image sizes for use on websites.

References:

1. Karen, Lewis(2009)Graphic Design for Architects: A Manual for Visual Communication,
2. Routledge Publishers, New York
3. Guan, M & Zhou, L(2011) Graphic Design in Architecture, Design Media Publishing Ltd
4. Bringhurst, Robert(1996) The Elements of Typographic Style, Hartley & Marks Inc.,U.S

B19AR7043	PRODUCT DESIGN	L	P	D	C
Duration:14 Wks		2	1	0	3

Course Objectives:

1. To highlight the history, definitions and purpose of product design and explain the role of product designers
2. To Illustrate the relationship between Man-machine system and environment and also discuss ergonomics and the influence of human factors on product design.
3. To explain the various aspects of product design, emphasizing on concepts of sustainable design.
4. To illustrate the process of product development through an exercise

Course Outcomes:

On completion of the course, learners will be able to:

1. Develop understanding of history, definitions and purpose of product design and outline the role of product designers.
2. Interpret relationship between Man-machine system & environment and analyse concepts like applied anthropometry, universal design & user centric design
3. Obtain basic skills required to handle simple product design projects like conceptualization, prototype development, manufacturing and marketing based on customer needs
4. Compare current trends in product development process from detailing, materiality, technicality to imagebility

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7043/ PD	CO1	3	3	3	0	1	0	1	3	3	2	2
	CO2	3	3	0	3	0	0	3	2	3	3	1
	CO3	3	3	1	2	3	3	3	3	3	3	2
	CO4	2	3	3	3	2	1	3	2	2	3	2

Course Contents:

UNIT 1
Introduction to Product Design:

Various elements – History of Product Design – Definition of Product Design, understanding of Product Design - Purpose of Product Design – Role of Product Designers.

UNIT 2
Ergonomics:

Definition of human factors, Application of human factors data. Human activities, their nature and effects. Man-machine system and physical environment. Human performance and system reliability. Information input and processing. Human control systems. Applied anthropometry – Human response to climate.

UNIT 3
Aspects of Product Design:

Form, Color, Material, Technology and recyclability, Packaging. Multiple Utility oriented approach to Product Design. Concepts of Green and Sustainable Design.

UNIT 4
Design Thinking Process:

Empathize, Define, and Ideate, Prototype & Test.
Develop skills to conceptualize, create & market the product based on customer needs.

Exercise: Design of Household elements, tools and devices, Design of furniture, Design of Industrial Products. Element design for the physically and mentally disabled people.

References:

1. The Design of Everyday Things by Don Norman
2. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler.

3. Cradle to Cradle: Remaking the way we make things by William McDonough and Michael Braungart.
4. Product Design & Development by Karl T. Ulrich and Steven D. Eppinger.

B19AR7051	VERNACULAR ARCHITECTURE	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. Brief overview on various approaches, concepts and provide a world view on the study of Vernacular architecture

2. Describe vernacular architecture across different regions in India as a response to climate, culture and context.

3. Discuss the impact of the Colonial rule on the Vernacular architecture in India through the study of Colonial settlements and towns.

4. Showcase vernacular architecture through Case studies as sustainable architecture that lends itself to new uses as seen in adaptive reuse and eco-tourism in both urban and non-urban context

Course Outcomes:

On completion of the course, learners will be able to:

1. Identify and recognize the term 'Vernacular' and the importance of studying domestic buildings of the past in Indian and World context.
2. Acquire knowledge on the classification of prototypes in different regions and illustrate the finer details using Plans and sections.
3. Relate, compare and associate the planning principles in Vernacular architecture to Climate, Geography, Geology, Socio- cultural factors within different regions in the Indian subcontinent.
4. Associate the terms Adaptive reuse, eco-tourism and sustainability to new age Vernacular architecture in the context of Colonial Heritage towns and settlements.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7051/ VA	CO1	3	3	3	3	3	3	3	3	3	3	3
	CO2	2	2	2	2	2	2	2	2	2	2	2
	CO3	3	3	3	3	3	3	3	3	3	3	3
	CO4	3	3	3	3	3	3	3	3	3	3	3

Course Contents:

UNIT I

Introduction

Definition and classification of Vernacular architecture , Vernacular architecture as a process , methods of survey and study of vernacular architecture, Cultural and contextual responsiveness of vernacular architecture. Global view of Vernacular and its implications.

Research paper readings and discussions to understand vernacular architecture across the world.

UNIT II

Vernacular architecture of the Western and Northern regions of india

Forms spatial planning, cultural aspects, symbolism, color, art, materials of construction and construction technique of the vernacular architecture of the following:

- Bhunga houses in the deserts of Kutch and Havelis of Rajasthan
- Geographical regions of Himachal Pradesh and Kashmir with respect to Kath-Kuni and Dhajji Dewari systems.
- Gujarat: Evolution from Rural to Urban in North Gujarat and South Gujarat, Colonial influence on Havelis of Bohras of Siddhpur

UNIT III

Vernacular Architecture of South India

Forms, spatial planning, cultural aspects, symbolism, art, color, materials of construction and construction technique, proportioning systems, religious beliefs and practices in the vernacular architecture of the following:

- Kerala: Evolution of the Nalukettu, performance spaces- Koothampalam, Houses of the coastal regions.
- Tamil Nadu: Houses and palaces of the Chettinad region; Agraharams of the temple towns.

Vernacular walk through settlement in urban context to understand planning and response to Climate

UNIT IV

Colonial Influences on Vernacular Architecture of India and future of vernacular

Colonial influences of Dutch, French, Portuguese and British in different regions of India- Evolution of the Bungalow from the traditional Bangla.

Settlement patterns and house typologies in Pondicherry and Cochin and Goa: Influence of Colonial over Vernacular-

Future of Vernacular architecture: The Paradox of conserve or rebuild; introduce adaptive reuse and Eco-tourism as sustainable measures : *Student presentations and discussions on Case studies*

References:

1. Paul Oliver, Encyclopedia of Vernacular Architecture of the World, Cambridge University Press,1997.

2. Amos Rapoport, House, Form & Culture, Prentice Hall Inc. 1969.

3. R W Brunskill: Illustrated Handbook on Vernacular Architecture, 1987.

4. V.S. Parmar, Haveli – Wooden Houses and Mansions of Gujarat, Mapin Publishing Pvt. Ltd., Ahmedabad, 1989.

5.Kulbushanshan Jain and Minakshi Jain – Mud Architecture of the Indian Desert, Aadi Centre, Ahmedabad 1992.

6. G.H.R. Tillotsum – The tradition of Indian Architecture Continuity, Controversy – Change

since 1850, Oxford University Press, Delhi, 1989.

7. Carmen Kagal, VISTARA – The Architecture of India, Pub: The Festival of India, 1986.

8. S. Muthiah and others: The Chettiar Heritage; Chettiar Heritage 2000

9. Willi Weber and Simos Yannas, Lessons in Vernacular Architecture, Routledge 2014

B19AR7052	BARRIER FREE ARCHITECTURE	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To outline the various concepts of barrier free design and types of disabilities

2, To introduce the minimum access provisions required for barrier free environment in various types of building and design elements

3. To acquaint with the types of signage's and design requirement for barrier free architecture

4. To provide an overview on the National and International disability acts and policies through case studies

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquire knowledge on the various concepts of barrier free design and types of disabilities
2. To apply the minimum access provisions required for barrier free environment in various types of building and design elements
3. To illustrate design requirements for signages in barrier free environment
4. To interpret the bye-laws and regulations pertaining to barrier free environment

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7052/ BARRIER FREE ARCHITECTURE	**CO1**	3	1	3	2	3	3	2	3	3	3	3
	CO2	2	2	2	2	2	2	2	2	2	2	2
	CO3	3	3	3	3	3	1	3	2	3	3	3
	CO4	3	3	3	1	3	3	2	3	3	3	3

Course Contents:

UNIT–I: INTRODUCTION

Definition of Barrier free built environment, defining the basic concepts of barrier free design, need for barrier free concepts in architecture, concepts of universal design. Definition of Disability. Type of disabilities, Study of dimensions that can be used for guidance when designing facilities and equipment to be used by persons with disabilities, like Reach Ranges, Circulation Dimensions-Wheelchair Dimensions, Walkway Width for Crutch Users, Vision Cone, Heights of People, and Lighting.

UNIT-II: STUDY OF BARRIER FREE DESIGN ELEMENTS

Minimum access provisions required in various types of buildings: Space Allowances – Minimum access provisions, general allowances. To study the anthropometrics and dimensions of mobility devices, special fixtures for barrier free design. Barrier free construction materials and dimensions for flooring, walls, doors, windows, staircases, elevators, toilets, entrances and corridors. Design elements outside the building like curb ramps, pedestrian crossing, public toilets, and parking, signages, flooring and street furniture. Case examples of Barrier free architecture in India and across the globe

Site visit and study of Barrier free design implemented in the immediate environment of the City neighbourhood.

UNIT-III: SIGNAGE

Types of Signage, signage requirements, Signage Specifications – Character Proportion, Character Height, Raised / Braille Characters and Pictogram, Finish and Contrast, Mounting Location and Height, Symbols of Accessibility, Illumination Levels. Signage Design- Language, Sign Typeface, Suggested Sizes for Letters and Symbols, Text Design, Colour and Contrast. Sign Installation – Illumination, Sign positioning.

Learning to be supplemented through design exercises on the same

UNIT-IV: DISABILITY ACTS AND NATIONAL POLICIES

Introduction to Provisions of persons with Disabilities (Equal opportunities, Protection of Rights and Full Participation) Act, 1995, National Policy for provisions for elderly persons, Concept of equal opportunity, human rights, social justice and empowerment of physically challenged persons. Introduction to similar efforts in other countries. Initiatives at global and International level for protection of rights of disabled and the elderly. American disabilities Act 1990 Information on various types of national Institutes, agencies and professional bodies involved in disabled welfare, associated norms and standards thereof. The role of NGO's, professional and outreach.

Learning to be enhanced through discussions and expert lectures

References:

1. Ministry of Urban Affairs and Employment. Central Public Works Department, India, "Handbook on Barrier Free and Accessibility", 2014.
2. Ministry of Urban Affairs and Employment. Central Public Works Department, India, "Guidelines and Space Standards for Barrier Free Environment for Disabled and Elderly Person, 1998.
3. Unnati. Team "Design Manual for a Barrier – Free Built Environment", Handicap International, December, 2004.
4. ADA Accessibility Guidelines for Buildings and Facilities (ADAAG) US: American Disabilities Act.
5. The National Building Code of India, 2005.

6. Micheal J. Bednar. “Barrier Free Environments”, Dowden, Hutchinson and Ross, Ive 1977.

OPEN ELECTIVES OFFERED FOR STUDENTS OF OTHER SCHOOLS

FROM FACULTY OF ARCHITETCURE

B19AR7061	1. INDIAN ART AND ARCHITECTURAL HERITAGE	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Description:

The course is targeted towards students who are keen to discover the art and architectural heritage of India. The course provides a concise overview of the chronological evolution, socio cultural linkages and stylistic variations observed in art and architecture in India from Pre historic to Contemporary times. The pedagogy will include audio visual lecture sessions followed by creative explorations by students for in-depth understanding of selected topics. Visits to art museums and architectural monuments will be conducted to ensure greater learning and comprehension.
Apart from enhancing general awareness, the course will be helpful for those preparing for competitive examinations such as Civil services exam where Indian art and culture is included in the syllabus for both Prelims as well as General Studies (mains) paper.

Course Objectives:

1. To acquaint students with multi-disciplinary knowledge and options to choose from various fields.
2. To facilitate students in enhancing the latest skills in high demand fields
3. To enhance the employability of students with relevant certification on current trending fields.
4 To provide students with networking opportunities in terms of collaboration with other individuals across nations.

Course Outcomes:

On completion of the course, learners will be able to:
1. Develop knowledge on multi-disciplinary courses selected from across fields
2. Discover latest skills in high demand fields like AI, IOT, cloud engineering, circular economy, sustainability, UI/UX, design thinking etc.
3. Acheive high employability with relavant certification from online courses with access to expertise from world class universities

4. Develop networking skills through collaboration with peers accross nations, show cultural sensitivity and be able to adapt to any environment easily

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7061	**CO1**	2	2	1	3	2	2	3	3	3	0	3
	CO2	3	3	2	3	1	3	3	3	3	3	1
	CO3	2	2	3	2	1	2	1	3	2	1	2
	CO4	2	1	0	2	2	3	0	3	3	0	3

Course Contents:

UNIT – I

AN INTRODUCTION TO ART & HERITAGE

-An introduction to Indian culture and its primary components. Religion and philosophy from ancient India to Contemporary times. Link between culture, art and architecture. Defining Heritage, Types of Heritage and their significance.

- Definition of Indian art; Beauty and Aesthetics in the Indian context, Philosophical background of Indian art, Fundamental concepts of Indian art- *Rasa, dhwani, vakrata, Auchitya*.

- Introduction to Visual arts in India- An outline of Chronological evolution of painting styles in India

- Indian art-Characteristics and examples- *Prehistoric period; Ancient period*- Buddhist and Hindu paintings

UNIT – II

APPRECIATION OF VISUAL ARTS IN INDIA -

-Indian art- Characteristics and examples- *Medieval period:* schools of painting like the Rajasthani, Pahari, Kangra, Kulu, Basoli etc.

-Indian art-Characteristics and examples- *Modern period:* Raja Ravi Verma, Bengal School of Art, Progressive Artists Group, Madras School of art, Modern Indian artists

-Folk and Vernacular art forms like the Mithila painting, Kalamkari painting, Warli painting, Gond, Pattachitra, Kalighat painting etc.

-An overview of Movements &*isms* in art around the world-impressionism, expressionism, surrealism, cubism, pop art etc.

UNIT – III

APPRECIATION OF INDIAN ARCHITECTURE-I –*Buddhist and Hindu architecture*

-Architectural advancements of Indus valley Civilization;

-Buddhist Architecture- Stambha, Stupa, Viharas, Chaityas. Examples from Sanchi, Amravati, Ajanta, Ellora etc.

-Hindu temple architecture in the South of India- Typical parts of a Hindu temple; Examples from Chalukyas, Rashtrakutas, Cholas, Pandyas, Hoysalas, Vijaynagara dynasties

-Hindu and Jain temple architecture in the North of India- Examples from Orissa, Central India, Rajasthan and Gujarat styles of Architecture

UNIT –IV

APPRECIATION OF INDIAN ARCHITECTURE-II – *Islamic, Colonial & Contemporary Architecture*

-Islamic architecture in India- Typical Parts of an Islamic mosque and Tomb; Examples from Delhi Sultanate- Slave, Khilji, Tughluq, Syed, Lodi dynasties

-Mughal Architecture- Examples from Delhi and Agra; Provincial Islamic styles- Punjab, Malwa, Bengal, Gujarat, Bijapur, Bidar, Nizam

-British Colonial and Indo Saracenic architecture in India- Characteristic features and examples from Delhi, Kolkata, Madras and Bangalore

-Contemporary Indian architecture- Characteristic style and Works of Corbusier, Laurie Baker, BV Doshi, Charles Correa, Raj Rewal; Listing of Important contemporary buildings and their architects.

References:

1. Indian Art (Oxford History of Art), ParthaMitter, Oxford, 2001
2. The Art & Architecture of the Indian Subcontinent (Pelican History of Art Series), J.C. Harle, The Yale University Press, 1994
3. Indian Art: A Concise History, Roy C. Craven, Thames & Hudson Ltd, 197
4. Percy Brown, Indian Architecture – Buddhist & Hindu, D B Taraporevala Sons & Co.
5. Percy Brown, Indian Architecture – Islamic period, D B Taraporevala Sons & Co.
6. Satish Grover, Islamic Architecture, CBS Publications
7. Lang, Jon T. A concise history of modern architecture in India. Orient Blackswan, 2002.

8. Bahga, Sarbjit, Surinder Bahga, and YashinderBahga. Modern Architecture in India: Post-independence Perspective. Galgotia Publishing Company, 1993.

OPEN ELECTIVES OFFERED FOR STUDENTS OF OTHER SCHOOLS

FROM FACULTY OF ARCHITETCURE

B19AR7062	2. FINE ARTS	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To acquaint students with multi-disciplinary knowledge and options to choose from various fields.
2. To facilitate students in enhancing the latest skills in high demand fields
3To enhance the employability of students with relevant certification on current trending fields.
4 To provide students with networking opportunities in terms of collaboration with other individuals across nations.

Course Outcomes:

On completion of the course, learners will be able to:

1. Develop knowledge on multi-disciplinary courses selected from across fields
2. Discover latest skills in high demand fields like AI, IOT, cloud engineering, circular economy, sustainability, UI/UX, design thinking etc.
3. Acheive high employability with relavant certification from online courses with access to expertise from world class universities
4. Develop networking skills through collaboration with peers accross nations, show cultural sensitivity and be able to adapt to any environment easily

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7062	CO1	2	2	1	3	2	2	3	3	3	0	3
	CO2	3	3	2	3	1	3	3	3	3	3	1
	CO3	2	2	3	2	1	2	1	3	2	1	2
	CO4	2	1	0	2	2	3	0	3	3	0	3

Course Contents:

UNIT –I

Introduction to Visual art and its fundamentals; Theory of colours,

Free HandSketching in pencil and pastel colors for Still life, Shading objects with different tones, like light and Shade.

UNIT II

Introduction to Water color, Poster color and Acrylic color paintings.

Creative painting on different mediums like terracotta,Fabric, Canvas etc.

UNIT III

Introduction to traditional art in India for example Warli Painting, Gond painting, Madhubani painting, kalamkari painting

UNIT IV

Creative sculptures using different mediums, Terracotta art, Installations

References:

1. Gill, Robert W., Rendering with pen & Ink, Thames and Hudson
2. Judith Collins, techniques of Modern artists, Chartwell Books, 1997

B19AR7062	3. FUNDAMENTALS OF INTERIOR DESIGN	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Contents:

UNIT-I

Introduction

Definition and process of interior design - vocabulary of interior design in terms of principles and elements. Understanding interior spaces using activity analysis and anthropometrics. Basic guidelines for developing a drawing- Plan and elevation, views.

UNIT-II

Components of Interior Spaces -

Interior Treatment and Finishes: floors, ceilings, walls, partitions, window treatments, accessories Furniture Design: Importance of furniture, Ergonomics, Materials, matching Furniture to Themes. Concept of a Panel board- collecting all finishing materials relevant to a project and presenting to the client.

UNIT-III

Integration into Design

Integrating Services into Interior Design: Water supply and drainage, Electrical, Air-conditioning. Basics of representation of toilets, kitchens etc. with the services.

UNIT IV

Design Development through Drawings

Design of a Kitchen/ Living room / Child's room using all knowledge gained. Presenting through drawings and Panel board.

References:

1. Francis D.K. Ching, "Interior Design Illustrated", V.N.R. Pub. NY 1987

2. Joseph DeChiara, Julius Panero, Martin Zelnik, "Time Saver's Standards for Interior Design", McGraw-Hill Professional 2001

3. John F. Pile, "Interior Design", John Wiley and Sons 2004

4. Steport - De - Van Kness, Logan and Szebely, "Introduction to Interior Design", Macmillan Publishing Co NY 1980.

5. Julius Penero and Martin Zelnik, "Human Dimensions and Interior space", Whitney

OPEN ELECTIVE CHOICES FOR STUDENTS OF ARCHITETCURE

B19AR7061/62/63	OPEN ELECTIVES (OFFERED FROM OTHER SCHOOLS / ON ONLINE PLATFORMS (LIKE SWAYAM/MOOC ETC)	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To acquaint students with multi-disciplinary knowledge andoptions to choose from various fields.
2. To facilitate students in enhancing the latest skills in high demand fields
3 To enhance the employability of students with relevant certification on current trending fields.
4 To provide students with networking opportunities in terms of collaboration with other individuals across nations

Course Outcomes:

On completion of the course, learners will be able to:
1. Develop knowledge on multi-disciplinary courses selected from across fields
2. Discover latest skills in high demand fields like AI, IOT, cloud engineering, circular economy, sustainability, UI/UX, design thinking etc.
3. Acheive high employability with relavant certification from online courses with access to expertise from world class universities
4. Develop networking skills through collaboration with peers accross nations, show cultural sensitivity and be able to adapt to any environment easily

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR7063	CO1	2	2	1	3	2	2	3	3	3	0	3
	CO2	3	3	2	3	1	3	3	3	3	3	1
OPEN	CO3	2	2	3	2	1	2	1	3	2	1	2
ELECTIVES	CO4	2	1	0	2	2	3	0	3	3	0	3

Semester VIII

B19AR8010	ARCHITECTURAL DESIGN -VII	L	P	D	C
Duration:14 Wks		2	0	7	13

Course Objectives:

1. To identify and categorize the different informal parameters relevant to the process of designing an urban environment.
2. To analyse the process of preparing an urban planning proposal
3. To synthesise the outputs from the above to suggest visual, tactile and measurable improvements in the places that make up our urban living environment
4. To undertake the exercise of the design of the un-built landscape environment, as part of 3) above.

Course Outcomes:

On completion of the course, learners will be able to:
1. Acquire an understanding of the urban design process, including all the parameters and the

roles played by the different interest groups in the realization of an urban design scheme

2. Develop the skill of handling Design projects of an urban scale as different from the detailing of the individual architectural building projects.
3. Demonstrate the ability to be able to visualize at the urban scale and think in terms of

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR9010/ AD-VII	CO1	3	3	2	3	1	0	0	0	3	1	3
	CO2	0	2	3	3	1	0	2	1	0	3	3
	CO3	0	1	3	2	3	0	0	0	0	0	1
	CO4	1	0	2	2	3	3	3	2	2	3	3

Course Contents:

UNIT 1

Discussion on Design brief, Site visit and Survey, Case Studies

The studio shall begin with an introduction to a) the design brief, and b) the proposed site. This will be followed up by case studies documenting implemented urban designs so as to understand the design process. The documentation shall be an intensive exercise with teams of two or more who would a) Identify the project (across Bangalore or Karnataka or India) and b) Analyse the entire design process against all the assigned parameters.

UNIT 2

Site Analysis

This would consist of a detailed site analysis including a) SWOT analysis b)City scape analytical models showing density, built vs. open, skyline, road network, transit-oriented development, service lines, land use and height of the buildings showing various systems integrated in functioning of an urban built environment. Get an overview of the existing urban fabric and understand the issues.

UNIT 3

Conceptual Design

The studio will focus on learning the process of evolving urban design guidelines and generation of a concept based on the inferences obtained from the case studies and the site analysis. Exercises in conceptual modeling shall be conducted using suitable software.

UNIT 4

Detailed Design

The conceptual design process will be taken forward to a detailed design level in this unit. The students would learn to refine the conceptual design thought process and come up with the final design solution, synthesizing all the inputs and criticism received during the conceptual design process. They will carry out detailed design modelling and simulation.

References:

1. Neufert, Ernst architect's data. Crosby Lock Wood and Sons
2. Time Saver Standards for Architectural Design Data. McGraw Hill.
3. Essentials of Urban Design By Mark Sheppard
4. Sustainable Urbanism: Urban Design With Nature By Douglas Farr
5. Paul Sprelregen Urban Design: The architecture of Towns and cities
6. Bacon N. Edmund. Design of cities. Penguin Books, New York 1976.
7. Krier Rob, Urban Space 3rd Ed, Academy Editions, London 1984.
8.

B19AR8020	PRE THESIS	L	P	D	C
Duration:14 Wks		0	4	0	2

Course Objectives:

1. To facilitate topic selection on the basis of the project synopsis

presented to the panel by aprocess of iteration and elimination

2. To facilitate the student in definition of aim, objectives, scope, limitations and methodologyof the project
3. To guide the student to research into the selected project through literature review ofquality research papers, journals and books
4. To enable students to select

Course Outcomes:

suitable case studies that will bring clarity in defining spatial requirements, Site selection and special requirements pertaining to the topic.

On completion of the course, learners will be able to:

1. Use Fundamental knowledge of history, technology, regulations, culture, climate and context to identify a project for detailed study
2. Formulate the synopsis by applying analytical reasoning and critical thinking
3. Apply skills of research and critical evaluation in drawing inferences from the literature and case studies to substantiate the chosen project and present the same through reports and drawings
4. Evaluate the project need, feasibility and identify a suitable Site for designing the same in the given context

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR8020/ PRE-THESIS	CO1	3	1	3	1	0	1	0	1	3	0	2
	CO2	3	2	3	3	3	3	3	3	3	2	3
	CO3	3	2	3	3	3	3	3	2	1	2	3
	CO4	3	2	3	3	3	3	3	1	3	1	3

Course Contents:

Pre-Thesis course will give opportunity to students to start preparation for the Architectural design thesis project. Student is expected to develop a design of his or her own choice and to demonstrate the ability to use effectively the tools of independent investigations and judgment to evolve design criteria. The application of these may be original design or research-oriented work.

UNIT I

Identification of a domain of interest and select a few topics of suitable scale. Develop a synopsis for each of the chosen topics. Using critical evaluation and process of elimination, develop any one idea to detail

UNIT II

Apply analytical reason and critical thinking to formulate the aims, objectives, scope, limitations and possible methodology for the project chosen.

UNIT III

Domain research, identification and prioritization of parameters for thesis,literature survey for identified parameters, secondary case studies

UNIT IV

Identification of Site, justification and need for the project, identification of primary case studies, prepare the guidelines and checklist for case studies and detailed site studies

B19AR8030	LANDSCAPE DESIGN	L	P	D	C
Duration:14 Wks		2	2	0	3

Course Objectives:

1. To introduce evolution of landscape architecture through different era across the world

2. To elaborate the Botanical varieties and their characteristics for Landscape design

3. To familiarize the students with various elements of landscape architecture

4. To introduce the Landscape development process using the elements of landscape

Course Outcomes:

On successful completion of the course students shall be able to

1. Comprehend the origin and concept of landscape architecture and understand the significance of influencing trends and methodology practiced during various period of time in the evolution of landscape architecture.

2. Identify the botanical characteristics of landscape elements and wisely choose the right

plants and trees as per the Landscape design requirement.

3. Categorize various man-made elements of landscape and the importance of each

elements for landscape design

4. Comprehend the significance of Landscape architecture and incorporate it along with

architecture (building) from the beginning through site planning.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR8030/ LANDSCAPE DESIGN	**CO1**	1	3	1	2	2	0	1	2	1	2	1
	CO2	2	1	3	2	0	1	1	2	2	2	1
	CO3	2	3	3	2	1	2	1	1	3	2	2
	CO4	1	1	2	1	2	1	3	3	1	3	1

Course Contents:

UNIT I: LANDSCAPE DESIGN AND BUILT ENVIRONMENT

Role of Landscape design in built environment. Terminology: Land, Landscape, Landscape Architecture, Landscape Architect. Evolution of concepts in landscape design in integrating built spaces to open spaces. Historical Background: Oriental (Asia) and occidental (countries of west). Evolution of architecture in modern era: Case study of some influential contemporary landscape architecture and their salient features: Duisburg – Nord Park (Landschaftspark) Duisburg, Germany, Fresh kills landfill – New York, Highline Park – New York and Borneo Sporenburg-Amsterdam, The Netherlands

UNIT II: LANDSCAPE ELEMENTS: NATURAL

Landforms, water and vegetation. Selection and management of plant material in relation to built environment, taxonomy and classification of plants. Study and analysis of existing landscaped areas Introduction to study of plant materials in relation to landscape architecture and design. Appearance, functional and visual effects of plants in landscape design. Selection and management of plant material in relation to built environment, taxonomy and classification of plants, trees, shrubs.

UNIT III: LANDSCAPE ELEMENTS: MAN-MADE

Landscape structure, Landscape shelters, Steps / Walls / Fences /Screens / Trellis, Landscape features or accessories, Pathways and paved area and Outdoor / street furniture. Natural and Manmade landscape in urban and rural landscape. Contemporary attitude to development and design of open spaces like urban spaces, courtyards, gardens, parks, Streetscape, street furniture, pavements and other architectural elements in relation to Landscape design

UNIT IV: SITE PLANNING

Site planning with reference to distinct characteristics like topography, vegetation, hydrology, access, surroundings etc. Principles of landscape design and built environment. Philosophical and design issues related to site development-spatial and contextual relationships of built and outdoor space and circulation, site and its relationship to surroundings, importance of climate and social factors in development of site.

B19AR8041	URBAN DESIGN	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To impart the knowledge about various developments in the field of urban Design.
2. To describe the elements of Urban design and how Cities are structured
3. To give an overview of urban design as an interface between the fields of architecture and urban planning
4. To describe changing trends due to urbanization and suburbanization of cities.

Course Outcomes:

On completion of the course, learners will be able to:

1. Define the term Urban Design and identify the elements of urban design
2. Interpret the structure of a city through elements of urban design and realise the Importance of agencies and authorities.
3. Demonstrate an ability to comprehend the nature of urban design and related problems And identify solutions through field study.
4. Analyze urban form, size, qualitative and quantitative techniques of assessing Requirements and planning amenities and apply the learnings in Design proposals.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR8041/ UD	CO1	3	0	2	2	2	2	2	2	3	1	2
	CO2	3	3	2	3	3	3	1	2	3	3	2
	CO3	3	3	3	3	3	3	3	2	3	3	3
	CO4	3	3	2	3	3	3	3	3	3	3	3

Course Contents:

UNIT 1

Introduction to Urban design - Discussion on Architecture, Urban Design, and nature of urban design projects in public and private developments. Urban design guidelines followed during various periods. Introduction to the term's legibility, permeability and urban morphology.

UNIT 2

Structure of cities- sectors, blocks, streets, squares, buildings and open spaces. Elements of Urban Spaces: squares and streets. Role of planning agencies such as development authorities, Urban Arts Commission in the development of cities. Influence of city development policies namely Master plans, zoning regulations on urban Design.

UNIT 3

Urban Design process - Field Study, Identification of area for study.

UNIT 4

Design Proposals, Developments, and urban design guidelines

References:

1. Bacon N. Edmund. Design of cities. Penguin Books, New York 1976.
2. Krier Rob, Urban Space 3rdEd, Academy Editions, London 1984.
3. Mumford Lewis City in History, Its origin transformation and itsprospects.
4. Paul Sprelregen Urban Design: The architecture of Towns and cities
5. Morris, Anthony, J.E. History of Urban Form.
6. Kostof, Spiro, City Shaped: Urban Patterns and Meanings Through History.

B19AR8042	CONSERVATION STUDIES	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To introduce the definition, principles, ethics and value of heritage conservation.
2. To explain how to conduct the assessment of a heritage building including the different methods of survey and the types of damages that can affect a heritage building.
3. To demonstrate different preservation techniques in architectural conservation

4. To discuss and assess various national and international case study examples of architectural conservation

Course Outcomes:

On completion of the course, learners will be able to:

1. Explore various concepts and prevailing practices in conservation and also explore the role of various national and international organizations working towards the conservation of heritage structures.
2. Provide condition assessment of a heritage building through non-destructive survey methods.
3. Suggest the levels of intervention and also provide solutions for repair and replacement of components.
4. Explore successful case studies to understand the diverse conservation strategies utilized for heritage management

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR8042/ CONSERVATION STUDIES	**CO1**	3	0	2	0	0	3	0	3	3	0	3
	CO2	3	0	0	3	0	0	0	3	3	0	0
	CO3	0	0	0	3	0	3	0	0	3	0	3
	CO4	3	0	0	3	3	0	0	0	3	0	3

Course Contents:

UNIT –I

Introduction: Definition, types, need; principles, ethics & value; tangible & intangible components, Degree of Intervention; Evaluation & assessment; Documentation; Procedures & techniques; Concepts & prevailing practices in conservation, restoration, retrofitting, rehabilitation, consolidation, protection, adaptive reuse. Architectural Conservation: Preservation & conservation philosophies; Pioneers & societies in field of conservation; International Charters; International approaches from UNESCO, ICCROM, GETTY foundation, etc.; National approaches: A.S.I., State Archeology, INTACH, Urban Art Commission, Heritage Commissions, local bodies, etc.; Techno legal provisions, codes & byelaws for interventions.

UNIT II

Assessment of Building Condition: Understanding of original building conditions; Documentation of current conditions- non-destructive survey methods, environmental monitoring, simple & sophisticated analytical methods; Types & causes of damages; Damage to building components & structural systems - superstructure & substructure; Location & degree of damages - defect monitoring methods, their impact - diagnosis of failure & damages.

UNIT III

Preservation Techniques In Architectural Conservation: Analysis of problem; Types, Degrees & Limitations for intervention; Levels of intervention- Structure, building complex, precinct & heritage zone; Provision of solutions for repair & replacement of components; Restoration (in case of living monuments), preservation, reconstruction & maintenance. Sequence & phasing; Materials & methods; Detailing & finishing.

UNIT IV

Case Studies in Architectural Conservation: Examples of iconic conservation projects; Heritage zones; Conservation strategies- documentation, analysis, techniques, interventions & outcomes; Models of preservation, reconstruction & adaptive reuse. Influences & benefits - Physical, contextual, political, social, cultural, economic, ecological, tourism, technological, material, spatial & visual.

References:

1. Glendinning Miles , The Conservation Movement: a History of Architectural Preservation(ROUTLEDGE 2013) , 978-0-415-54322-4
2. Agnoletti, Mauro, ed ,Conservation of Cultural Landscapes, 2006
3. Oliver, Paul, Built to meet Needs: Cultural Issues in Vernacular Architecture, 2006
4. Beckmann, Poul ,Structural Aspects of Building Conservation ISBN 1417544341
5. E.F.N. Ribeiro ,The Law and the Conservation of Man-made Heritage in India,1989
6. New Delhi: INTACH
7. Tripathi, Alok, Ancient monuments and Archaeological Sites and Remains Act, 1958: with Rules Amendments, Notifications and Orders, 2007
8. McGlade, James, ed. and Leeuw, Sander Van Der, ed. , Time, Process and Structured Transformation in Archaeology, 2010

B19AR8051	ADVANCED BUILDING MATERIALS	L	P	D	C
Duration:14 Wks		2	1	0	3

Course Objectives:

1. To identify the range of upcoming building materials and technologies
2.To impart knowledge of their composition along with their primary physical and chemical properties
3.To provide exposure to the students to the primary & secondary applications of these materials, along with their advantages and disadvantages including their sustainable characteristics

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquaint themselves with some of the latest building materials and technologies, along with their characteristics and main composition
2. Acquire the knowledge of their different areas of application along with the justification for the same
3. Develop an insight into the sustainable characteristics of these materials and technologies

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR9051/ ABM	CO1	3	0	2	0	0	3	0	3	3	1	3
	CO2	2	0	0	2	0	0	0	3	3	0	0
	CO3	0	0	0	3	0	3	0	0	0	0	3
	CO4	3	0	0	3	3	0	0	0	3	0	3

Course Contents:

UNIT 1

Introduction to the upcoming building materials and technologies

The studio shall begin with an introduction to the upcoming building materials and technologies along with an explanation of the need for having these materials and technologies. This would be followed by a discussion on their physical and chemical composition and an analysis of their major physical and chemical properties. The materials and technologies can include the following, though not limited to these:

i. EPS Core Panel System
ii. Lost-in-place formwork system- Plaswall Panel system
iii. Advanced Building System – Emmedue
iv. Light Gauge Steel Framed Structure (LGSF).
v. Bamboo Matt Corrugated sheets
vi. Bamboo wood
vii. Glass Fibre Reinforced Gypsum Panel System
viii. Waffle-Crete
ix. Corian

UNIT 2
Advantages & Disadvantages

This would consist of a detailed discussion on the important advantages and disadvantages of each of these building materials and technologies. Considering the present scenario, special emphasis would be laid on the sustainable qualities of each of the materials and technologies and their impact on the environment, including their carbon footprints.

UNIT 3
Practical Applications

This unit will mainly focus on the practical applications of these materials and technologies, including the functional and aesthetic justifications and implications of the same, so as to enable the students to be able to make a judicious selection of a particular material/ technology on a case to case basis, and become aware of the short term as well as long term implications of their use.

UNIT 4
Detailing

This unit would consist of developing an understanding of the various types of detailing that can be developed using these materials and technologies. It would include a study of the conventional detailing and methods of improving the same. It would also include the development of the detailing in conjunction with other materials and understanding the short term and long-term impacts.

References:

- Compendium of building materials and technologies, BMTPC
- User manuals for EPS, Plaswall Panel system, Emmedue, Light Gauge Steel Framed Structure, Glass Fibre Reinforced Gypsum Panel System, Waffle-Crete
- IPIRTI publications on Bamboo Matt Corrugated sheets and Bamboo wood
- User manual for Corian

B19AR8052	REAL ESTATE & VALUATION	L	P	D	C
Duration:14 Wks		2	1	0	3

Course Objectives:

1. Explain concepts of managing retail real estate and corporate real estate effectively.
2. To understand land as a resource.
3. To appreciate the role of team work to make a successful project
4. To provide adequate inputs so as to make to the whole development as a smooth activity and ultimately be aware of the tactical aspects of marketing the completed property.

Course Outcomes:

``Identify concepts of Real Estate management and describe the Real Estate Market

1. Illustrate the wide range of issues that reflect the principal areas of specialization in the real estate profession
2. Stimulating an awareness of the issues involved in international real estate
3. Developing analytical and methodological skills that are critical for management, decision-making and problem-solving roles.
4. **Mapping of Course Outcomes with programme Outcomes**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR9052/ REAL ESTATE MGT AND DEV	CO1	1	1	3	0	1	2	3	2	3	1	2
	CO2	0	3	2	1	1	3	2	2	2	1	1
	CO3	3	2	2	1	3	1	3	2	3	1	3
	CO4	3	2	2	1	3	2	1	1	1	2	2

Course Contents:

UNIT- 1 REAL ESTATE DEVELOPMENT -

Fundamental concepts and techniques, recognizing institutional and entrepreneurial elements, issues encountered in various phases of development like site evaluation and land procurement, development team assembly, market study and development scheme, construction & project management, project marketing and hand-over of completed projects.

Project Feasibility, Development Financing, Asset Disposal and Redevelopment Options, Analyses of Development Sites and Case Studies, integrated case study on a specific development project, which requires reviewing, analysing and resolving the problems or strategic issues.

UNIT- 2 URBAN POLICY & REAL ESTATE MARKETS

Impact of Government Regulations and Public Policies on Real Estate Markets, include urban land rent and location theories, land use structures, community and neighborhood dynamics, degeneration and renewal in urban dynamics, private-public participation, government policies on 95 public and private housing, and urban fiscal policy including property taxation, local government finance.

UNIT- 3 CORPORATE REAL ESTATE ASSET MANAGEMENT

Strategic plans to align real estate needs with corporate business plans; Performance measurement techniques to identify asset acquisition or disposal; methods for enhancing value through alternative uses, efficient space utilization or improving user satisfaction.

UNIT- 4 COMMERCIAL REAL ESTATE APPRAISAL

Determination of the capitalization rates across different types of properties; Appraisal of freehold and leasehold interests; Critical analysis of the valuation approaches adopted for securitized real estate; Asset pricing models; investment flexibility and future redevelopment opportunities.

REFERENCES:

1. Barron’s real estate hand book V Edition, Hauppauge, NY, Barron , 2001

2. Project planning scheduling & control in construction an encyclopedia of terms &applications , New York, Wiley, 1995

3. Gerald R Cortesi, “Mastering Real estate principles” (2001); Dearborn Trade Publishing, New York, U.S.A.

4. Fillmore W Galaty, “Modern Real estate practice” (2002); Dearborn Trade Publishing, New York, U.S.A.

5. Tanya Davis, “Real estate developer’s handbook”, (2007), Atlantic pub company, Ocala, USA.

6. Mike .E. Miles, “Real estate development – Principles & Process 3rd edition, (2000); Urban Land Institute, ULI – Washington DC

7. Richard B Peiser& Anne B. Frej, “Professional real estate development” – The ULI guide to the business – (2003), Urban Land Institute U.S.A.

B19AR8071/72/73	(ADVANCED SOFTWARE/PARAMETRIC MODELING/BUILDING AUTOMATION)	L	P	D	C
Duration:14 Wks		2	0	0	2

Course Objectives:

1. To give an overview of 3D modeling software as a tool for basic understanding of design representation and techniques
2. To illustrate and develop the techniques for generating creative forms.
3. To create a design that respond to the visualization using advanced software
4. To integrate the outputs by simulation, evaluation and animation using advanced software

Course Outcomes:

1. Acquire knowledge of advanced drawing techniques, editing object, exploded assemblies to modify.
2. Understand the methods and application to create Surface modeling, Generative and parametric forms to represent their designs skills.
3. Visualize their designs through advanced software tools like BIM analysis evaluation and Simulation.
4. Comprehend in totality the complex nature of 3d printing and photorealistic rendered video presentation of their designs.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR8071/72/73	**CO1**	1	1	0	2	1	1	0	1	2	1	2
	CO2	1	3	1	2	1	1	0	1	2	3	2
	CO3	3	3	3	2	1	1	1	2	3	3	3
	CO4	3	2	3	2	1	2	2	2	2	3	2

Course Contents:

UNIT I

Introduction to modeling Interface

Understanding the drafting interface by learning selection methods, modify command, drawing objects and essential software tools. Fundamentals application of the software to transform 2D to 3D model. Exercise to understand navigation, groups, parameters, printing, the import and export of drawings.

UNIT II-Forms and Modeling

Application of surface modeling: – Introduction to concepts of BIM (Building Information Modeling) and other modeling software's. Exercise to understand 3D modeling techniques and to create generative and dynamic forms, use of mesh tool, surfaces transform through to nurbs, Boolean solid operations and manipulating properties.

UNIT III- Simulation and Energy analysis

Conceptual energy analysis and evaluating the project by performance, BIM material substitution, object library, project phase and project lifecycle management. Integrate the BIM model with virtual reality as 3D interactive models

UNIT IV- Rendering and Animation

Classroom exercises to generate a 3d Model using the software's learnt and the application of the different worksets by material mapping, light setting, real-time rendering, walkthrough videos and 3d printing techniques.

References:

1. http://docs.mcneel.com/rhino/6/usersguide/en-us/index.htm
2. http://bimscape.com/beginners-guide-to-revit-architecture/https://www.sdcpublications.com/pdfsample/978-1-58503-812-1-2.pdf
3. User's Guidehttps://www.ace-hellas.gr/wp-content/uploads/2014/10/978-1-58503-973-9-7.pdf
4. http://digitaltoolbox.info/grasshopper-basic/interface/

B19AR8060	CERTIFICATION COURSE ON ENTREPRENEURSHIP DEVELOPMENT	L	P	D	C
Duration:14 Wks		2	0	0	2

Course Objectives:

1. To familiarize students with basic concepts in the area of entrepreneurship
2. To facilitate development of personal creativity and entrepreneurial initiative
3. To introduce students to the key steps in the elaboration of business idea and understanding the stages of the entrepreneurial process
4. To emphasize to students the need for lifelong self learning using various media

Course Outcomes:

On completion of the course, learners will be able to:

1. Identify the elements of success of entrepreneurial ventures,
2. Evaluate the effectiveness of different entrepreneurial strategies,
3. Specify the basic performance indicators of entrepreneurial activity,
4. Engage in life long learning through online and other media

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR9060/ CERTIFICATION	CO1	3	1	1	0	1	2	1	2	3	1	2
	CO2	0	3	2	1	1	3	2	2	2	1	1
	CO3	3	2	2	1	1	1	2	2	3	1	3
	CO4	3	2	2	1	1	2	1	1	1	2	2

Course Contents:

Students are encouraged to take up online learning courses offered through various platforms such as SWAYAM, NPTEL, MOOC, Coursera, EDX etc in the field of entrepreneurship development. As

Architecture professional's students must acquire the necessary skills and knowledge to be able to independently run an entrepreneurial venture. The certification course must introduce the students to the basics of entrepreneurship and provide an experience in self-learning concepts through online medium.

A list of recommended courses will be shared with the students at the start of the semester.

Semester IX

<table>
<tr><td>B19AR9010</td><td rowspan="2">PRACTICAL TRAINING</td><td>L</td><td>P</td><td>D</td><td>C</td></tr>
<tr><td>Duration:14 Wks</td><td colspan="3">18 working weeks</td><td>26</td></tr>
</table>

Course Objectives:

1. To equip students with knowledge of fundamental concepts in architecture & construction process
2. To equip students with practical exposure on architectural design process to formulate and solve real life problems
3. To equip students with skills in verbal, written and graphical communication of architectural design to convince clients.
4. To expose students to management of projects and dealing with various stakeholders through team work

Course Outcomes:

On completion of the course, learners will be able to:

1. Demonstrate an understanding of fundamental concepts in architecture & construction
2. Gain practical exposure on architectural design process to formulate and solve real life problems
3. Acquire advanced skills in verbal, written and graphical communication of architectural design to deliver to clients, contractors.
4. Gain experience in managing projects, dealing with various stakeholders and team work

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19AR8010/ PT	CO1	3	3	2	3	1	0	0	0	3	1	3
	CO2	0	3	3	3	1	0	3	1	0	3	3
	CO3	0	3	3	3	3	0	0	0	0	0	3
	CO4	1	0	2	2	3	3	3	2	2	3	3

Course Contents:

Practical training under an Architect registered with Council of architecture envisages the following:

The students of architecture are to undertake a practical training for a period of two semesters under a registered Architect or in the architectural wing/department of an organization with senior Architects in its roll. The organization may be governmental, Private or non-governmental voluntary organizations namely CPWD State PWD Department or Board for Urban Planning, and NGO's involved in Housing, Urban development planning, or Environmental Planning under a senior Architect. Training may also be in allied areas namely interior design, Landscape Architecture, Visual design, etc. where a senior architect offers support and training.

9. The School shall scrutinize the Credentials of the training organization before permitting any student to take up the internship / practica1 training under that organization.
10. All Training organizations are requested to furnish the attendance and progress report every month to the School. A minimum of 80% of attendance at the Office for a period of 20 Calendar weeks is required for the students to qualify to register for the next semester.
11. After internship and practical training students are to submit the details of work or project in which they have involved. Report shall be submitted in written forms to the School along with a certificate from the employment along with copies of Drawings prepared.
12. The School at the end of the semester shall conduct the evaluation of the student’s performance and achievement in the form of Viva Voce.

Distribution of Credits shall be as follows: Method of evaluation VIVA in presence of external Jury:

Rubrics will be shared with the students at the start of the semester

S.no	Description	Duration/No of visits	No of credits
1	Training report- to include daily log and weeklyreports signed by Office authority	16 working weeks	20
2	Site learnings and material study report with sketchbook	No of visits	02
3	Hard copy of drawings	No of drawings	02

	produced at work		
4	Materials study/ Office management		02

Semester X

B19ARX010	THESIS	L	P	D	C
Duration:14 Wks		6	0	8	18

Course Objectives:

1. Demonstrate special capabilities in the chosen topic
2. Assimilate the knowledge, both theoretical and practical, that the student has gained during the course of his study
3. Enhance the student's abilty to derive design solution in both local and global context
4. Provide an opportunity for the student to achieve a culmination of his development in respect of the knowledge, attitudes and skills gained over the entire course of study

Course Outcomes:

On completion of the course, learners will be able to:

1. Acquire a deeper insight into the chosen topic of interest through research and critical thinking.
2. Apply the fundamental knowledge of history, culture, technical and professional expertise gained to address environmental and social needs through the chosen topic.
3. Demonstrate creative abilities to deliver design solutions in both local and global context
4. Interpret the design and learnings by demonstrating effective visual, written and verbal communicative skills through the final output of drawings, models & presentations

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19ARX010/ THESIS	CO1	2	2	3	2	1	2	2	2	3	2	2
	CO2	2	2	3	2	1	2	1	2	3	2	2
	CO3	2	3	1	1	2	1	1	1	2	2	1
	CO4	0	2	1	3	2	4	2	1	2	2	2

Course Contents:

1. The Thesis shall deal with large built environment project. Work shall be conducted and presented by the individual student in the form of technical report and design drawings. Work shall be comprehensive in nature involving primary data collection, feasibility studies and architectural programming. Large buildings, urban design projects may be taken for the final project/thesis in consultation with faculty.
2. Students are encouraged to pick up live projects.

3. The thesis shall include an area of special interest of relevance, and shall detail its application and design solution. Eg. Interior designs, Services, Socio-economic studies, Structural design, Computer software or images etc.
4. The process for Thesis Project will include – Description, Case Study, Site Study- Analysis & Inferences, Development of specific Design Guidelines; Design Program & Area Requirements, Conceptual Development, Design Development, Final Design, Presentation.

Rules and Regulations – Thesis Submission

12. Each individual student in consultation with the guide appointed shall prepare initial synopsis and project plan. The project shall be submitted to the School and the thesis committee appointed by the
13. School views the viability of the project. The approved topic shall be taken up by the student for the thesis work.
14. Role of the guide is not only to provide academic support and facilitate but also to monitor progress of the work. The guide shall maintain the attendance of his / her student.
15. The media of presentation may be unconventional drawing sheets or in digital format with appropriate signature of the school.
16. A jury appointed by the School shall evaluate.
17. The student has to complete the stage requirements including attending and presenting all the interim reviews in sequence with endorsement of the guide and such will only be allowed to present for the final evaluation by the School appointed jury.

Unit 1

Literature study, case study presentation through drawings and presentations. Site location finalization. The media could be digital or handmade drawings. Identification of Special study

Unit 2:

Concept drawings

Unit 3

Design development, arriving at detailed built form, application of special study, site plan

Unit 4

Preparation of report of the project, Final drawings with detailed plans, elevation, sections, 3d views, details of any special aspects like sustainability, acoustics, structural integrity, Landscaping many more associated with architecture.

B19ARX021	ARCHITECTURAL JOURNALISM	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1.To introduce to the basic structure and principles of architectural journalism
2.To explain the techniques and procedure for conducting architect and client interviews as well as video coverage
3.To illustrate the writing techniques required for architectural journalism and also explain the ethics, laws and legislation
4.To explain the techniques and legal aspects related to editing and publishing

Course Outcomes:

On completion of the course, learners will be able to:

1.Explore the structure, principles, processes and different mediums of architectural journalism
2.Conduct interviews, shoot videos to create walkthrough of buildings and interview of architects and client
3.Explore the different techniques adhering to the laws and legislations related to design
4. Explore the editing and publishing techniques to create a good layout for the articles related to architecture.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19ARX021/ AJ	CO1	0	0	3	2	0	2	0	2	1	0	3
	CO2	3	2	0	2	2	2	1	1	2	0	2
	CO3	0	0	3	2	2	2	1	1	2	2	2
	CO4	1	0	3	2	2	2	1	1	2	1	2

Course Contents:

UNIT I

Overview – Definition, Significance, scope, purpose, structure, principles, techniques, processes, mediums, study of potential readers, contemporary architectural journalism.

UNIT II

Environment ,Social Change, Persuasion- Interviewing techniques, Argument and debate as a technique in the investigation of social problems; evidence, proof, refutation, persuasion; training in argumentative speaking. Theories of journalism, Introduction to architectural software's needed in journalism and photography, Video coverage, walkthrough of buildings, production of contemporary architectural journalism. Understanding the individual demands in the context of newspapers, radio, film, and television.

UNIT III

Writing techniques – Styles, format, purpose, medium, frequency, clear structure, coherent & distinctive look, visual appearance, graphic design, genres, image, descriptive & analytical reports.

Ethics, laws & legislations – Plagiarism, Intellectual property rights, Disclaimers, copyright, author's rights, patents & royalties, trade mark, legal boundaries, libel & invasions of privacy, permissions, references & credits

UNIT IV

Editing & Publishing – Proof reading, Editing techniques, Page make up, Layout, color scheme, Font, Abstract, Pictures, Ads ,News, Photo editing - Book previews, Publishing – Print & Electronic.

References:

1. Pappal, Suneja (2018), Exploration of Architectural Journalism in India, Copal Publisher.

2. Anton, Simons & Axel, Hausberg (2012), Construction and Manual Architectural Photography, Dom Publishers

3. Lee, Evans Nick (2014), An introduction to Architectural Conversion, Riba Publishing

4. Rob, Krier (2010), Architectural Composition, Menges Publishers

B19ARX022	DISASTER MITIGATION AND MANAGEMENT	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To introduce the definition of disaster, different types of disasters and hazards and thereby the risk and vulnerability involved.
2. To elaborate on important disaster through case studies, to understand the impact of disaster over human life
3. To familiarize the mitigation and management techniques of disaster
4. To provide training and risk awareness through different programs

Course Outcomes:

On completion of the course, learners will be able to:

1. Examine the risk and vulnerability of different types of natural and man-made disasters
2. Comprehend the magnitude and intensity of different types of disasterthrough environment impact assessment.
3. Categorize various mitigation and management techniques with respect to the disaster managementpolicy
4. Prepare a disaster risk assessment for a place with current technologies and digital tools

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19ARX022/ DMM	CO1	3	0	0	0	0	0	0	3	3	0	1
	CO2	3	0	3	2	0	0	0	2	3	0	3
	CO3	0	0	3	0	3	2	0	3	0	0	3
	CO4	0	0	3	3	3	0	0	2	0	0	3

Course Contents:

UNIT: I

Definition and types of disaster

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forestfires.

UNIT: II

Study of Important disasters

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements, case studies of disasters.

UNIT: III

Mitigation and Management techniques of Disaster

Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, Building design and construction in highly seismic zones, retrofitting of buildings.

UNIT IV

Training, awareness program and project on disaster management

Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in different places.

References:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program(2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, ButterworthHeineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role ofEnvironmental Knowledge, Narosa Publishing House,Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers IndiaLTD.

B19ARX030	CONSTRUCTION MANAGEMENT	L	P	D	C
Duration:14 Wks		3	0	0	3

Course Objectives:

1. To introduce the students to the concept of construction management in the profession.
2. To introduce the students to various techniques of construction project management.
3. To familiarize students with basic computer applications for construction management.
4. To familiarize students with digital media

Course Outcomes:

On completion of the course, learners will be able to:

1. Assimilate fundamental knowledge on the theory of construction management and understand the responsibility of the architect as a team player
2. Identify and resolve problems using critical thinking related to project scheduling through case studies
3. Acquire problem solving abilities pertaining to management of projects using different techniques and tools
4. Develop an insight into the application of the required software for construction management

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
B19ARX030/ CM	CO1	1	0	1	2	0	3	3	2	2	3	2
	CO2	1	3	3	3	1	2	3	2	1	3	3
	CO3	1	1	3	3	0	3	3	1	1	3	3
	CO4	0	2	0	3	3	3	0	3	0	0	3

Course Contents:

UNIT-1

Concept of Construction Management: Objectives of Construction Management, Historical Background, Relevance and importance of management skills in the present day profession, Players and relationships between them in the building construction industry, Role of Architect in Construction Management, Project life cycle analysis

UNIT-2

Current management system: Scheduling of construction, planning of construction site. Advantages of network Management, network analysis, elements of network, network rules, constraints, errors in network, construction of networks (a simple Building)

UNIT-3

CPM & PERT: CPM: Critical path analysis, Project duration, Construction of CPM Calendar, Activity times and FLOATS, Optimization through CPM Techniques, PERT Technology: PERT AND Three time estimates, beta distribution curve, Slack in PERT, Critical Path Analysis of a PERT network, Central Limit Theorem, Probability of completion of projects, CPM / PERT: Difference between CPM & PERT, Bar chart versus network, resource allocation and resource leveling, Controlling and monitoring, Updating. Project time, cost and finance management.

UNIT-4

Computer applications of project management: Computer applications of project scheduling and management. Introduction to new trends and research in construction management.

Case studies- Application of knowledge & Understanding of project management tools.

References:

1. Construction Planning and Management by Dr U.K.Srivastava, Galgotia Publication Pvt Ltd, New Delhi

REVA UNIVERSITY
Bengaluru, India

School of Applied Sciences

B. Sc., (Physics, Chemistry, Mathematics)

HANDBOOK

2019-22

Rukmini Knowledge Park,
Kattigenahalli, Yelahanka, Bangalore - 560 064
Phone No: +91-080-66226622, Fax: 080-28478539

Registrar
REVA University
Bengaluru - 560 064

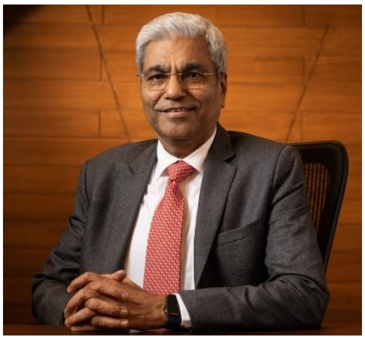
Rukmini Educational
Charitable Trust

www.reva.edu.in

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. S Y Kulkarni
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 graduates in a big way. The B.Sc. (PCM) degree program of REVA University is designed to prepare physists, chemists, mathematiciens, scientists, teachers, professionals & administrators who are motivated, enthusiastic & 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. The curriculum caters to and has relevance to local, regional, national 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. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environmental and sustainability.

This handy document containing brief information about B.Sc. (PCM) 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 teacher's involvement and guidance. We will strive to provide all needed comfort andcongenial environment for your studies. I wish you and all students' pleasant stay in REVA and grand success in your career.

Dr. Beena G
Director
School of Applied Sciences

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 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 awards 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, Mathematics , Physics and Statistics, Mathematics Statistics and Computer Science, and Bioinformatics, Biology Mathematics & Computer Science and also Post Graduate Diploma in Clinical Research Management, Post Graduate Diploma in Functional Geneomics & Bioinformatics. 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

BOS MEMBERS

REVA UNIVERSITY

Ref: RU/BOS-CHEM/2018-19/01

Date: 25.05.2018

NOTIFICATION

Under the direction of the Hon'ble Chancellor and as per the provisions REVA University Statutes relating to Formation of the Boards of Studies, their powers and functions, 2013 the Board of Studies in Chemistry (UG) comprising of following members is constituted.

Sl. No.	Name of Members	Designation
1.	**Dr. N.Ramesh** Dean, Science & Technology and Training, Placement and Planning, REVA University Ph: +91-9880514718, E-mail:dean.tpp@reva.edu.in	Chairperson
2.	**Dr. G. S. Suresh** Associate Professor NMKRV College for Woman, Jayanagara, Bangalore Ph: 080-22443695, E-mail:sureshssmrv@yahoo.co.in	External Member
3.	**Dr. Ramakrishna Reddy K** Associate Professor, Department of Chemistry Govt. Science College (Autonomous), Bangalore Ph:+91-9886730374, E-mail: rkrchem@gmail.com	External Member
4.	**Dr. Madhusudana Reddy M B** Associate Professor, School of Chemical Science Reva University Ph:+91-9480224757, E-mail: madhusudana@reva.edu.in	Internal Member
5.	**Dr. Lakshmi B** Associate Professor School of Chemical Science, Reva University Ph:+91-9902632762, E-mail: lakshmib@reva.edu.in	Internal Member

The tenure of office of members of the Board of Studies in Chemistry (UG) shall be for a period of three years or until further orders.

REGISTRAR

B. Sc – PCM (Physics, Chemistry, Mathematics)

Programme Overview

Physics and Chemistry are parts of physical sciences belong to the group of natural science. Natural science is concerned with description, prediction and understanding of natural phenomenon based on empirical evidence from observation and experimentation. Mathematics helps in developing empirical relations among various parameters for better understanding of the Phenomenon. Since centuries, study of physics, chemistry and mathematics in universities has become a practice because of their importance for understanding nature and life on the Universe.

The School of Applied Sciences at REVA UNIVERSITY has designed to offer B.Sc. in Physics, Chemistry and Mathematics as an undergraduate degree programme to create motivated, enthusiastic, thinking and creative graduates to fill the roles as teachers, professors, scientists, professionals and administrators.

Indian economy is experiencing an upward growth right from the beginning of 21^{st} century except for a short stint during the mid of present decade necessitating well qualified science graduates to work as teachers, professors, scientists, 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. The proposed B.Sc. (PCM) programme designed will act as a foundation and first degree to prepare teachers, professors, scientists, professionals and administrators to meet the challenges of growing economy as well as to meet the growing aspirations of the youth.

The B.Sc. (PCM) programme at the School of Applied Sciences, has been developed by the members of the faculty based on interactions with various universities, research establishments and industries in India and abroad.

The curriculum is outcome based and it imbibes required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in communication skills and interdisciplinary topics 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 industry and research organizations makes this programme unique.

Program Educational Objectives (PEO's)

The programme educational objectives of the **B Sc (P.C.M)** course is to prepare graduates to

PEO-1	Demonstrate problem solving skills in physics, chemistry and mathematics by communicating effectively either leading a team or as a team member.
PEO-2	Express oral and written interpersonal skills in order to understand, learn and advance their careers through research developments and seeking higher education.
PEO-3	Understand the professional, ethical and social responsibilities through lifelong learning skills

Program Outcomes (POs)

1. Demonstrate the knowledge in the areas of physics, chemistry and mathematics
2. Apply the fundamentals of physics, chemistry and mathematics to formulate, solve and interpret complex problems.
3. Comprehend, analyze, model and solve complex problems in the areas of physics, chemistry and mathematics.
4. Recognize the need to expertise in the areas of physics, chemistry and mathematics by self-upgradation through lifelong learning.
5. Communicate with clarity and coherence, both written and verbally.
6. Exhibit professional and ethical responsibility.
7. Encourage collaborative learning through group activities and hands-on learning.
8. Use latest computer techniques and tools to carry out scientific investigations and develop new solutions and solve problems related to environment and society.

Programme Specific Outcomes (PSOs)

After successful completion of the programme, the graduates shall be able to

1. Acquire a strong conceptual foundation in the area of physics, chemistry and mathematics using latest software tools and technologies, along with analytical and managerial skills to arrive at cost effective and optimum solutions.
2. Implant the capacity to apply theoretical concepts to design and develop solutions.

Eligibility for B.Sc (PCM) program

Pass in PUC/10+2 examination with Physics, Mathematics and Chemistry as compulsory subjects and obtained minimum 45% marks (40% in case of candidate 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 thereto.

REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Engineering Graduate Degree Programs, 2019

(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 the **"REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Programs- 2019"**

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

2. The Programs:

The following programs and all Graduate Degree programs to be instituted and introduced in REVA University in coming years shall follow these regulations.

B.Sc in:

Physics Chemistry and Mathematics

Biotechnology, Biochemistry and Genetics

Mathematics, Physics and Statistics

Mathematics Statistics and Computer Science

Bioinformatics, Biology Mathematics & Computer Science

Medical Laboratory Technology

3. Definitions:

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

(i) L= Lecture (ii) T= Tutorial (iii) P=Practice; where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion/selfstudy/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 that equip students to acquire the much-required skill component.

4. Courses of study and Credits

4.1. The study of various subjects in B.Sc., degree program is grouped under various courses. Each of these course carries credits which are based on the number of hours of teaching and learning.

4.1.1. In terms of credits, every **one-hour session of L amounts to 1 credit per Semester.** 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** over a period of one Semester of 16 weeks for teaching-learning process.

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

4.1.3. **A course shall have either or all the four components.** That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

4.1.4. **The concerned BoS will assign Credit Pattern for every course based on the requirement. However, generally, courses can be assigned with 1-4 Credits depending on the size of the course.**

4.1.5. Different **Courses of Study** are labelled and defined as follows:

Core Course:

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz – (i) Foundation Course (ii) Hard Core Course, and (iiI) Soft Core Course.

a. Foundation Course (FC)

Foundation Courses are four courses including language study which are mandatory in nature prescribed by the University and should be completed successfully as part of Graduate Degree Program irrespective of the branch of study.

b. Hard Core Course (HC):

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.

c. Soft Core Course (SC):

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.

d. Open Elective Course: 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 O**pen Elective Course.**

e. Project Work / Dissertation:

Project work / Dissertation work is a special course involving application of knowledge in solving / analysing /exploring a real-life situation / difficult problem. A project work carrying **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.**

5. Eligibility for Admission:

Pass in PUC/10+2 examination with Physics, Mathematics and Chemistry as compulsory subjects with minimum 45% marks (40% in case of candidate 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 thereto.

6. Scheme, Duration and Medium of Instructions:

6.1 The Three-Year degree program is of 6 semesters (3 years) duration. A candidate can avail a maximum of 12 semesters (6 years) as per double duration norm, in one stretch to complete the ThreeYear Degree, including blank semesters, if any. Whenever a candidate opts fo blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

6.2 The medium of instruction shall be English.

7. Credits and Credit Distribution

7.1 A candidate has to earn 144 credits for successful completion of Three-Year Degree with a distribution of credits for different courses as given in Table - 1 given below:

Table-1

Credits and Credit Distribution for ThreeYear degree programs

Course Type	Credits for Three Year Degree (6 semesters)
Hard Core Course	A minimum of 76 but not exceeding 100
Soft Core Course	A minimum of 12 but not exceeding 24
Foundation Courses	A minimum of 04 but not exceeding 16
Core Courses (languages)	A minimum of 14 but not exceeding 24
Open Elective Course	A minimum of 04
RULO	A minimum of 2 but not exceeding 12
Total	**144**

7.2 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) or Open Elective (OE)**.

7.3 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) by the BoS concerned.

However, following shall be the

RULO (REVA Unique Learning Offerings) courses with credits mentioned against them, common to all branches of study. However, the BOS of respective program/ discipline shall decide about the total credits for RULO courses.

RULO Courses		
Sl. No.	**Course Title**	**Number of Credits**
1	Sports, Yoga, Music, Dance, Theatre	2
2	MOOC / Swayam/ Coursera/Internship	4
3	Soft Skill Training	4
4	Skill Development Course	2
	Total	**12**

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

7.5. A candidate can enrol for a maximum of 30 credits and a minimum of 20 credits per Semester. However, he/she may not successfully earn a maximum of 30 credits per semester. This maximum of 30 credits does not include the credits of courses carried forward by a candidate.

7.6. 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 144 credits 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. Add-on Proficiency Certification / Diploma:

8.1 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 144 credits for the Three-Year Graduate degree programs.

8.2 Add on Proficiency Diploma:

To acquire Add on Proficiency Diploma, 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 144 credits for the Three-Year Graduate degree programs.

The Add on Proficiency Certification / Diploma so issued to the candidate contains the courses studied and grades earned.

9. Assessment and Evaluation

a) Each course is assessed for a total weight of 100%. Out of the total 100% weight; 50% weight is for Continuous Internal Assessment (CIA or IA) and the remaining 50% for the Semester End Examination (SEE). This is applicable for theory, laboratory, workshop, studio and any such courses

b) Out of 50% weight earmarked for Internal Assessment (IA)- 15% for test-1, 15% for test-2 and 20% for Assignments and this is applicable for theory-based courses

c) The tests and assignments are conducted as per the semester academic calendar provided by the University

The details as given in the table

Component	Description	Conduction	Weight Percentage
C1	Test-1: IA1	6^{th} week from the starting date of semester	15
	Test-2: IA2	12^{th} week from the starting date of semester	15
C2	1 Assignment 1	7^{th} week	10
	2 Assignment 2	13^{th} week	10
C3	SEE including practical	between 17^{th} Week-20^{th} Week	50
Results to be Announced			**By the end of 21^{st} week**

Note: IA or CIA includes C1 and C2

Each test must be conducted for a duration of 60 minutes, setting the test question paper for a maximum of 30 marks. The final examination must be conducted for a duration of 3 hours and the question paper must be set for a maximum of 100 marks.

d) Students are required to complete courses like technical skills, placement related courses, Open electives and any such value addition or specialized courses through online platforms like SWAYAM/NPTEL/Any other reputed online education aggregator. Students are required to choose the courses on the advice of their course coordinator/Director and required to submit the course completion certificate along with percentage of marks/grade scored in the assessment conducted by the online education aggregator. If the online education aggregator has issued a certificate along with the grade or marks scored to students, such courses will be considered for SGPA calculations, in case the aggregator has issued only a certificate and not marks scored, then such courses will be graded through an examination by concerned School, in case, if grading is not possible, students will be given a pass grade and award the credit and the credits will not be considered for SGPA calculations. The Online/MOOCs courses will not have continuous internal assessment component

Such of those students who would like to discontinue with the open elective course that they have already registered for earning required credits can do so, however, they need to complete the required credits by choosing an alternative open elective course.

Setting question paper and evaluation of answer scripts.

i. For SEE, three sets of question papers shall be set for each theory course out of which two sets will be by the internal examiners and one set will be by an external examiner. In subsequent years by carrying forward the unused question papers, an overall three sets of question papers should be managed and depending on the consumption of question papers either internal or external examiner be called for setting the question paper to maintain an overall tally of 3 papers with the conditioned mentioned earlier. The internal examiner who sets the question paper should have been course tutor

ii. The Chairman of BoE shall get the question papers set by internal and external examiners.

iii. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation. It is the responsibility of the BoE to see that all questions contained in the question paper are within the prescribed syllabus of the concerned course.

iv. There shall be single valuation for all theory papers by internal examiners. However, there shall be moderation by the external examiner who has the subject background. In case no external examiner with subject background is available, a senior faculty member within the discipline shall be appointed as moderator.

v. The SEE examination for Practical work / Field work / Project work/Internship will be conducted jointly by internal and external examiners as detailed below: However, the BoE on its discretion can also permit two internal examiners.

vi. If a course is fully of (L=0):T:(P=0) type or a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.

10. Evaluation of Practical's and Minor Project / Major Project / Dissertation

10.3.1. A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

10.3.2. In case a course is fully of P type (L=0: T=0: P=4), the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a) Continuous Internal assessment (CIA) = 50 marks

b) Semester end practical examination (SEE) = 50 marks

The 25 marks for continuous assessment shall further be allocated as under (IA or CIA):

i	Conduction of regular practical throughout the semester	20 marks
ii	Maintenance of lab records/industry reports	15 marks
iii	Laboratory test and viva	15 marks
	Total	50 marks

The 50 marks meant for Semester End Examination, shall be allocated as under:

i	Conduction 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

10.3.3. The SEE for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

10.3.4. In case a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.

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

10.4. 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:

1	First Dissertation presentation describing the problem definition	Should be done a semester before the project semester	Weightage: 0%
2	Dissertation Progress presentation-1	7th week from the start date of project semester	Weightage: 25%
3	Dissertation progress presentation-2	14th Week from the start date of project semester	Weightage -25%
4	Final project Viva and Dissertation Submission	17th -20th Week of project Semester	Weightage: 30% for Dissertation Weightage: 20% for Final Viva Voce

11. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1, C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of 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 taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

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

- The Registrar (Evaluation) - 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.

12. Eligibility to Appear Semester End Examination (SEE)

12.1 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 course(s), as provided in the succeeding sections, shall be eligible to appear for SEE examination.

12.2 Requirements to Pass a Course

Students are required to score a total minimum of 40% (Continuous Internal assessment and SEE) in each course offered by the University/ Department for a pass (other than online courses) with a minimum of 25% (12) marks in final examination

13. Requirements to Pass the Semester

To pass the semester, a candidate has to secure minimum of 40% marks in each subject / course of the study prescribed in that semester.

13.1 Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters of first year shall move to third semester of second and final year of the study. However, he / she shall have to clear all courses of all semesters within the double duration, i. e., within sixyears of admission of the first semester failing which the student has to re-register to the entire program.

13.2 Provision to Withdraw Course:

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is Soft Core Course or Open Elective Course.

A DROPPED course is automatically considered as a course withdrawn.

13.3. Re-Registration and Re-Admission:

a) 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 end semester examination (C3) and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b) 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.

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.

a) 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 (C4) examination and such student shall seek re-admission as provided in 7.8.4.

b) Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

15. Absence during Mid Semester Examination:

In case a student has been absent from a mid-semester (C1,C2) examination 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 Head of the School, for make-up examination. The Head 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 test for such candidate(s) well in advance before the C3 examination of that respective semester. Under no circumstances C1,C2 test shall be held after C3 examination.

16. Grade Card and Grade Point

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

16.2. Final Grade Card: Upon successful completion of M.Sc., Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

16.3. 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 > 90	9	v*9	**A^+**
70 > 80	8	v*8	**A**
60 > 70	7	v*7	**B^+**
55 > 60	6	v*6	**B**
50 > 55	5.5	V*5.5	**C^+**
40 > 50	5	v*5	**P**
0-40	0	v*0	**F**
ABSENT			**AB**

O - Outstanding; **A**-Excellent; **B**-Very Good; **C**-Good; **D**-Fair; **E**-Satisfactory; **F** - Fail

Here, P is the percentage of marks (P=[C1+C2+C3]) 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.

16.3.1. 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 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	4	A^+	9	4X9=36
Course 2	4	A	8	4X8=32
Course 3	3	B^+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	P	5	3X5=15
Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			188

Thus, **SGPA = 188 ÷ 24 = 7.83**

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	P	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 (96) for Two year Post Graduate degree program is 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. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration: No.1

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	6.83	24 x 6.83 = 163.92
2	24	7.71	24 x 7.71 = 185.04
3	24	8.68	24 x 8.68 = 208.32
4	24	9.20	24 x 9.20 = 220.80
Cumulative	96		778.08

$$\text{Thus, } CGPA = \frac{24x6.83+24x7.13+24x8.68+24x9.20}{96} = 8.11$$

16.3.2. 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 8.10 x 10=81.0

16.3.3. 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	P	Pass	Satisfactory

Overall percentage=10*CGPA

17. Challenge Valuation

a) A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script 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 Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for SEE
The answer scripts 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.

b) 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
PE01	√	√	√	√	√	√	√	√	√	√
PE02	√	√	√	√	√	√	√	√	√	√
PE03	√	√	√	√	√	√	√	√	√	√
PE04	√	√	√	√	√	√	√	√	√	√

Attainment of CO (Course Outcome)

CO Attainment	Value
0.4 - 0.6	1
0.6 - 0.75	2
> 0.75	3

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1030	CO1	3	3	3	3	2		1	3	3	3
	CO2	3	3	3	3	2		3	3	3	3
	CO3	3	3	3	2	2		2	3	3	3
	CO4	3	3	3	2	2				2	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1040	CO1	3	3	2	1			1	1	2	3
	CO2	3	2	2	1			1	2	3	3
	CO3	2	3	2	2		1		2	3	2
	CO4	3	3	2	1					3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1050	CO1	3	2	2						2	3
	CO2	3	2	2						2	3
	CO3	3	2	2						3	3
	CO4	3	2	1	1					2	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1070	CO1	3	2	2		1				3	3
	CO2	3	2	2		1				3	3
	CO3	2	2	2		1				3	2
	CO4	3	2	2		1				2	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1080	CO1	2			3		2	2	2	2	2
	CO2	3	2		3		2	1	3	3	3
	CO3	3	3	3	3			2	2	3	2
	CO4	3	3	2	2		2	2	3	3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1090	CO1	3	2	2		1				3	3
	CO2	3	2	2		1				3	3
	CO3	2	2	2		1				2	3
	CO4	3	2	2		1				3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2030	CO1	3	2	2	3					3	2
	CO2	2	2	2	2					3	3
	CO3	3	2	2	3					3	3
	CO4	3	2	2	2					3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2040	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	PSO1	PSO2
B19PC2050	CO1	3	2	2						3	2
	CO2	2	2	2						3	3
	CO3	3	2	2						3	3
	CO4	3	2	2						3	2

Course Code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2080	CO1	3	2	2		1				3	3
	CO2	3	2	2	1	1				3	3
	CO3	2	2	2	2	2				3	3
	CO4	3	2	2		1				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2090	CO1	2	2	3	2	1		2	2	1	3
	CO2	3	3	3	3	1		2	3	2	2
	CO3	3	2	2	3			2	2	3	2
	CO4	2	3	2	2	1		2	3	2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2X10	CO1	3	2	2		1				3	3
	CO2	3	2	2	1	1				3	3
	CO3	2	2	2	1	1				3	3
	CO4	3	2	2		1				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3030	CO1	3	3	3	3			1	2	3	3
	CO2	3	3	3	3			2	2	3	3
	CO3	3	2	2	2			2	2	3	3
	CO4	3	3	2	2			2	2	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3040	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	PSO1	PSO2
B19PC3050	CO1	3	3	3	3			1	2	3	3
	CO2	3	3	3	3			1	2	3	3
	CO3	3	2	2	2			2	2	3	3
	CO4	3	2	2	2			2	2	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3090	CO1	3	3	3	3				3	3	1
	CO2	3	3	2	1				1	2	2
	CO3	3	3	2	2			1	3	2	1
	CO4	3	3	3	1				3	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3X10	CO1	1	2	1	1	1	1	1	1	2	1
	CO2	2	2	1	1	1	2	1	2	2	2
	CO3	1	2	1	2	2	2	1	1	1	1
	CO4	2	1	2	2	1	2	2	2	1	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3X20	CO1	3	2	2	1			1	1	3	2
	CO2	3	2	2	1			1	1	3	3
	CO3	3	2	2	1			1	1	3	2
	CO4	3	2	2	1			1	1	2	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

B19PC4030	CO1	3	2	1	1			1	3	3	2
	CO2	3	2	3	2				2	3	2
	CO3	3	3	3	3			2	3	3	3
	CO4	3	2	2	2			2	2	3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4040	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	PSO1	PSO2
B19PC4050	CO1	3	3	3	3			1	3	3	3
	CO2	3	2	1	2			1	2	3	3
	CO3	3	2	2	2			1	2	3	3
	CO4	3	3	3	3			1	3	3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4070	CO1	3	2	1	1			1	3	3	2
	CO2	3	2	3	2				2	3	2
	CO3	3	3	3	3			2	3	3	3
	CO4	3	2	2	2			2	2	3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4080	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	PSO1	PSO2
B19PC4090	CO1	3	2	2	1			1	1	3	2
	CO2	3	2	2	1			1	1	3	3
	CO3	3	2	2	1			1	1	3	2
	CO4	3	2	2	1			1	1	2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5010	CO1	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5020	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	PSO1	PSO2
B19PC5030	CO1	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3

Course Code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5040	CO1	3	3	2	3	2				3	3
	CO2	3	3	2	3	2				3	3
	CO3	3	3	2	3	2				3	2
	CO4	3	2	1	2	2				3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5090	CO1	3	3	3	2	2		2	2	2	3
	CO2	3	3	3	2	2		2	2	3	3
	CO3	2	2	1	3	2		2	3	3	2
	CO4										
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5X10	CO1	3	3	3	2	2		2	2	2	3
	CO2	3	3	3	2	2		2	2	3	3
	CO3	2	2	1	3	2		2	3	3	2
	CO4										
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5X20	CO1	1	2	2	1			2		3	1
	CO2	1	2	1	3			3		3	1
	CO3	1	2	2	2			2		3	1
	CO4	1	1	2	1			2	2	3	1
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5X30	CO1	1	2	2	3			2		3	1
	CO2	1	2	2	3			3		3	1
	CO3	1	2	1	2			3	2	3	1
	CO4	1	3	3	2			2	3	3	1
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6010	CO1	3	3	2	2	1				3	3
	CO2	3	3	2	1	1				3	3
	CO3	3	3	2	1	1				3	2
	CO4	3	2	2		1				3	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6020	CO1	2	2	2	1		1		1		1
	CO2	3	2	1	1				2	1	1
	CO3	2	1	2	2		1		1	2	1
	CO4	2	3	1	2		1	1	1	1	
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6030	CO1	3	3	2	3					3	2
	CO2	3	3	3	3					3	3
	CO3	3	2	3	2					3	2
	CO4	3	2	3	3					3	3
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6090	CO1	3	2	2		1				3	3
	CO2	3	2	2	1	1				3	3
	CO3	2	2	2	1	1				3	3
	CO4	2	2	2	1	1				2	2
Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

B19PC6X10	CO1	3	3	3	3			2	2	3	2
	CO2	3	3	2	3			2	2	3	1
	CO3	3	3	2	3			2	2	3	2
	CO4	2	2	3	3			2	2	3	3

Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6X20	CO1	3	2	2	2					3	3
	CO2	3	2	3	2					2	2
	CO3	3	3	2	3					3	3
	CO4	3	2	2	2					3	3

Course Code	**POs/COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6X30	CO1	3	3	2	2					2	3
	CO2	3	2	2	3					3	2
	CO3	3	2	3	2					3	2
	CO4	3	3	2	2					3	3

B. Sc – PCM
(Physics, Chemistry, Mathematics)
Scheme of Instruction and Detailed Syllabus
(Effective from the Academic Year 2019-22)

Scheme of Instruction **Duration: 6 Semesters (3 Years)**

Sl. No	Course Code	Title of the Course	CC/FC/ HC/SC	Credit Pattern				
				L	T	P	Total	Hours
FIRST SEMESTER								
1	B19PC1011	Language – II: Kannada	CC					
2	B19PC1012	Language – II: Hindi	CC	2	1	0	3	4
3	B19PC1013	Language – II: Additional English	CC					
4	B19PC1020	Functional English - I	CC	2	1	0	3	4
5	B19PC1030	Mechanics and Fluid Dynamics	HC	2	1	0	3	4
6	B19PC1040	Chemistry-I	HC	2	1	0	3	4
7	B19PC1050	Mathematics - I	HC	2	1	0	3	4
8	B19PC1060	Constitution of India and Professional Ethics	FC	2	0	0	2	2
		Practicals						
7	B19PC1070	Physics Lab-I	HC	0	0	2	2	3
8	B19PC1080	Chemistry Lab-I	HC	0	0	2	2	3
9	B19PC1090	Mathematics Lab-I	HC	0	0	2	2	3
		Total Credits		**12**	**05**	**06**	**23**	**31**
SECOND SEMESTER								
1	B19PC2011	Language – II: Kannada	CC					
2	B19PC2012	Language – II: Hindi	CC	2	1	0	3	4
3	B19PC2013	Language – II: Additional English	CC					
4	B19PC2020	Functional English - II	CC	2	1	0	3	4
5	B19PC2030	Heat and Thermodynamics	HC	2	1	0	3	4
6	B19PC2040	Chemistry-II	HC	2	1	0	3	4
7	B19PC2050	Mathematics - II	HC	2	1	0	3	4
8	B19PC2060	Environmental Studies	FC	2	0	0	2	2
9	B19PC2070	Sports/Yoga/Music/Dance/Theatre	RULO	2	0	0	2	2
		Practicals						
8	B19PC2080	Physics Lab-II	HC	0	0	2	2	3
9	B19PC2090	Chemistry Practical-II	HC	0	0	2	2	3
10	B19PC2X10	Mathematics - II Lab	HC	0	0	2	2	3
		Total Credits		**14**	**05**	**06**	**25**	**33**

THIRD SEMESTER								
1	B19PC3011	Language – II: Kannada	CC					
2	B19PC3012	Language – II: Hindi	CC	2	1	0	3	4
3	B19PC3013	Language – II: Additional English	CC					
4	B19PC3020	Communicative English - I	CC	2	1	0	3	4
5	B19PC3030	Waves, Acoustics and Optics	HC	2	1	0	3	4
6	B19PC3040	Chemistry-III	HC	2	1	0	3	4
7	B19PC3050	Mathematics – III	HC	2	1	0	3	4
8	B19PC3060	Physics in everyday life	OE					
9	B19PC3070	Chemistry in daily Life	OE	4	0	0	4	4
10	B19PC3080	Classical Optimization	OE					
		Practicals						
12	B19PC3090	Physics Lab –III	HC	0	0	2	2	3
13	B19PC3X10	Chemistry Practical-III	HC	0	0	2	2	3
14	B19PC3X20	Mathematics - III Lab	HC	0	0	2	2	3
		Total Credits		**14**	**05**	**06**	**25**	**33**
FOURTH SEMESTER								
1	B19PC4011	Language – II: K / H / AE	CC	2	1	0	3	4
2	B19PC4012	Language – II: K / H / AE	CC	2	1	0	3	4
3	B19PC4013	Language – II: K / H / AE	CC	2	1	0	3	4
4	B19PC4020	Communicative English - II	CC	2	1	0	3	4
5	B19PC4030	Electricity and Magnetism	HC	2	1	0	3	4
6	B19PC4040	Chemistry-IV	HC	2	1	0	3	4
7	B19PC4050	Mathematics – IV	HC	2	1	0	3	4
8	B19PC4060	Soft Skill Training	RULO	1	1	0	2	3
		Practicals						
9	B19PC4070	Physics Lab –IV	HC	0	0	2	2	3
10	B19PC4080	Chemistry Practical-IV	HC	0	0	2	2	3
11	B19PC4090	Mathematics - IV Lab	HC	0	0	2	2	3
		Total Credits		**11**	**06**	**06**	**23**	**32**
FIFTH SEMESTER								
1	B19PC5010	Quantum Mechanics	HC	1	1	0	2	3
2	B19PC5020	Chemistry-V	HC	1	1	0	2	3
3	B19PC5030	Mathematics – V	HC	1	1	0	2	3
4	B19PC5040	Mathematics – VI	HC	1	1	0	2	3
	B19PC5051	Renewable Energy Resource						
5	B19PC5052	Solid State Physics	SC	2	0	0	2	2
	B19PC5053	Semiconductor Physics						
	B19PC5061	Hetero Cyclic Chemistry & Chemistry of Natural Products						
6	B19PC5062	Polymer Chemistry	SC	2	0	0	2	2
	B19PC5063	Industrial Chemistry						

7	B19PC5071	Complex Analysis	SC	2	0	0	2	2
	B19PC5072	Fluid Dynamics						
	B19PC5073	Number Theory						
8	B19PC5080	Soft Skill Training	RULO	1	1	0	2	3
		Practicals						
9	B19PC5090	Physics Lab – V	HC	0	0	2	2	3
10	B19PC5X10	Physics Lab –VI	HC	0	0	2	2	3
11	B19PC5X20	Chemistry –V	HC	0	0	2	2	3
12	B19PC5X30	Chemistry – VI	HC	0	0	2	2	3
		Total Credits		**12**	**05**	**08**	**24**	**33**
	SIXTH SEMESTER							
1	B19PC6010	Nuclear Physics	HC	1	1	0	2	3
2	B19PC6020	Chemistry-VI	HC	1	1	0	2	3
3	B19PC6030	Numerical methods	HC	1	1	0	2	3
4	B19PC6041	Physics of Clouds	SC	2	0	0	2	2
	B19PC6042	Astro Physics						
	B19PC6043	Digital Electronics and Communication						
5	B19PC6051	Electro Analytical Chemistry	SC	2	0	0	2	2
	B19PC6052	Chemistry of Bio Molecules						
	B19PC6053	Solid State Chemistry						
6	B19PC6061	Fuzzy Mathematics	SC	2	0	0	2	2
	B19PC6062	Topology						
	B19PC6063	Discrete Mathematics and Graph Theory						
7	B19PC6070	MOOC / Swayam / Internship	RULO	0	0	2	2	3
8	B19PC6080	Soft Skill Training	RULO	1	1	0	2	3
		Practicals						
9	B19PC6090	Physics Lab – VII	HC	0	0	2	2	3
10	B19PC6X10	Mathematics - V Lab	HC	0	0	2	2	3
11	B19PC6X20	Numerical Methods Lab	HC	0	0	2	2	3
12	B19PC6X30	Project	HC	0	0	2	2	3
		Total Credits		**10**	**4**	**10**	**24**	**33**
		Total Credits of all Semesters					**144**	**195**

Semester-wise Summary of Credit Distribution

Semester	L	T	P	Total	Total Hours
I	12	5	6	23	**31**
II	14	5	6	25	**33**
III	14	5	6	25	**33**
IV	11	6	6	23	**32**
V	10	4	10	24	**33**
VI	10	4	10	24	**33**
Total Credits	**711**	**299**	**444**	**144**	**195**

B. Sc – Physics, Chemistry, Mathematics (PCM)
Detailed Syllabus

(effective from Academic Year 2019)

FIRST SEMESTER

B19PC1011	Language-II: Kannada	L	T	P	C
Duration:14 Wks		2	1	0	3

Prerequisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉÎ ¥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.

Course Objectives:

£Á®Ì ¸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 DAiÉÌ 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.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÀzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

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.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
4. 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	PSO1	PSO2
B19PC1011	CO1					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Unit-I: **12 Hrs**

1. ¸ÀvÀåªÀAvÉ ºÀqÉzÀªÀé - d£À¥ÀzÀ VÃvÉ
2. £É®¸ÀÄUÉ ¤£Àß ªÀPÀëzÉÆ¼É - ¥ÀA¥À
3. PÀÄqÀÄ ZÀ¥À¼É d¥ÀzÀ ªÀÄtÂAiÀÄA - £ÁUÀªÀªÀÄð
4. avÀæªÀÄ¥ÁvÉæ gÀªÀÄvÉ £Áj - d£Àß

Unit-II: **12 Hrs**

1. C©ÞAiÀÄÄªÉÆªÉÄð PÁ®ªÀ±À¢A ªÀÄgÁåzÉAiÀÄA zÁAlzÉÃ.... - £ÁUÀZÀAzÀæ
2. ªÀZÀ£ÀUÀ¼ÀÄ - CPÀÌªÀÄºÁzÉÃ«
3. ªÀZÀ£ÀUÀ¼ÀÄ - §¸ÀªÀtÚ
4. UÀÄAqÀAiÀÄå£À gÀUÀ¼É - ºÀjºÀgÀ

Unit-III: **12 Hrs**

1. zÀÄµÀÖ§Ä¢ÞAiÀÄÄA zsÀªÀÄð§Ä¢ÞAiÀÄÄA - zÀÄUÀð¹AºÀ
2. PÀ¯ÁärAiÀÄ PÉÆÃt - ªÀiÁ¹Û
3. AiÀiÁgÀÆ CjAiÀÄzÀ «ÃgÀ - PÀÄªÉA¥ÀÄ
4. ¸ÀªÀÄ¸ÉåAiÀÄ ªÀÄUÀÄ - wæªÉÃtÂ

Unit-IV: **12 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 ªÀÄAvÀÄÜ ¥À£ÀåÀ ¸ÀÄAzÀgÀ ±À¹ÛçÀ, ¥ÀÄgÀt £ÀªÀÄ ZÀÆqÀªÀÄAtÀ, ¥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

B19PC1012	Language-II: Hindi	L	T	P	C
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

- अध्येता, पी.यु.सी के स्तर पर द्वितीय भाषा के रूप में हिन्दी का अध्ययन करना चाहिए।
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है।
- हिन्दी व्याकरण का अवबोधन आवश्यक है।
- हिन्दी-अंग्रेजी अनुवाद से संबंधित जानकारी जरुरी है।

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना।
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना।
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना।
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना।

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है।
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है।

3. समाज में अंतर्निहित पद्धतियां एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है |

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1012	CO1					2	3	2			
	CO2					2	2	3			
	CO3					3	3	3			
	CO4					3	2	3			

Course Contents:

इकाई – 1: कहानी, संस्मरण **12 hrs.**

कहानी – नशा – प्रेमचंद
कहानी – सुखमय जीवन – चंद्रधर शर्मा गुलेरी
संस्मरण – शरत के साथ बिताया कुछ समय – अमृतलाल नागर

इकाई – 2: कहानी, आत्मकथा **12 hrs.**

कहानी – मरने से पहले – भीष्म साहनी
कहानी – लाल हवेली – शिवानी
आत्मकथा – जेल– जीवन की झलक - गणेश शंकर विद्यार्थी

इकाई – 3: कहानी, व्यंग्य रचना **12 hrs.**

कहानी – चाय का एक प्याला – कैथरीन मैन्सफील्ड
व्यंग्य रचना – भेड़े और भेडियें – हरिशंकर परसाई

इकाई – 4: अनुवाद, संक्षेपण **12 hrs.**

अनुवाद : अंग्रेज़ी – हिन्दी (शब्द एवं अनुच्छेद)
संक्षेपण : परिच्छेद का एक तिहाई भाग में |

सूचना : प्रत्येक इकाई 25 अंक केलिए निर्धारित है |

References:

1. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त
2. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त
3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
7. कार्यालय अनुवाद निदेशिका
8. संक्षेपण और पल्लवन - के.सी.भाटिया&तुमन सिंग

B19PC1013	Language-II: Additional English	L	T	P	C
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To ensure the development of the linguistic prowess of the students
2. To motivate the students to appreciate literature
3. To help students build strong language fundamentals
4. To promote an appreciable reading habit among the students

Course Outcomes:

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 vocabulary range
3. Critically analyse a piece of prose or poetry
4. Express 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	PSO1	PSO2
B19PC1013	CO1					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Contents:

Unit-I: Values and Ethics **12 Hrs**

Literature: Rabindranath Tagore - Where the Mind is Without Fear, William Wordsworth – Three Years She Grew in Sun and Shower, Saki – The Lumber-room, William Shakespeare – Extract from *Julius Caesar* (Mark Antony's Speech) Language: Vocabulary Building

Unit-II: Natural & Super Natural **12 Hrs**

Literature: John Keats – La Belle Dame Sans MerciCharles Dickens – The Signal Man
Hans Christian Anderson - The Fir TreeWilliam Shakespeare – An Excerpt from *The Tempest*
Language: Collective Nouns

Unit-III: Travel and Adventure **12 Hrs**

Literature: R.L. Stevenson – Travel, Elizabeth Bishop - The Question of Travel, H.G. Wells – The Magic Shop, Jonathan Swift – Excerpt from *Gulliver's Travels Book – I*
Writing Skills: Travelogue

Unit-IV: Success Stories **12 Hrs**

Literature: Emily Dickinson – Success is Counted SweetestRupert Brooke – Success

Dr. Martin Luther King - I Have a DreamHelen Keller – Excerpt from *The Story of My Life*

Writing Skills: Brochure &Leaflet

Reference Books:

1. Tagore, Rabindranath. *Gitanjal*i. Rupa Publications, 2002.
2. Wordsworth, William. *The Complete Works of William Wordsworth*. Andesite Press, 2017.
3. Munro, Hector Hugh. *The Complete Works of Saki*. Rupa Publications, 2000.
4. Shakespeare, William. *The Complete Works of William Shakespeare*. Sagwan Press, 2015.
5. Chindhade, Shirish. *Five Indian English Poets: Nissim Ezekiel, A.K. Ramanujan, ArunKolatkar, DilipChitre, R. Parthasarathy*. Atlantic Publications, 2011.
6. Dickens, Charles. *The Signalman and Other Horrors: The Best Victorian Ghost Stories of Charles Dickens: Volume 2*. Createspace Independent Publications, 2015.
7. Anderson, Hans Christian. *The Fir Tree*. Dreamland Publications, 2011.
8. Colvin, Sidney (ed). *The Works of R. L. Stevenson. (Edinburgh Edition)*. British Library, Historical Prints Edition, 2011.
9. Bishop, Elizabeth. *Poems*. Farrar, Straus and Giroux, 2011.
10. Swift, Jonathan. *Gulliver's Travels*. Penguin, 2003.
11. Dickinson, Emily. *The Complete Poems of Emily Dickinson*. Createspace Independent Publications, 2016.
12. Brooke, Rupert. *The Complete Poems of Rupert Brooke*. Andesite Press, 2017.
13. King, Martin Luther Jr. &James M. Washington. *I Have a Dream: Writings and Speeches That Changed The World.* Harper Collins, 1992.
14. Keller, Helen. *The Story of My Life*. Fingerprint Publishing, 2016.
15. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
16. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
17. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
18. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.

B19PC1020	**Functional English-I**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To develop basic communication skills in English for the learners of Bachelor of Science.
2. To prioritize listening and reading skills among the learners.
3. To simplify writing skills needed for academic as well as workplace context.
4. To examine that the learners, use the electronic media such as internet and supplement the learning materials used in the classroom.

Course Outcomes:

On completion of the course, learners will be able to:

1. Interpret audio files and comprehend different spoken discourses/ excerpts in different accents.
2. Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies.
3. Make use of reading different genres of texts adopting various reading strategies.
4. Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1020	CO1					3	3	3	1		
	CO2					3	3	3	2		
	CO3					3	3	3	2		
	CO4					3	3	3	1		

Course Contents:

Unit-I: Functional English **12 Hrs**

Grammar: Prepositions; Modal Auxiliaries, Listening: Listening to audio (verbal & sounds) Speaking: Debating Skills, Reading: Skimming a reading passage; Scanning for specific information, Writing: Email communication

Unit-II: Interpersonal Skills **12 Hrs**

Grammar: Tenses; Wh-questions, Listening& Speaking: Listening and responding to video lectures / talks, Reading: Reading Comprehension; Critical Reading; Finding key information in a given text, Writing: Process descriptions (general/specific); Recommendations

Unit-III: Multi tasking Skills **12 Hrs**

Grammar: Conditional Sentences, Listening & Speaking: Listening to specific task; focused audio tracks and responding, Reading: Reading and interpreting visual material, Writing: Channel conversion (flowchart into process); Types of paragraph (cause and effect / compare and contrast / narrative / analytical); Note Taking/ Note Making.

Unit-IV: Communicative Skills **12 Hrs**

Grammar: Direct and indirect speech, Listening & Speaking: Watching videos / documentaries and responding to questions based on them; Role plays, Reading: Making inference from the reading passage; predicting the content of a reading passage, Writing: Interpreting visual materials (line graphs, pie charts etc.); Different types of Essay Writing

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.

B19PC1030	**Mechanics and Fluid Dynamics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Basics of Physics.

Course Objectives:

1. Equip with the basics of physics to solve problems involving Forces, Moments, Centroids and Moment of inertia
2. Impart knowledge about the relationship between the motion of bodies and moment of inertia
3. Familiarise with the principles of Kinematics and Hydrodynamics for practical applications.
4. Impart knowledge about fundamental laws of fluid mechanics and the Bernoulli's principle of practical applications for flow rate measurements.

Course Outcomes:

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

1. Apply Newton's laws of motion to as certain the state of the systems.
2. Compute the elastic properties of the materials.
3. Apply the concepts of conservation of energy and momentum to elastic and inelastic Collisions.
4. Summarise the concepts of surface tension and viscosity.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1030	**CO1**	**3**	**3**	**3**	**3**	**2**		**1**	**3**	**3**	**3**
	CO2	**3**	**3**	**3**	**3**	**2**		**3**	**3**	**3**	**3**
	CO3	**3**	**3**	**3**	**2**	**2**		**2**	**3**	**3**	**3**
	CO4	**3**	**3**	**3**	**2**	**2**				**2**	**2**

Course Contents:

Unit-I **12 Hrs**

Motion of a particle: The position vector r(t) of a moving particle and its Cartesian components. Velocity and acceleration as the vector derivatives, radial and transverse component of velocity and acceleration for arbitrary planar motion, centripetal force and its derivation using vector notation, problems.

Frames of reference: Inertial reference frames with examples and uniform rectilinear motion in an inertial frame, Special theory of relativity. The Galilean principle of relativity, Galilean transformation equation. Non-inertial reference frame- illustration of an earth as non–inertial frame, concept of weightlessness by freely falling Lift. Qualitative discussion on centrifugal force, Coriolis force.

Unit-II **12 Hrs**

Conservation Laws: Basic symmetries of nature, Conservation of linear momentum for a system of two particles, Rocket motion in a uniform gravitational field (single stage rocket equation -- with and without gravity), Multi stage rocket, Elastic and inelastic collisions, Elastic Head on collision, Elastic oblique collision in lab frame, reduced mass, problems.

Conservation of energy: Conservative and non-conservative forces with examples, conservation of energy in a conservative force field. Applications – **1.** Vertical oscillations of loaded light spiral spring, **2.** Calculation of escape velocity in the gravitational field of the earth.

Unit-III **12 Hrs**

Conservation of Angular Momentum: Relation between torque and angular momentum, concept of Central forces, Kepler's laws of planetary motion –derivation using Newton's law of gravitation.

Fluid Dynamics: Streamline and Turbulent Flow Expression for critical velocity, Reynold's number and its significance, coefficient of viscosity, Stokes law (no derivation) terminal velocity-Expression for terminal velocity of small ball falling through viscous fluid.

Surface Tension: surface tension-expression for pressure inside curved liquid surface. The drop-weight method, Angle of contact - Quincke's method –Theory.

Unit-IV **2 Hrs**

Rigid body Dynamics: Moment of Inertia of a body; Theorem of Moment of Inertia-Parallel and perpendicular axes theorem with proofs (2-D case); Calculation of moment of inertia of a disc, annular ring, solid sphere and rectangular bar; Conservation of angular momentum with illustrations.

Elasticity: Hooke's law. Moduli of elasticity. Relation between elastic constants. Poisson's ratio-limiting values, bending moment. Theory of single cantilever. Torsion-calculation of couple per unit twist.

Reference Books:

1. J C. Upadhyay. Classical Mechanics, 11th edition, 2014
2. David Halliday. Robert Resnick, and Jearl Walker, Fundamentals of Physics, Sixth Edition, John Wiley & Sons, Inc.
3. Berkeley. Physics -Vol. 1, 2nd edition
4. D.C. Mathur. Mechanics, 5th edition 2016
5. Brijlal & Subramanyam. Properties of Matter, S Chand and Co., New Delhi

B19PC1040	Chemistry-I	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

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:

1. Formulate Rydberg equation to calculate all spectral lines of hydrogen atom.
2. Discuss the importance of atomic number in constructing periodic table.
3. Examine the role of reagents, named reactions and their applications in organic chemistry.
4. 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	PSO1	PSO2
B19PC1040	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: **2 Hrs**

Atomic Structure Quantum Mechanics: Fundamental particles of atoms, atomic orbitals Planck Quantization - Black body radiation, various atomic models, Bohr's theory and its limitations, dual behavior of matter and radiation, De Broglie's hypothesis equation, Heisenberg Uncertainty principle. Hydrogen atomic spectra, Aufbau and Pauli exclusion principles. Hund s multiplicity rule electronic configurations of the elements.

Quantum Mechanics: Introduction, wave functions, time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance.

Unit-II: **12 Hrs**

Periodic Table and Periodicity Modern periodic law: Division of elements into s, p, d & f blocks based on their outer shell configuration. Periodic properties-periodicity & causes of periodicity.

i. Atomic radius – definitions of covalent, metallic & vanderwall's radius; calculation of atomic radius from inter nuclear distance
ii. Ionic radius –definition; calculation of iso electronic ions by paulings method.

iii. Ionization energy and electron affinity, -definations; principles of methods of determination.
iv. Electronegetivity evaluation by Paulings and Mullikan's methods.

Trends of the above properties across a period and down a group. Application of the above in predicting oxidizing / reducing property across a period. Comparative study of groups 1,2, 16 and 17 with respect to electronic configuration, atomic and ionic radii, ionization energy, electronegetivity and compound (halides, oxides and carbonates of groups 1 and 2 ; detailed comparative study of diagonal relationship between Li and Mg, cause for diagonal relationship ; hydrides of group 16 and 17) Applications of electronegetivity.

Unit-III: **12 Hrs**

Introduction to Organic Chemistry: Alkanes: methods of formation (corey-house reaction and de carboxylation of carboxylic acid) and physical and chemical properties. (Melting and Boiling point, Free radical substitution reactions-Halogenation, Nitration), Oxidation reaction-Combustion.

Alkenes: Preparation of alkenes 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.

Types of organic reactions: Definition with examples of addition, substitution, elimination and rearrangement reactions

Reactive intermediates: Generation, stability of carbocations, carbanions, free radicals, nitrene, carbenes and ylide.

Hybridization: Tetravalency of carbon, sp^3, sp^2 and sp – hybridization (in brief). Bond length, bond angle, bond energy, localized and delocalized chemical bonds –hyperconjugation, inductive effect, mesomeric effectandresonance effect. (self study).

Unit-IV: **12 Hrs**

Gaseous state: Maxwell-Boltzmann distribution of molecular velocities (no derivation – assume equation) explanation. Effect of temperature on distribution of molecular velocities using distribution curve (graph). Boltzmann factor (significance and equation). Energy distribution as a function of temperature. Types of molecular velocities and relation ship between – average (uav) - root mean square velocity (urms) - most probable velocity (ump) and numerical.

The critical phenomena – Andrew's experiments on CO_2, critical constants – Tc, Pc and Vc. temperature and Critical pressure by using 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 (to be derived) 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').

Text Books:

1. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
2. Bahl, A. & Bahl, B.S. 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. Principles of Inorganic Chemistry by Puri, Sharma, Kalia

Reference Books:

1. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
2. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
3. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
4. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
5. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
6. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
7. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

B19PC1050	Mathematics-I	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Definition and types of matrices, differentiation and integration formulas and knowledge about differential equation, order and degree.

Course Objectives:

1. Familiarize the concepts of matrix and its applications in various fields.
2. Understand the concepts of successive differentiation and n^{th} order derivative.
3. Learn about reduction formula with limit and without limit and differentiation under integral sign - Leibnitz rule.
4. Provide the fundamental concepts of differential equations and apply multiple approaches/appropriate techniques to solve first order ODEs.

Course Outcomes:

1. Apply the matrix theory to solve the system of linear equations.
2. Demonstrate the knowledge of successive differentiation to solve the problems relative with standard formulae and Leibnitz theorem to find n^{th} differentiation of functions.
3. Gain the Knowledge of reduction formulae and differentiation under integral sign by Leibnitz rule to solve integral equations.
4. Utilize the concepts of order, degree and linearity of ODE and recognize ODEs.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1050	**CO1**	**3**	**2**	**2**						**3**	**2**
	CO2	**3**	**2**	**2**						**3**	**2**
	CO3	**3**	**2**	**2**						**3**	**3**
	CO4	**3**	**2**	**1**	**1**					**3**	**2**

Course Contents:

Unit-I: Theory of Matrices **12 Hrs**

Elementary row and column transformations (operations), Equivalent matrices, Theorems on it. Row - reduced echelon form, Normal form of a matrix, Rank of a matrix, Problems. Homogeneous and Non – Homogeneous systems of '*m*' linear equations in '*n*' unknown's, Consistency criterion, Criterion for uniqueness of solutions. Solution of the same by elimination method. Eigenvalues and Eigenvectors of a square matrix of order 2 and 3, Standard properties, Cayley-Hamilton theorem (**with proof**). Finding A^{-1}, A^{-2} & A^2, A^3, A^4. Solving the linear equations with three unknowns.

Unit-II: Differential Calculus – 1 **12 Hrs**

Successive differentiations, n^{th} differentiation of standard functions

$$\left(e^{ax}, (ax+b)^n, \frac{1}{(ax+b)}, \log(ax+b), \sin(ax+b), \cos(ax+b), e^{ax}\sin(bx+c), e^{ax}\cos(bx+c)\right)$$

Leibnitz's theorem (**with proof**) and its application (problems).

Unit-III: Integral Calculus - 1 **12 Hrs**

Reduction formula for

$\int \sin^n xdx, \int \cos^n xdx, \int \tan^n xdx, \int \cot^n xdx, \int \sec^n xdx, \int \operatorname{cosec}^n xdx$ & $\int \sin^m x \cos^n xdx$, with definite limits, Differentiation under integral sign by Leibnitz rule.

Unit-IV: Differential Equation – 1 **12 Hrs**

Solutions of ordinary differential equations of first order and first degree: Linear differential equations, Reducible to linear differential equation, Exact equations, Equation reducible to exact. Equations of first order and higher degree, Non linear first order, Higher degree – (Mention) Solvable for p, Solvable for y, Solvable for x, Clairaut's equation, Singular solution, Geometric meaning. Orthogonal trajectories in Cartesian and polar forms.

Text Books:

1. Shanthi Narayan and P. K. Mittal, Differential Calculus, Reprint. New Delhi: S. Chand & Company Ltd., 2011.
2. Shanthi Narayan, Integral Calculus, Reprint. New Delhi: S. Chand and Company Ltd., 2004.
3. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed. New Delhi, India: S Chand and Company Ltd., 2011.
4. Krishnamoorty V K and Mainra V P and Arora J L, An Introduction to Linear Algebra, Reprint. New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.
5. G K Ranganath, Text book of B.Sc., Mathematics, Revised ed. New Delhi, India: S Chand and Co., 2011.

Reference Books:

1. G B Thomas and R L Finney, Calculus and Analytical geometry, 10th ed.: Addison – Wesley, 2000.
2. S. Narayanan & T. K. Manicavachogam Pillay, Calculus: S. Viswanathan Pvt. Ltd., 1996, vol. I & II.
3. S. Narayanan and T. K. Manicavachogam Pillay, Calculus (I & II). Chennai, India: S. Viswanathan Pvt. Ltd., 1996.

4. Joseph Edwards, An elementary treatise on the differential calculus: with applications and numerous examples, Reprint. Charleston, USA: BiblioBazaar, 2010.

Course Code	Course Title	Course Type	L	T	P	C	Hrs/Week
B19PC1060	Constitution of India and Professional Ethics	FC	2	0	0	2	2

Course Objectives:

1. To impart knowledge on Constitution of India.
2. To facilitate the understanding of Fundamental Rights, Duties and other Rights which is been given by our law.
3. To facilitate the understanding of Constitution perspective and make them face the world as a bonafide citizen.
4. To attain knowledge about ethics and also know about professional ethics.
5. Explore ethical standards followed by different companies.

Course Outcomes:

On completion of this course the student will be able to:

1. Explain the Indian constitutional provisions and fololow them.
2. Demonstrate the fundamental rights and human rights.
3. Explain the duties and more importantly practice them in a right way.
4. Adopt the habit of raising their voice against a unconstitutionality of any laws and upon any legal discrimination as we have session of debates on Constitutional validity.
5. Demonstrate professional ethics and know about etiquettes about it.
6. Practice ethical standards of different companies which will increase their professional ability.

Course Content:

Unit -I: Constitution of India: **6 Hrs**

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: Legislature and Executive **6 Hrs**

Organs of the Government; 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: Professional Ethics **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 Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence.

Text Books:

1. M V Pylee, An introduction to Constitution of India
2. M Govindarajan, S Natarajan, V S Senthil Kumar, Engineering Ethics.
3. Dr. Durga Das Basu, Introduction to constitution of India

B19PC1070	Physics Lab-I	L	T	P	C
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Knowledge of Higher secondary/Pre-University level physics.

Course Objectives:

1. Develop the ability to apply knowledge of Physics and engineering in calculating the elastic properties of materials.
2. Equip with the ability to use the techniques, modern engineering tools necessary for
3. material testing.
4. Impart the knowledge of using the techniques, skills for testing of fluid properties.
5. Equip with knowledge of professional and ethical responsibility in the areas of material testing.

Course Outcomes:

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

1. Compute the values of moment of inertia, mass and density and elastic properties of a given material through experiment.
2. Compute the liquid properties like surface tension and viscosity of the given liquid through experiment.
3. Calculate acceleration due to gravity through experiment.
4. Develop the ability to communicate effectively the mechanical properties of materials.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1070	**CO1**	**3**	**2**	**2**		**1**				**3**	**3**
	CO2	**3**	**2**	**2**		**1**				**3**	**3**
	CO3	**2**	**2**	**2**		**1**				**2**	**3**
	CO4	**3**	**2**	**2**		**1**				**3**	**2**

Course Contents:

Any EIGHT of the following experiments:

1. Bar pendulum: Determination of the acceleration due to gravity (graphical method).
2. Fly wheel: Determination of moment of inertia, mass and density.
3. Drop weight method: Determination of surface tension of water and kerosene.
4. Quincke's method: Determination of surface tension and angle of contact of mercury.
5. Determination of Young's modulus by single cantilever method.
6. Searle's double bar: Determination of young's modulus, the rigidity modulus, bulk modulus and Poisson's ratio.
7. Torsional pendulum: Determination of the rigidity modulus.
8. Determination of the Young's modulus by stretching method.
9. Determination of terminal velocity of small ball falling through viscous fluid and its coefficient of viscosity.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S. Sudha.D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G. L. Souires, "Practical Physics", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
4. Practical Physics – S. L. Gupta &V. Kumar (PragatiPrakashan).

B19PC1080	Chemistry Lab-I	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

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:

1. Acquire the skill of handling glasswares, chemicals and instuments used in the laboratory.
2. Prepare the standard solutions and use the same for the estimation of requied from the given solution.
3. Build analytical skills such as recording the reading, interpretation of the date and drawing conclusions.
4. 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	PSO1	PSO2
B19PC1080	**CO1**	**2**			**3**		**2**	**2**	**2**	**2**	**2**
	CO2	**3**	**2**		**3**		**2**	**1**	**3**	**3**	**3**
	CO3	**3**	**3**	**3**	**3**			**2**	**2**	**3**	**2**
	CO4	**3**	**3**	**2**	**2**		**2**	**2**	**3**	**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. Khosla, B. D.; Garg, V. C. & Gulati, A. 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. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
5. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry

B19PC1090	Mathematics Lab-I	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Definition and types of matrices, differentiation and integration formulas and knowledge about differential equation, order and degree.

Course Objectives:

1. Practical introduction to understand the concepts of matrix and its applications in various fields.
2. Acquire skill in solving problems on differential equation using *Maxima*.
3. Gain proficiency in using *Scilab* and *Maxima* to solve the problems of differential calculus and integral calculus

Course Outcomes:

1. Demonstrate the use of *Scilab* to understand concepts in matrix theory.
2. Be familiar with the built-in functions to find derivatives of any order in differential calculus
3. Acquire problem solving skills on differential equation
4. Exhibit the use of *Scilab* and *Maxima* to understand and interpret the concepts of reduction formula.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC1090	CO1	3	2	2		1				3	3
	CO2	3	2	2		1				3	3
	CO3	2	2	2		1				2	3
	CO4	3	2	2		1				3	2

Course Contents:

1. Introduction to *Scilab*.
2. Introduction to *Scilab* commands connected with matrices.
3. Computation with matrices.
4. Row reduced echelon from and normal form.
5. Establishing consistency or otherwise and solving system of linear equations.
6. Introduction to *Maxima*
7. *Maxima* commands for derivatives and n^{th} derivatives.
8. Introduction to n^{th} derivative without Leibnitz rule.
9. n^{th} derivative with Leibnitz rule.
10. *Maxima* commands for reduction formula with or without limit.
11. *Scilab* and *Maxima* commands for plotting functions.
12. Solution of differential equations using *Scilab*/*Maxima* and plotting the solution – I.
13. Solution of differential equations using *Scilab*/*Maxima* and plotting the solution – II.

Suggested Text Books and References:

1. SCILAB: A Practical Introduction to Programming and Problem Solving [Print Replica] Kindle Edition by Tejas Sheth (Author).
2. The Maxima Book Paulo Ney de Souza Richard J. Fateman Joel Moses Cliff Yapp 19th September 2004.

SECOND SEMESTER

B19PC2011	Language-II: Kannada	L	T	P	C
Duration:14 Wks		2	1	0	3

Prerequisites:

- 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.

Course Objectives:

£Á®Ì ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ JgÀqÀ£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è ¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ ¥ÀæªÁ¸À PÀxÀ£À ¸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.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. 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
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

¥ÁæaÃ£À, ªÀÄzsÀåPÁ°Ã£À PÁªÀåUÀ¼ÀÄ, ºÉÆ¸ÀUÀ£ÀßqÀzÀ ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ ¥ÀæªÁ¸À PÀxÀ£À ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃlUÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
4. 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	PSO1	PSO2
B19PC2011	CO1					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Course Contents:

Unit-I: ªÀÄzsÀåPÁ°Ã£À PÁªÀå **12 Hrs**

1. ZÀAzÀæªÀÄw «¯Á¥À - gÁWÀªÁAPÀ
2. ºÀUÉUÀ¼À£ÀÄ »ArzÀ£ÀÄ ªÀÄ£ÀzÉÆ¼ÀUÉ - PÀÄªÀiÁgÀªÁå¸À
3. ªÀÄÄ½îrzÀ ªÀÄgÀ£ÉÃjzÀAvÁzÀÄzÀÄ - ®QëöäÃ±À
4. UÉÆÃgÀPÀë ¥Àæ¸ÀAUÀ - ZÁªÀÄgÀ¸À

Unit-II: ªÀÄzsÀåPÁ°Ã£À PÁªÀå **12 Hrs**

1. wæ¥À¢UÀ¼ÀÄ - ÀªÀðdÕ ºÉ¼ÀªÀ£À
2. ªÀÄÄAzÀPÉÌ ¯ÉÃ¸ÀÄAIÄ £ÀªÀÄUÉ – PÀmÉÖ VjAiÀÄªÀÄä
3. UÀÄgÀÄ«£À UÀÄ¯ÁªÀÄ£ÁUÀÄªÀ vÀ£ÀPÀ - ¥ÀÄgÀAzÀgÀ zÁ¸ÀgÀÄ
4. PÀgÉzÀÄ PÉÆlÖ£ÀÄ ±Á¥ÀªÀ£ÀÄ - PÀ£ÀPÀzÁ¸ÀgÀÄ

Unit-III: ¯ÉÃR£ÀUÀ¼ÀÄ **12 Hrs**

1. ªÉÆÃPÀë ºÀÄqÀÄPÀÄvÀÛ ¦æÃwAiÀÄ §AzsÀ£ÀzÀ°è - ¦. ®APÉÃ±À
2. gÁªÀÄ-PÀÈµÀÚ-²ªÀ - ÉÆÃ»AiÀiÁ
3. ªÀiÁ£À«ÃAiÀÄvÉ CAvÁgÀ¯Áè - zÉÃªÀ£ÀÆgÀÄ ªÀÄºÁzÉÃªÀ
4. ¨sÀÆvÁ¬Ä ªÀÄÄ¤zÁ¼ÀÄ - ªÀÄÄgÁj §¯Áè¼À

Unit-IV: ¥ÀæªÁ¸À PÀxÀ£À **12 Hrs**

1. £À£ÉÆß¼ÀV£À ºÁqÀÄ PÀÆå¨Á - f.J£ï. ªÉÆÃºÀ£ï

¥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. ºÀA¥À £ÁUÀgÁdAiÀÄå, ¸ÁAUÀvÀå PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
4. PÁ¼ÉÃUËqÀ £ÁUÀªÁgÀ, wæ¥À¢, gÀUÀ¼É ªÀÄvÀÄÛ eÁ£À¥ÀzÀ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
5. ¸ÀA. ¨É£ÀUÀ¯ï gÁªÀÄ gÁªï ªÀÄvÀÄÛ ¥Á£ÀåA ¸ÀÄAzÀgÀ ±Á¹ÛçÃ, ¥ÀÄgÁt £ÁªÀÄ ZÀÆqÁªÀÄtÂ, ¥ÀæPÁ±ÀPÀgÀÄ ¥Àæ¸ÁgÁAUÀ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ. 2010
6. ¸ÀA. §¸ÀªÀgÁdÄ J¯ï. ¸ÀªÀðdÕ£À ªÀZÀ£ÀUÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ VÃvÁ §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 2012
7. ªÀÄgÀÄ¼À¹zÀÝ¥Àà PÉ, µÀlà¢ ¸Á»vÀå, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
8. ¸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

9. ¸ÀA. f.J¸ï.¨sÀmï., PÀÁªÀiÁgÀªÀå¸À£À PÀuÀðl ¨sÀgÀvÀ PÀxÀªÀÄÀÄdj ¥ÀæªÉÃ±À, ¥ÀæPÁ±ÀPÀgÀÄ CPÀëgÀ ¥ÀæPÁ±À£À, ºÉUÉÆÎÃqÀÄ, ¸ÁUÀgÀ. 2006
10. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, zsÁgÀªÁqÀ. 2009
11. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
12. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 201

B19PC2012	Language-II: Hindi	L	T	P	C
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

- अध्येता, पी.यु.सी के स्तर पर द्वितीय भाषा के रूप में हिन्दी का अध्ययन करना चाहिए।
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है।
- हिन्दी व्याकरण का अवबोधन आवश्यक है।
- हिन्दी-अंग्रेजी अनुवाद से संबंधित जानकारी जरुरी है।

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना।
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना।
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना।
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना।

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है।
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है।
3. समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है।
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है।

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2012	CO1					2	3	2			
	CO2					2	2	3			
	CO3					3	3	3			
	CO4					3	2	3			

Course Contents:

इकाई – 1: प्राचीन कविता, आधुनिक कविता **12 hrs.**

कबीर के दोहे
कविता –जलियाँवाला बाग में बसंत- सुभद्राकुमारी चौहान
कविता – सुभाष की मृत्यु पर - धर्मवीर भारती

इकाई – 2: मध्यकालीन कविता, आधुनिक कविता **12 hrs.**
रसखान के दोहे
कविता – हमारी जिन्दगी - केदारनाथ अग्रवाल
कविता –चलना हमारा काम है।- शिवमंगल सिंह सुमन

इकाई – 3: मध्यकालीन कविता, आधुनिक कविता **12 hrs.**
मीराबाई के पद
कविता – मेरे सपने बहुत नहीं हैं- गिरिराज कुमार माथुर
कविता – अभी न होगा मेरा अंत – निराला

इकाई – 4: अनुवाद, निबंध **12 hrs.**
अनुवाद : हिन्दी – अंग्रेजी
निबंध :

1. भारत में किसानों की स्थिति
2. निर्वाचन आयोग का महत्व
3. प्रेस की आजादी कितनी सार्थक
4. भारतीय नारी
5. साहित्य का उद्देश्य

References

1. पाठ्य पुस्तक – रेवा विश्वविद्यालय
2. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त
3. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त
4. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
5. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
6. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
7. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
8. कार्यालय अनुवाद निदेशिका
9. हिन्दी निबंध संग्रह

B19PC2013	**Language-II: Additional English**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To ensure the development of the linguistic prowess of the students
2. To motivate the students to appreciate literature

3. To help students build strong language fundamentals
4. To promote an appreciable reading habit among the students

Course Outcomes:

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 vocabulary range
3. Critically analyse a piece of prose or poetry
4. Express 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	PSO1	PSO2
B19PC2013	CO1					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Contents:

Unit – I **12 Hrs**

Literature: Toru Dutt - Casuarina Tree**;** Robert Frost – Stopping by Woods on a Snowy Evening**;** Tomas Rivera–The Harvest**;** C.V. Raman – Water – The Elixir of Life; **Language:** Degrees of Comparison

Unit – II **12 Hrs**

Literature: Tadeusz Rozewicz – Pigtail**;** Jyoti Lanjewar – Mother**;** Sowvendra Shekhar Hansda – The Adivasi Will Not Dance**;** Harriet Jacobs – Excerpt from *Incidents in the Life of a Slave Girl***;** **Language:** Prefix and Suffix

Unit – III **12 Hrs**

Literature: Kamala Das – An Introduction**;** Usha Navrathnaram – To Mother; Rabindranath Tagore – The Exercise Book**;** Jamaica Kincaid – Girl**; Writing Skills:** Dialogue Writing

Unit – IV **12 Hrs**

Literature: Rudyard Kipling – The Absent-minded Beggar; Sir Arthur Conan Doyle – The Hound of the Baskervilles; Aldous Huxley – The Beauty Industry**; Writing Skills:** Story Writing

Reference Books:

1. Agrawal, K.A. *Toru Dutt the Pioneer Spirit of Indian English Poetry - A Critical Study*. Atlantic Publications, 2009.
2. Latham, Edward Connery (ed). *The Poetry of Robert Frost*. Holt Paperbacks, 2002.
3. Gale, Cengage Learning. *A Study Guide for Tomas Rivera's The Harvest*. Gale, Study Guides, 2017.
4. Basu, Tejan Kumar. *The Life and Times of C.V. Raman*. PrabhatPrakashan, 2016.
5. Rozewicz, Tadeusz. *New Poems*. Archipelago, 2007.

6. Manohar, Murli. *Critical Essays on Dalit Literature*. Atlantic Publishers, 2013.
7. Hansda, SowvendraShekhar. *The Adivasi Will Not Dance: Stories*. Speaking Tiger Publishing Private Limited, 2017.
8. Jacobs, Harriet. *Incidents in the Life of a Slave Girl*. Createspace Independent Publication, 2014.
9. Das, Kamala. *Selected Poems*. Penguin Books India, 2014.
10. Tagore, Rabindranath. *Selected Short Stories of Rabindranath Tagore*. Maple Press, 2012.
11. Gale, Cengage Learning.*A Study Guide for Jamaica Kincaid's Girl*. Gale, Study Guides, 2017.
12. Kipling, Rudyard. *The Absent-Minded Beggar*. Hardpress Publishing, 2013.
13. Doyle, Arthur Conan. *The Hound of the Baskervilles*. General Press, 2017.
14. Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt Ltd., 1988.
15. Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.
16. Samson, T. (ed.) *Innovate with English.* Cambridge University Press, 2010.
17. Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.

B19PC2020	**Functional English-II**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To utilize the ability of using language skills effectively in real-life scenarios.
2. To develop the learners' competence in employability skills.
3. To improve the habit of writing, leading to effective and efficient communication.
4. To prioritize specially on the development of technical reading and speaking skills among the learners.

Course Outcomes:

On completion of the course, learners will be able to:

1. Interpret audio files and comprehend different spoken discourses/ excerpts in different accents.
2. Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies.
3. Make use of reading different genres of texts adopting various reading strategies.
4. Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2020	**CO1**					**3**	**3**	**3**	**1**		
	CO2					**3**	**3**	**3**	**2**		
	CO3					**3**	**3**	**3**	**1**		
	CO4					**3**	**3**	**3**	**1**		

Course Contents:

Unit – I **12 Hrs**

Grammar: Active and passive voice; **Listening & Speaking:** Listening to informal conversations and interacting; **Reading:** Developing analytical skills; Deductive and inductive reasoning; **Writing:** Giving Instructions; Dialogue Writing

Unit – II **12 Hrs**

Grammar: Compound words; Phrasal verbs; **Listening:** Listening to situation based dialogues; **Speaking:** Group Discussions; **Reading:** Reading a short story or an article from newspaper; Critical reading; **Writing:** Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives)

Unit – III **12 Hrs**

Grammar: Homonyms; Homophones; **Listening:** Listening to conversations; Understanding the structure of conversations; **Speaking:** Presentation Skills; **Reading**: Extensive reading; **Writing:** Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions - interpretation of data using charts, PPT); Precise Writing.

Unit – IV **12 Hrs**

Grammar: Idioms; Single Word Substitutes; **Listening:** Listening to a telephone conversation; Viewing model interviews (face-to-face, telephonic and video conferencing); **Speaking:** Interview Skills, Mock Interviews; **Reading:** Reading job advertisements and the profile of the company concerned; **Writing:** Applying for a job; Writing a cover letter with résumé / CV.

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.

B19PC2030	**Heat and Thermodynamics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Concepts of Physics.

Course Objectives:

1. Impart knowledge about basics of physics to solve problems involving mean velocity, probable velocity.
2. Explain the relationship between the laws of radiation.

3. Familiarise with the principles of Thermodynamics for practical applications.
4. Familiarize with fundamental laws of Thermodynamics.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

1. Apply the laws of Kinetic theory of gases and concept of Low Temperature Physics to analyse and explain the problems in thermodynamics.
2. Demonstrate the concepts of different laws to explain the nature of radiation emitted by various bodies.
3. Analyse the heat flow in different bodies by the concepts of thermal conductivity and thermodynamics.
4. Interpret scientific information of heat and thermodynamics.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2030	**CO1**	**3**	**2**	**2**	**3**					**3**	**2**
	CO2	**2**	**2**	**2**	**2**					**3**	**3**
	CO3	**3**	**2**	**2**	**3**					**3**	**3**
	CO4	**3**	**2**	**2**	**2**					**3**	**2**

Course Contents:

Unit-I **12 hrs**

Kinetic theory of gases: Degrees of freedom. Principle of equipartition of energy based on kinetic theory of gases, U=3/2 RT-derivation. Maxwell's law of distribution of molecular velocity (no derivation)-its interpretation. Mean free path-derivation probability of a molecule having mean free path. Andrews isothermals, Vander walls equations-expression for critical constants, calculation of mean velocity, most probable velocity and RMS velocity.
Low Temperature Physics: Ideal and real gases. Porous plug experiment and its theory, Joule Thomson expansion-expression for the temperature of inversion, inversion curve. Relation between temperature of inversion and critical temperature of gas.

Unit-II **12 hrs**

Radiation: Planck's quantum theory of radiation, Stefan's law, Derivation of Planck's law of radiation - Deduction of Rayleigh-Jeans' law and Wien's displacement law from Planck's radiation law, Induced absorption, spontaneous and stimulated emission of radiation, Einstein's coefficients under thermal equilibrium condition.
Thermal conductivity: Equation of flow of heat through a solid bar. Determination of the thermal conductivity of a bad conductor by Lee and Charlton method.

Unit-III **12 hrs**

Thermodynamics-I: Thermodynamic coordinates, concept of heat, work and internal energy, The Zeroth law of Thermodynamics, Indicator and phase diagrams, Isothermals and Adiabatic changes – Expression for work done, First law of Thermodynamics-mathematical formulation.

Second law of thermodynamics – Kelvin Planck's statement and Clausius statement. The Carnot engine – expression for efficiency, the Carnot's theorem-its proof. Reversible and irreversible process, reversibility of carnot's cycle, Refrigerators-principle of working and coefficient of performance. Qualitative discussion on diesel engine.

Unit-IV **12 hrs**

Thermodynamics-II: Thermodynamic scale of temperature and its identity with perfect gas scale, Clausius-Clapeyron first latent heat equation. The concept of Entropy, Entropy of ideal gas, Change of entropy in reversible and irreversible cycles. Principle of increase of entropy –Clausius inequality, Entropy and II law of Thermodynamics, Concept of absolute zero and the third law of thermodynamics, thermodynamic potentials – internal energy, Gibb's free energy, Helmholtz free energy and their significance, Maxwell's equations.

Reference Books:

1. Brijal and Subramanyam: Heat and Thermodynamics 5^{th} edition,2016
2. Heat and Thermodynamics for Degree Students. Author, J. B. Rajam. Edition, 9. Publisher, S. Chand, 1981.
3. D.S. Mathur: Heat, S. Chand, 1995
4. David Halliday, Robert Resnick, and Jearl Walker, Fundamentals of Physics, Sixth
5. Edition, John Wiley & Sons, Inc. Kittal & Dekkar

B19PC2040	Chemistry-II	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

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:

1. Apply Fajans rules and determine the percentage covalent character of an ionic compound.
2. Categorise the oraganic cyclic compounds into aromatic, non-aromatic and anti-aromatic character.
3. Draw conclusions form the properties of the solute and solvents and their interactions.
4. Explain the preparation of artificial semipermeable membrane by Morse-Frazer method.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2040	**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: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, dipole moment and percentage ionic character.

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, trigonalbipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules (O_2, N_2) of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. Hydrogen bond and vanderwalls interaction, metallic bond and coordinate bond (introduction).

Unit-II: **12Hrs**

Aromaticity-Huckel's rule with respect to benzenoids, (benzene, naphthalene, anthracene and phenanthracene) and non-benzenoid compounds (cyclopentadienylanion, cycloheptadienylcation) anti-aromaticity.

Aromatic electrophillic substitution – 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). Friedelcraft alkylation and Acylation.

Stereochemistry I- Stereo isomerism; Optical isomerism; Symmetry and chirality; Optical isomerism in lactic acid and tartaric acid; Sequence rules; Enantiomers, diastereomers; Geometrical Isomerism; E-Z system of nomenclature, conformational analysis of ethane butane and Cyclohexane.

Unit-III: **12Hrs**

Liquid mixtures: Classification of, completely miscible and completely immiscible pairs of binary mixtures – partially miscible liquids (explanation with examples for each type). Raoult's law, definition of ideal and non- ideal solutions based on Raoult's law.

Partially miscible liquids: Critical solution temperature (CST) – types – phenol-water system, triethylamine-water system, (mutual solubility temperature (MST) vs composition curves to be drawn). Effect of addition of non-volatile solute on CST.Binary mixtures of completely miscible liquids.

Vapour pressure – definition, vapor pressure – composition diagrams and boiling point – composite diagrams. Classification into the types – obeying Raoult's law (type I), showing positive deviation from Raoult's Law (type II) and showing negative deviation from Raoult's Law (type III) – examples for each type.
Principles of fractional distillation: Fractional distillation of type I, type II and type III liquid mixtures (with examples). Azeotropic mixtures (definition). Binary mixtures of completely immiscible liquids (with examples), weight fraction of distillates (no derivation), principle of distillation, applications (numerical problem on weight fractions of components).

Unit-IV: **12 Hrs**

Properties of liquids: Viscosity- Coefficient of viscosity, effect of temperature, size, weight, shape of molecules and intermolecular forces on it. Surface tension and Parachor-Definition, mathematical expression, numerical problems and factors affecting them.
Colligative Properties: Concept of vapour pressure, variation of vapour pressure with temperature. Effect of dissolution of solute on the vapour pressure of the solvent. Raoult's law – relation between relative lowering of vapour pressure and molar mass (to be derived). Determination of relative molar mass of solute by dynamic method.
Elevation of boiling point and its relation to lowering of vapour pressure and molar mass (to be derived). 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). 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 (mention application), determination of osmoticpressure by Berkley-Hartley's method, laws of osmotic pressure analogy with gas laws, determination ofmolar mass from osmotic pressure measurements (relation to be derived), isotonic solutions, plasmolysis.

Suggested Text Books:

1. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
2. Bahl, A. & Bahl, B.S. 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. Principles of Inorganic Chemistry by Puri, Sharma, Kalia

Reference Books:

1. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
2. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
3. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
4. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
5. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
6. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
7. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

B19PC2050	Mathematics –II	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Definition and properties of groups, concept of polar and Cartesian form, formulas and knowledge about differentiation and partial derivatives.

Course Objectives:

1. Make the students to learn fundamental concepts of groups.
2. Make the students to develop the knowledge of differential calculus in polar coordinates.
3. Make the students to be familiar with curve tracing.
4. Find derivative of functions of more than one variable.
5. Illustrate about the application areas of partial differentiation.

Course Outcomes:

1. Explain the classification of finitely generated abelian groups and subgroups.
2. Demonstrate asymptotes and singular points
3. Gain knowledge on the concepts such as asymptotes, singular points and apply the same for curve tracing
4. Master the fundamental concepts of partial differentiation and apply Euler's theorem for homogeneous functions.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2050	**CO1**	**3**	**2**	**2**						**3**	**2**
	CO2	**2**	**2**	**2**						**3**	**3**
	CO3	**3**	**2**	**2**						**3**	**3**
	CO4	**3**	**2**	**2**						**3**	**2**

Course Contents:

Unit-I: Group Theory-1 **12 Hrs**

Binary operation, Algebraic structure, Problems on finding identity and inverse. Definitions of semi group and group, Abelian group, problems on finite and infinite groups. Properties of group with proof, Standard problems on groups, Any group of order less than five is abelian, permutation groups.

Unit-II: Differential Calculus -2 **12Hrs**

Polar coordinates, Angle between the radius vector and the tangent, Angle of intersection of curves (polar form), Polar sub tangent and polar subnormal, Perpendicular from pole on the tangent, Pedal equations, Derivative of an arc in Cartesian, parametric and polar forms.

Unit-III: Differential Calculus – 3 **12Hrs**

Curvature of plane curves, Formula for radius of curvature in Cartesian, parametric, polar and pedal forms, Centre of curvature, Evolutes. Singular points, Asymptotes, Envelopes. General rules for tracing of curves.

Unit-IV: Partial Differentiation – 1 **12 Hrs**

Partial differentiation, Function of two and three variables, First and higher derivatives, Homogeneous functions - derivatives - Euler's theorem and its extension (with proof). Total derivative and differential, Differentiation of implicit functions and composite functions – Problems, Jacobians - Properties of Jacobians problems.

Suggested Text Books:

1. The first course in Abstract Algebra by John B Fraleigh, Narosa Publishing House.
2. Topics in Algebra, I N Herstein, Wiley easter.
3. Shanthi Narayan and P. K. Mittal, Differential Calculus, Reprint. New Delhi: S. Chand & Company Ltd., 2011
4. G K Ranganath, Text book of B.Sc., Mathematics, Revised ed. New Delhi, India: S Chand and Co., 2011.

Reference Books:

1. G B Thomas and R L Finney, Calculus and Analytical geometry, 10th ed.: Addison – Wesley, 2000.
2. S. Narayanan & T. K. Manicavachogam Pillay, Calculus: S. Viswanathan Pvt. Ltd., 1996, vol. I & II.
3. S. Narayanan and T. K. Manicavachogam Pillay, Calculus (I & II). Chennai, India: S. Viswanathan Pvt. Ltd., 1996.
4. Joseph Edwards, An elementary treatise on the differential calculus: with applications and numerous examples, Reprint. Charleston, USA: BiblioBazaar, 2010.
5. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.

B19PC2060	**Environmental Studies**	**L**	**T**	**P**	**C**
Duration:14 Wks		**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 rural area
2. Influence the new patterns of behaviors of individuals, groups and society as a whole towards the environment
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 education programs.

Course Outcomes:

On successful completion of this course, the student will be able to:

1. Adapt the environmental conditions and protect it
2. Estimate the role of individual, government and NGO in environmental protection.
3. Interpret the new renewable energy resources with high efficiency through active research.
4. Analyze the ecological imbalances and protect it.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2060	CO1	1	2	1	1	1	2	3	1	1	1
	CO2	1	3	1	1	1	3	3	1	1	1
	CO3	2	3	2	1	3	3	3	1	1	1
	CO4	1	2	1	1	1	2	3	1	1	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 and world.

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 natural disasters.

Unit-III **6 Hrs**

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 Hrs**

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 JagadishKrishnaswamy, (2017),
2. Wiley India Private Ltd., New Delhi, Co-authored &Customised by Dr. M. S. Reddy & Chandrashekar, REVA University.
3. "Environmental Studies", by R.J. Ranjit Daniels and JagadishKrishnaswamy, (2009), Wiley India Private Ltd., New Delhi.
4. "Environmental Studies" by Benny Joseph, Tata McGraw – Hill Publishing Company Limited.
5. Environmental Studies by Dr. S. M. Prakash, Elite Publishers Mangalore, 2007
6. Rajagopalan R. 2005, "Environmental Studies – from Crisis to cure", Oxford University Press.
7. Environmental Science by Arvind walia, Kalyani Publications, 2009.
8. Environmental Studies by AnilkumarDey and Arnab kumarDey.

Course Code	Course Title	Course Type	L	T	P	C	Hrs/Week
B19PC2070	**Sports / Yoga / Music / Dance / Theatre**	**RULO**	**2**	**0**	**0**	**2**	**2**

Note: Music, Dance, and Theater courses are offered by the School of Performing Arts, whereas the Sports and Yoga courses are offered by the Department of Physical Education. The students have to choose any **ONE** of these courses.

A. YOGA FOR HEALTH (B19PC2071)

Course Objectives:
Following are the Course Objectives.

- To prepare the students for the integration of their physical, mental and spiritual faculties;
- To enable the students to maintain good health;
- To practice mental hygiene and to attain higher level of consciousness;
- To possess emotional stability, self control and concentration; and

- To inculcate among students' self discipline, moral and ethical values.

Course Outcomes:

On completion of the course learners will be able to:

- Practice yoga for strength, flexibility, and relaxation.
- Learn techniques for increasing concentration and decreasing anxiety
- Become self disciplined and self-controlled
- Improve physical fitness and perform better in studies
- Gain self confidence to face the challenges in the society with commitment to serve the society

Course Content:

Unit-I:
Yoga: Introduction; **Surya Namaskara: -** 12 counts

Unit-II:
Asanas: Sitting- Vajrasana, Dandasana, Padmasana, Matsyasana, Paschimottasana, Shirasasana.
Asanas: Standing- Tadasana, Trikonasana, Parshwa konasana, Veerabadrasana.

Unit-III:
Asanas: Prone Position- Bhujangasana, Dhanurasana.
Asanas: Supine Position- Sarvangasana, Halasana.
Mudras- Dhyana mudra, Namaste mudra, Nasika mudra

Unit-IV:
Pranayams: - Anuloma – Viloma, Basthrika, Bhramari.
Dhyana & its types: Competition format, Rules and their interpretations

B. VOLLEYBALL (B19PC2072)

Course Objectives:

To learn the rules, fundamental skills, and strategies of volleyball

1. To develop skills in passing, setting, serving, spiking, and blocking.
2. To learn basic offensive and defensive patterns of play.
3. To develop a positive attitude towards volleyball as a lifetime sport and to improve physical fitness through participation in volleyball.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with volleyball.
2. Apply these skills while playing volleyball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

Unit-I

- Introduction about Volleyball

- Players Stance, Receiving and passing
- The Volley (Overhead pass), The Dig (Underhand pass), Service Reception

Unit-II

- Service- Under Arm Service, Tennis Service, Side Arm Spin Service, Round Arm Service, High spin service, Asian serve / American serve (floating)
- Setting the ball- Set for attack, Back set, Jump set

Unit-III

- Smash/Spike- Straight smash, Body turn smash, Wrist outward smash, Wrist inward smash
- Block- Single block, Double block, Three-man block
- Rolls- Overhead pass & back rolling, One hand underhand pass with side rolling, Forward dive

Unit-IV

- Attack Combination, Defense Systems, Libero play
- Court marking, Rules and their interpretations and Duties of officials

C. BASKETBALL (B19PC2073)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of Basketball
2. To develop technical skills in passing, in ball handling, individual offense, individual defense, rebounding, screen, team offense, team defense and fast break.
3. To learn basic offensive and defensive strategies of play.
4. To develop a positive attitude towards Basketball as a lifetime sport and to improve physical fitness through participation in Basketball.
5. To develop positive understanding and appreciation of the basketball game.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with basketball.
2. Apply these skills while playing basketball and exhibit improved performance
3. Improve physical fitness and practice positive personal and lifestyle.
4. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

Unit-I

- Basketball: Introduction
- Grip; Player stance- Triple threat stance and Ball handling exercises
- Passing (Two hand/one hand)- Chest pass, Bounce Pass, over head pass, Underhand pass, Hook Pass, Behind the back pass, Baseball pass, Side arm pass and passing in running.
- Receiving-Two Hand receiving, one hand receiving, receiving in stationary position, receiving while jumping, receiving while running.

Unit-II

- Dribbling- How to start dribble, how to stop dribble, High / Low dribble with variations
- Shooting- Layup shot and its variations, One hand set shot, one hand jump shot, Free throw, Hook shot, Tip-in shot.
- Stopping- Stride/Scoot, Pivoting and Faking /Feinting footwork.

Unit-III

- Rebounding- Defensive rebound, Offensive rebound, Box out, Rebound Organization.
- Individual Defensive- Guarding the man with the ball and without the ball.
- Offensive drills, Fast break drills, Team Defense/Offense, Team Tactics

Unit-IV

- Court marking, Rules and their interpretations

D. FOOTBALL (B19PC2074)

Course Objectives:

1. To learn the rules, fundamental skills, and strategies of football.
2. To develop skills in passing, receiving, controlling the ball, dribbling, shielding, shooting, tackling, beating a defender and heading in football.
3. To learn basic offensive and defensive patterns of play
4. To use different parts of the body in utilizing the above skills while playing football
5. To develop a positive attitude towards football as a lifetime sport and to improve physical fitness through participation in football.

Course Outcomes:

On completion of the course learners will be able to:

1. Learn basic skills and knowledge associated with football.
2. Apply these skills while playing football and exhibit improved performance
3. Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.
4. Improve physical fitness and practice positive personal and lifestyle.
5. Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Content:

Unit-I

Football: Introduction

- Kicks- Inside kick, Instep kick, Outer instep kick, Lofted kick, Chipping, Volley, Half Volley
- Trapping- Trapping rolling the ball, Trapping bouncing ball with sole

Unit-II

- Dribbling- With instep and outer instep of the foot.
- Heading- From standing, running and jumping.
- Feinting- With the lower limb and upper part of the body.

Unit-III

- Tackling- Simple tackling, Slide tackling.
- Throw-in- Standing and Sliding
- Goal Keeping- Collection of balls, Ball clearance, throwing and deflecting.

Unit-IV

- Ground marking, Rules and their interpretations

E. ATHLETICS (TRACK AND FIELD) (B19PC2075)

Course Objectives:

1. To teach students the skilled techniques in sprints, relay running, hurdles, long jump, high jump, and shot put and practice them.
2. To develop competence among students in demonstrating all the techniques covered in the course.
3. To make students understand some of the scientific and empirical principles and their rationale underlying the development of skilled performance.
4. To inculcate among students the habit of team work and cooperative learning and develop competence in detecting / correcting technique errors.
5. To develop a positive attitude towards sports in general and athletics in particular and to improve physical fitness through participation in various athletic games / sports activities.

Course Outcomes:

On completion of the course learners will be able to:

1. Display competencies in executing basic techniques and skills associated with select track and field events.
2. Develop basic skills and techniques to improve one's running posture and take-off position for different jumps.
3. Learn regular practice of select track and field events and improve physical fitness
4. Appreciate track and field events by applying sports science knowledge to explain the execution of the events.

Course Content:

Unit-I

- Athletics: Introduction
- Track Events - Steeple Chase, Race Walking, Middle- and Long-distance races
- Race walking - Technique, Faults and Officiating.
- Middle- and Long-distance races – Technique and Training

Unit-II

- Jumping Events - High Jump and Triple Jump: Basic Skills and techniques
- High Jump - Straddle Roll & Flop Technique, Approach, Take-off, Technique in the air, Clearance over the bar & Landing
- Triple Jump – Hop, Step and Jump Technique, Approach, Take-off & Landing

Unit-III

- Throwing Events - Discus Throw and Hammer Throw: Basic Skills and techniques
- Discus Throw - Standing and Rotatory techniques, Grip, Stance, Rotation Technique, Power stance, Release and Reverse (Follow through)

- Hammer Throw - Grip, Swings, Rotation foot work, Release and Follow through

Unit-IV

- Rules, Officiating and Marking - Ground / Sector Marking, Interpretation of Rules.

Reference Books

1. Arthur E. Ellison (ed) (1994). Athletic Training and Sports Medicine.
2. Ballisteros, J.M. (1998). Hurdles Basic Coaching Manual, IAAF.
3. Bosen K.O. (1993). Teaching Athletics Skills and Technique.
4. Bosen K.O. (1990). Study Material on Hurdles for the Regular Course Students.
5. Doherty K. (1995). Track and Field Omni book.
6. Martin, David E. Peter N. Coe (1991). Training Distance Runner.
7. Howard S. (1981). Science of Track and Field Athletics.
8. Briggs Graeme (1987). "Track and field coaching Manual", Australian Track and Field Coaches Association. Rothmans Foundation National Sports Division.
9. Carr, Gerry (1999). "Fundamentals of Track and Field. Track Athletics Title G.V. 1060 5.e. 368.
10. I.A.A.F. Level-II (2001). Text Book on Jumping Event.
11. Jarver, Jesse (1987). "The Jumps", Track and Field Coaching Manual Australia.

F. DRAMATICS (B19PC2076)

Pre-requisites: Students with background in Theatre Arts/ Keen interest in Dramatics.

Course Objectives:

- To imbibe the acting skills.
- To understand the broader applications of theatre studies in allied arts forms.
- To be able to use body language for better communication.
- Students shall also be able to understand voice modulation and Navarasas.

Course Outcomes:

On successful completion of this course, students should be able to:

- Freely express improvisation in non-verbal communication.
- Shall hone good acting skills and be able to emote better.
- Be able to put up a theatre act and play a key role.
- Be able to differentiate good acting and understand the importance of good lyrics, stage crafting, music, dance, costume and lighting.

Course Content:

UNIT – 1

Working on Body:

Body and its analysis. Understanding physical abilities (Anga, Pratyanga and Upanga). Challenges of the body. Using body as metaphor and language. The class's bodies as a collective, an ensemble, a collaborative team.

UNIT – 2

Sound and Movement:

Awareness of creating sound patterns, voice modulations, rhythm in speech and diaologues. Understanding the rhythm and patterns of movements like walking, framing, shaping, primitive and animal movements.

UNIT – 3

Characterization and Improvisation:

Observation of people around. Getting into the role and living it. Developing a character from establishment (pace and rhythm). Improvisation techniques of body and mind.

UNIT – 4

Group work and Production:

Develop a theme, concept or a play and include all the theatre skills, stage craft, costuming and put up an act. Choosing theme and characters.

Reference Books:

1. All about Theatre – Off stage – Chris Hogget.
2. Rangadalli Anataranga – K V Subbanna
3. The Indian Theatre – Hemendranath Das Gupta.
4. A Practical handbook for an Actor – Milisa Bruder, ee Milchel Cohn, Madeleine Oliek et al, Zigler Publisher.

G. INDIAN CLASSICAL DANCE FORMS

(Bharatanatyam, Kuchipudi, Mohiniyattam) (**B19PC2077**)

Prerequisites: Background of classical dance training or any other dance forms.

Note: Non-classical dancers can also join.

Course Objectives:

- To develop an understanding about the Indian classical dance forms and its universal application.
- To be able to understand the fine nuances of Classical dance.
- To understand the importance of health through Indian classical dance, strengthen the body capacity.
- To understand mythology and its characters in Indian classical dance form through lessons of Abhinaya.

Course Outcomes:

- To be able to identify and appreciate the classical dance forms.
- To be able to execute basics of Adavus with finesse.
- To be able to express through abhinaya.
- To be able to perform to perform the fundamentals in the chosen dance form.

Course Content:

Unit – 1

An introduction to Indian classical dance forms

Bharatanatyam, Kuchipudi, Mohiniyattam

Unit - 2

Learning of Fundamentals
Exercises and Adavus- I (Bharathanatyam, Kuchipudi, Mohiniyattam)

Unit - 3
Adavus –II (Bharathanatyam, Kuchipudi, Mohiniyattam)

Unit - 4
Learn a basic composition in the chosen dance form.

Reference Books

1. Indian classical dance forms –U S Krishna Rao, U K Chandrabhaga Devi
2. Classical Dances –Sonal Mansingh, Avinash Parischa
3. Kuchipudi – Sunil Kothari
4. Bharatanatyam an in-depth study- Saroja vydyanathan
5. Mohiniyattam – Bharathi Shivaji

H. PERCUSSION INSTRUMENT (TABLA AND MRIDANGAM) (B19PC2078)

Pre-requisites: Students with background in Percussion instruments and knowledge of Rhythm/ Keen interest in studying Mridagam / Tabala.

Course Objectives:
- To understand the Rhythmology.
- To understand the importance of Laya, Taala.
- To be able to understand the fine finger techniques of playing the instrument.

Course Outcomes:
On successful completion of this course, students should be able to:
- To be able to set instrument to Sruthi.
- To be able to play the fundamentals on instrument.
- To be able to learn and perform a particular taala.

Course Content:

UNIT - 1
1. Introduction to Musical Instruments; 2. Percussion Instruments; 3. Mridangam and its History

UNIT - 2
1. Introduction to Tala System; 2. Definitions of five jaathis and their recitation; 3. Adi Talam and its various forms; 4. Definitions and recitation of different gathis

UNIT - 3
1. Tisra Jaathi; 2. Khanda Jaathi; 3. Misra Jaathi; 4. Sankeerna Jaathi

UNIT - 4

1. Learning of Jathi Formation; 2. Basic jathis; 3. Jathis for Dance forms ; 4. Some Basic Definitions of Korvai, Teermanam etc.

Reference Books:

1. Mridangam- An Indian Classical Percussion Drum – Shreejayanthi Gopal
2. Theory and practice of Tabala – Sadanand Naimpally.
3. Theory and practice of Mridangam – Dharmala Rama Murthy
4. The Art of the Indian Tabala – Srdjan Beronja.

B19PC2080	Physics Lab-II	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Knowledge of basics of physics.

Course Objectives:

1. Impart knowledge about various laws of thermodynamics through experiments
2. Familiarise with the concepts of thermal conductivity through experiments
3. Familiarise with various experiments in thermodynamics and mechanics Lab
4. Enable to understand physical constant through experiments

Course Outcomes:

On completion of the course, learners will be able to:

1. Verify various laws of thermodynamics through experiments
2. Analyse the concepts of thermal conductivity through experiments
3. Demonstrate the various experiments in thermodynamics and mechanics Lab
4. Determination of physical constant through experiments

Mapping of Course Outcomes with programme Outcomes

Course Code	**POs/ COs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**
B19PC2080	**CO1**	**3**	**2**	**2**		**1**				**3**	**3**
	CO2	**3**	**2**	**2**	**1**	**1**				**3**	**3**
	CO3	**2**	**2**	**2**	**2**	**2**				**3**	**3**
	CO4	**3**	**2**	**2**		**1**				**3**	**3**

Course Contents:

Any **Eight** of the Following Experiments

1. Verification of Gaussian distribution law and calculation of standard deviation –Monte Carlo experiment.
2. Specific heat of a liquid by cooling – graphical method.
3. Determination of thermal conductivity of a bad conductor by Lee-Charlton method.
4. Verification of Stefan – Boltzmann law by using Ohm's law.
5. Determination of boiling point of a liquid using platinum resistance thermometer.
6. Determination of moment of inertia of irregular body using Torsional pendulum.

7. Determination of rigidity modulus by the static torsion method.
8. Determination of Young's modulus by uniform bending method.
9. Spiral spring: Determination of the acceleration due to gravity (graphical method).
10. Determination of wavelength of a given LASER by diffraction method.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S.Sudha.D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G. L. Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)

B19PC2090	Chemistry Lab-II	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

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. Catogerize the nitrogen containing functional groups based on their response to diazotization and carbylamine tests.

Course Outcomes:

1. Acquire knowledge of steps involved in organic functional group analysis.
2. Test for elements such as sulfur, nitrogen and halogens using sodium fusion extract.
3. Determine the physical constants of both compound and its derivative using melting point apparatus.
4. Examine the solubility of the given organic compound using solubility chart, that will dierect to perfom functional group anlaysis.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2090	**CO1**	**2**	**2**	**3**	**2**	**1**		**2**	**2**	**1**	**3**
	CO2	**3**	**3**	**3**	**3**	**1**		**2**	**3**	**2**	**2**
	CO3	**3**	**2**	**2**	**3**			**2**	**2**	**3**	**2**
	CO4	**2**	**3**	**2**	**2**	**1**		**2**	**3**	**2**	**2**

Course Contents:

Qualitative analysis of mono functional organic compounds

1. Acids, 2. Alcohols, 3. Aldehydes, 4. Amide, 5. Amine, 6. Halogenated hydrocarbons, 7. Hydrocarbons, 8. Ketones, 9. Nitro compounds, 10. Phenols

Reference Books for Practicals:

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.: NewDelhi (2011).

B19PC2X10	Mathematics Lab-II	L	T	P	C
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Definition and properties of groups, concept of polar and Cartesian form, formulas and knowledge about differentiation and partial derivatives.

Course Objectives:

1. Obtain skill in creating simple programs using *Scilab* and *Maxima*.
2. Acquire skill in tracing standard curves using *Maxima*.
3. Gain proficiency in using *Maxima* to solve problems on Differentiation and Euler's theorem and its extension.

Course Outcomes:

1. Acquire proficiency in using *Scilab* to find identity and inverse element of a group and in construction of Caley –Table.
2. Demonstrate the use of *Maxima* to understand and interpret the various types of functions from the algebraic and graphical points of view.
3. Sketch graphs of standard curves using *Maxima* to interpret tracing of curves.
4. Be familiar with the built-in functions to find derivatives of any order and solve application problems dealing with the concept of partial derivatives.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC2X10	**CO1**	**3**	**2**	**2**		**1**				**3**	**3**
	CO2	**3**	**2**	**2**	**1**	**1**				**3**	**3**
	CO3	**2**	**2**	**2**	**1**	**1**				**3**	**3**
	CO4	**3**	**2**	**2**		**1**				**3**	**3**

Course Contents:

1. Creating a *Scilab* program (Simple examples).
2. Creating a *Maxima* program (Simple examples).
3. Verifying whether given operator is binary or not.
4. To find identity and inverse element of a group.
5. Construction of Caley –Table.
6. Plotting of standard Cartesian curves using *Scilab* / *Maxima*.
7. Plotting of standard Cartesian curves using *Scilab* / *Maxima*.
8. Plotting of standard parametric curves using *Scilab* / *Maxima*.
9. Plotting of standard polar curves using *Scilab* / *Maxima*.
10. Obtain partial derivative of some standard function.
11. Verification of Euler's theorem and its extension.
12. Verification of Jacobians.

Suggested Text Books and References:

1. SCILAB: A Practical Introduction to Programming and Problem Solving [Print Replica] Kindle Edition by Tejas Sheth (Author).
2. The Maxima Book Paulo Ney de Souza Richard J. Fateman Joel Moses Cliff Yapp 19th September 2004.

THIRD-SEMESTER

B19PC3011	Language: Kannada-III	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

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.

Course Objectives:

£Á®ÄÌ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ ªÀÄÆgÀ£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÉÇÃzÀAiÀÄ, £ÀªÀå PÁªÀå, ¸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.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. 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
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÉÇÃzÀAiÀÄ, £ÀªÀå PÁªÀå, ¸ÀtÚPÀxÉUÀ¼ÀÄ ºÁUÀÄ £ÁlPÀ ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃl UÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÅzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀÅ ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ
4. 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	PSO1	PSO2
B19PC3011	CO1					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Course Contents:

Unit I £ÀªÉÇÃzÀAiÀÄ PÀ«vÉUÀ¼ÀÄ **12 Hours**

1. ªÀÄÄ¢AiÀÄ gÁªÀÄUËqÀ	©. JA. ²æÃ
2. ¨É¼ÀUÀÄ	zÀ.gÁ. ¨ÉÃAzÉæ
3. PÀ°Ì	PÀÄªÉA¥ÀÄ
4. PÀ£Àßqï ¥ÀzÀUÉÆ¼ï	f. ¦. gÁdgÀvÀßA

Unit II £ÀªÉÇÃzÀAiÀÄ ºÁUÀÄ £ÀªÀå PÀ«vÉUÀ¼ÀÄ **12 Hours**

1. CªÀzsÀÆvÀ	¸ÀÄ.gÀA.JPÀÄÌAr
2. ªÀÄ£É¬ÄAzÀ ªÀÄ£ÉUÉ	PÉ.J¸ï.£À
3. £À£Àß ºÀtvÉ	f.J¸ï.J¸ï.
4. £ÀA©PÉ	ZÀ£Àß«ÃgÀ PÀt«

Unit III ¸ÀtÚ PÀxÉUÀ¼ÀÄ **12 Hours**

1. ªÀÄÄzÀÝt ªÀÄ£ÉÆÃgÀªÉÄ ¸À¯Áè¥À	ªÀÄÄzÀÝt
2. zÁ½ £ÀqÉzÁªÀ CuÁÚ	CªÀÄgÉÃ±À £ÀÄUÀqÉÆÃtÂ
3. PÉÆ£ÉAiÀÄ VgÁQ	¤gÀAd£À
4. ªÀiÁ¤Ãlgï	vÉÃd¹é

Unit IV £ÁlPÀ **12 Hours**

«ÄÃrAiÀiÁ	C£ÀÄªÁzÀ.: PÉ. ªÀÄgÀÄ¼À ¹zÀÞ¥Àà

Suggested Text Books and References:

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. 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. DzsÀA¤PÀ PÀ£ÀßqÀ PÀªÀå ¨sÁUÀ-2, PÀAªÉA¥ÀA PÀ£ÀßqÀ CzsÀåAiÀA£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

B19PC3012	Language – II: Hindi	L	T	P	C
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

- अध्येता को, हिन्दी नाटक साहित्य का संक्षिप्त ज्ञान आवश्यक है |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |
- मीडिया लेखन की बुनियादी जानकारी चाहिए |
- अंग्रेज़ी – हिन्दी अनुवाद से संबंधित जानकारी जरुरी है|

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |
3. समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है |

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3012	CO1					2	3	2			
	CO2					2	2	3			
	CO3					3	3	3			
	CO4					3	2	3			

Course Contents:

इकाई – 1: नाटक **:** एक और द्रोणाचार्य – डॉ. शंकर शेष **12 hrs.**

लेखक परिचय
प्रथम दृश्य
द्वितीय दृश्य

इकाई – **2:** नाटक **:** एक और द्रोणाचार्य **12 hrs.**
तृतीय दृश्य
चतुर्थ दृश्य

इका ई – **3:** नाटक **:** एक और द्रोणाचार्य **12 hrs.**
पंचम दृश्य
छठा दृश्य

इकाई – **4:** अनुवाद, जनसंचार माध्यम **12 hrs.**

अनुवाद : अंग्रेजी - हिन्दी (समाचार पत्र से संबंधित)
जनसंचार माध्यम : स्वरुप, उद्भव और विकास |

सन्दर्भ ग्रन्थ :

1. एक और द्रोणाचार्य – डॉ. शंकर शेष
2. मीडिया लेखन एवं जनसंचार – डॉ.संजीव कुमार
3. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
4. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
5. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
6. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
7. कार्यालय अनुवाद निदेशिका
8. मीडिया विमर्श – रामशरण जोशी
9. संस्कृति, जनसंचार और बाजार – नन्द भरद्वाज

B19PC3013	Language-II: Additional English	L	T	P	C
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To ensure the development of the linguistic prowess of the students
2. To motivate the students to appreciate literature
3. To help students build strong language fundamentals
4. To promote an appreciable reading habit among the students

Course Outcomes:

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 vocabulary range
3. Critically analyse a piece of prose or poetry
4. Express 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	PSO1	PSO2
B19PC3013	**CO1**					**3**	**3**	**3**	**2**		
	CO2					**3**	**3**	**3**	**3**		
	CO3					**3**	**3**	**3**	**2**		
	CO4					**3**	**3**	**3**	**2**		

Course Contents:

UNIT-I: Gender & Identity **12hrs**

Anne Sexton – Consorting with Angels; Eugene Field – The Doll's Wooing; Suniti Namjoshi – Extracts from *Feminist Fables*; Ruth Vanita & Saleem Kidwai (ed) – *Same Sex Love in India* (Extract); Charlotte Perkins Gilman – The Yellow Wallpaper

UNIT-II: Love & Romance **12hrs**

Alfred Noyes – The Highway Man; William Shakespeare – Sonnet 116; Frank Richard Stockton – The Lady or the Tiger?; Oscar Wilde – The Nightingale and the Rose; William Shakespeare – *Excerpt from Romeo and Juliet* (Balcony Scene)

UNIT-III: War & Trauma **12hrs**

Lord Alfred Tennyson – The Charge of the Light Brigade; Taufiq Rafat – The Medal; Guy de Maupassant – Two Friends; Sadaat Hasan Manto – Toba Tek Singh; Bertolt Brecht – Excerpt from *Fear and Misery of the Third Reich*

UNIT-IV: Children's Literature **12hrs**

William Wordsworth – Three Years She Grew in Sun and Shower; D.H. Lawrence – Discord in Childhood; Hans Christian Anderson – The Snow Queen; Anna Sewell – *The Black Beauty* (Extract); Rudyard Kipling – *The Jungle Book* (Extract)

Reference Books:

1. Sexton, Anne. *The Complete Poems*. Houghton Mifflin, 1999.
2. Namjoshi, Suniti. *Feminist Fables*. Spinifex Press, 1998.
3. Vanita, Ruth &Saleem Kidwai (ed.) *Same Sex Love in India*. Penguin India, 2008.
4. Gilman, Charlotte Perkins. *The Yellow Wallpaper*. Rockland Press, 2017.
5. Gale, Cengage Learning. *A Study Guide for Alfred Noyes's "The Highwayman".* Gale, Study Guides, 2017. (Kindle Edition Available)
6. Shakespeare, William. *Poems and Sonnets of William Shakespeare*. Cosimo Classics, 2007.
7. Stockton, Frank Richard. *The Lady, or the Tiger?* Create space Independent Publications, 2017.
8. Wilde, Oscar. *The Collected Works of Oscar Wilde*. Wordsworth Editions Ltd., 1997.
9. Shakespeare, William. *Romeo and Juliet*. Rupa, 2001.
10. Tennyson, Lord Alfred. *The Complete Works of Alfred Tennyson*. Forgotten Books, 2017.
11. Owen, Wilfred. *The Poems of Wilfred Owen*. Wordsworth Editions Ltd., 1994.
12. Maupassant, Guy de. *Guy de Maupassant-The Complete Short Stories*. Projapati, 2015.

13. Manto, Sadaat Hasan. *Manto: Selected Short Stories*. RHI, 2012.
14. Brecht, Bertolt. *Fear and Misery in the Third Reich*. Methuen Drama, 2012.
15. Ricks, Christopher. *Metaphysical Poetry*. Penguin, 2006.
16. Anderson, Hans Christian. *Fairy Tales by Hans Christian Anderson*. Read Books, 2010.
17. Sewell, Anna. *The Black Beauty*. Maple Press, 2014.
18. Kipling, Rudyard. *The Jungle Book*. Amazing Reads, 2018.

B19PC3020	**Communicative English-I**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To attune young minds to concerns and issues which have a broad and wide scope of use and application to life.
2. To acquire a functional use of language in context.
3. To equip students to deliver formal and informal oral presentations to a variety of audiences in multiple contexts.
4. To enable students to construct effective written message in various formats and styles.
5. To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes:

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

1. Demonstrate ethical and political responsibilities in taking cognizance of issues relating to society, environment and media.
2. Develop a process-oriented approach to writing.
3. Make use of grammatical skills developed during the course aptly.
4. Utilize the target language effectively to focus on interpersonal skills and develop a good Command over the language.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3020	CO1					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Contents:

UNIT – I: **12Hrs**

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: 12Hrs

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: 12Hrs

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: 12Hrs

Remedial Grammar: Collocations; Prepositions**; Writing Skills:** Precis 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.

B19PC3030	**Waves and Optics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

This is introductory physics course which covers topics in simple harmonic motion waves, basic theory of light, optics, optical instruments and optical phenomenon like diffraction, interference and polarization.

Course Objectives:

1. To understand progressive and simple harmonic wave motions and the mathematical equations that govern them.
2. To understand superposition of simple harmonic wave motions and the phenomenon related to them.
3. To study the theory of light and the basic design principles of optical instruments.
4. To analyse and explain interference, diffraction and polarization of light.

Course Outcomes:

On completion of this course the student will be able to

1. Explain the phenomenon related to simple harmonic motion waves.
2. Explain the laws of reflection and refraction based on Huygen's principle.
3. Describe the working of optical instruments based on different types of lens.
4. Differentiate between interference, diffraction and polarization.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3030	CO1	3	3	3	3			1	2	3	3
	CO2	3	3	3	3			2	2	3	3
	CO3	3	2	2	2			2	2	3	3
	CO4	3	3	2	2			2	2	3	3

Course Contents:

UNIT-I **12 hours**

Waves

Waves in one dimension. Differential equation of wave motion. Relation between amplitude and intensity. Expression for velocity of progressive waves in a medium. Newton's formula, Laplace's correction. Longitudinal vibrations in a rod. Expression for frequency of vibration of a stretched string-harmonics. Kundt's tube experiment

Superposition of simple harmonic motions: Lissajou's figures, Equation for damped vibrations, Forced vibration, Solution in exponential form.

Resonance: Expression for amplitude and phase at resonance.

UNIT-II **12 hours**

Theory of light: Huygen's principle. Explanation of the laws of reflection and refraction. Lens formula.

Optics: Kerr effect. Determination of velocity of light by Kerr cell method, Defects of lenses.

Optical Instruments: Achromatic combinations of lenses. Huygen's and Ramsden's eye pieces. Resolving and magnifying power of the telescope and microscope (qualitative treatment only).

UNIT-III **12 hours**

Interference: Theory of interference. Expression for fringe width. Coherent sources. Interference by division of wave front and division of amplitude. Fresnel's biprism. Lloyd's mirror. Thin films of uniform thickness. Newton's rings. Interference at a wedge. Michelson's interferometer - Measurement of λ and $d\lambda$.

Diffraction: Fresnel and Fraunhofer diffraction. Explanation of rectilinear propagation of light. Theory of the zone plate. Comparison with a convex lens. Fresnel diffraction at a straight edge. Fraunhofer diffraction at a single slit. Transmission grating-theory for the case of normal incidence.

UNIT-IV **12 hours**

Polarization: Double refraction in uniaxial crystals. Huygen's theory. Positive and negative crystal. Principal refractive indices. Huygen's constructions of O and E wave fronts in a uniaxial crystal. Retarding plates. Production and analysis of linearly. Circularly and elliptically polarized light. Optical activity, Fresnel's theory, Rotatory polarization. Use of bi quartz. Applications of Polaroid's. Construction and working of Polarimetry, Specific rotation.

Suggested Text Books:

1. Halliday and Resnick: Fundamentals of Physics, 9th edition, Wiley India, 2011.
2. R. H. Dittaman and M. W. Zemansky: Heat and Thermodynamics, 7th edition, The McGraw-Hill companies, 2007.
3. S. J. Blundell and K. M. Blundell: Concepts in Thermal Physics, 2nd edition, Oxford University Press, 2006.
4. Brijlal, N. Subramanyam P.S. Hemne: Heat Thermodynamics and Statistical Physics, 1st edition. S Chand Publishing, 2007.
5. S C Gupta: Thermodynamics, 1st edition, Pearson, 2005.
6. Satya Prakash: Optics and Atomic Physics, 11th, Ratan Prakashan Mandir, 1994.
7. C. L. Arora: Refresher Course in Physics Vol I, S Chand publishing, 2011.
8. S. R. Shankara Narayana: Heat and Thermodynamics, 2nd edition, Sulthan Chand and Sons, 1990.

B19PC3040	Chemistry –III	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of chemical bonding, periodic table, stereochemistry, thermodynamics.

Course Objectives:

1. Conclude the different bonding like metallic, hydrogen and certain nature of bonding in metal carbonyls, Boron Carbon Nitrogen Sulphur and halogens.
2. Defend the following topics Alkyl halides, aryl halides, alcohols, nomenclature and reactions. Stereochemistry and Conformational analysis of acyclic alkane system.
3. Analysis of Ostwald's dilution law, Activity and activity coefficients, Mean ionic activity coefficients.
4. Develop the practical skills to understand the theory of strong electrolytes, Debye-Huckel-Onsagar equation, Debye-Huckel Limiting equation for activity coefficients.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Illustrate the nature of bonding in metal carbonyls, boron, halogens and its properties, identify different functional groups.
2. Understand the nomenclature, different reactions and its mechanism of various named reactions.
3. Analyze different stereochemical conformations of acyclic alkane system. Derive various equations like Debye-Huckel theory of strong electrolytes.
4. Conclude the limitations and advantages of Debye-Huckel-Onsager equation, Debye-Huckel Limiting equation.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3040	**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**

Metallic bond: Definition, factors favouring the formation of metallic bond, Band theory, explanation of electrical conductance of metals, semiconductors (n- and p-type), Insulators and Superconductors (Explanation and applications with suitable examples). **Hydrogen bonding:** Types of hydrogen bonding, conditions for the formation of H-bond. Hydrogen bonding in HF, H_2O, NH_3.
Metal carbonyls: Definition, classification with examples, nature of M-CO bonding in carbonyls.
Chemistry of Non-Metals:
Boron: Boron hydrates – diborane, preparation, structure and uses.
Carbon: Fullerenes – production, structure of C_{60} and $C_{70.}$ Diamond, graphite – properties and structure.
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 (any one method of preparation and any three properties to be discussed.

Unit-II: **12 Hrs**

Alcohols: Definition and classification, oxidation reaction ($CrO_{3,}$ Jones reagent, PCC) reduction reaction ($LiAlH_4$)
Phenols: Definition, classification with examples, acidity of phenols, effect of substituents on acidity of phenols. Mechanism of Reimer-Tiemann reaction and Kolbe reaction.
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.

Stereochemistry II- Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Configuration: Geometrical E/Z Nomenclature and Optical isomerism; Concept of chirality (up to two carbon atoms). Racemic mixture, racemisation and resolution. Threo and erythro; D and L; CIP Rules: R/S (for up to 2 chiral carbon atoms) atropisomerism. (up to two C=C systems). Geometrical isomerism in alicyclic compounds.

Unit-III: **12 Hrs**

Ionic equilibria: Ionic equilibria in aqueous solutions, strong and weak electrolytes – definition and examples. Ostwald's dilution law (to be derived) and its limitations (numerical problems). Activity and activity coefficients – definition and their relation. Mean ionic activity coefficients – ionic strength –determination and its calculation. Debye-Huckel theory of strong electrolytes (relaxation time effect, electrophoretic effect and viscous effect). Debye-Huckel-Onsagar equation (no derivation), Debye-Huckel limiting equation for activity coefficients (no derivation). Solvent system concept of acids and bases. Role of solvents in altering strengths of acids and bases. Hydrolysis of salts – derivation of hydrolysis constant and degree of hydrolysis of the salt of weak acid and weak base (ammonium acetate), effect of temperature on degree of hydrolysis.

Distribution Law: Nernst distribution law in liquid-liquid systems, distribution coefficient, statement of Nernst distribution law – verification of distribution law taking distribution of I_2 in H_2O and CCl_4 –limitations of the law, conditions for the validity of distribution law, association of the solute in one of the solvents, dissociation of the solute in one of the solvents, application of distribution law with respect to solvent extraction process (numerical problems).

Unit-IV: **12 Hrs**

Basic Thermodynamics: Definition of thermodynamic terms: system, surrounding etc. 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. Calculation of w. q. dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Temperature dependence of enthalpy, Kirchhoff's equation. Bond energies and applications of bond energies.

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. Mathematical expression for Freundlich's and Langmuir's adsorption isotherms. Applications of adsorption.

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. Adsorption isotherms.

Suggested Text Books:

1. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
2. Bahl, A. & Bahl, B.S. 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. Principles of Inorganic Chemistry by Puri, Sharma, Kalia

Reference Books:

1. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
2. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
3. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
4. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).

5. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
6. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
7. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

B19PC3050	**Mathematics-III**	**L**	**T**	**P**	**C**
Duration: 14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Differentiation, integration, basic concepts of differential equations, basic arithmetic and algebra.

Course Objectives:

1. Develop the knowledge about the subgroups and group homomorphisms.
2. Familiarize with the concept of higher order ordinary differential equations.
3. Understand the concept of Laplace transform.
4. Familiarize with Inverse Laplace transforms.

Course Outcomes:

1. Classify and generate subgroups and normal subgroups.
2. Solve higher order linear differential equations.
3. Apply the knowledge of Laplace transform.
4. Discuss inverse Laplace transforms.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3050	CO1	3	3	3	3			1	2	3	3
	CO2	3	3	3	3			1	2	3	3
	CO3	3	2	2	2			2	2	3	3
	CO4	3	2	2	2			2	2	3	3

Course Content:

Unit-I: Group Theory-2 **12 Hrs**

Subgroups-Theorems on subgroups (**with proof**), problems Normal subgroups, Homomorphism, Isomorphism, Left and Right cosets, The kernal of a homomorphism.

Unit-II: Differential Equations-2 **12 Hrs**

Higher order linear differential equations, Solution of homogeneous linear differential equations of order *n* with constant coefficients, Solution of the non-homogeneous linear differential equations with constant coefficients by means of polynomial operators, Method of undetermined coefficients, Method of variation of parameters, Linear differential equations with non-constant coefficients, Cauchy-Euler equation, System of linear differential equations, Solution of a system of linear equations with constant coefficients.

Unit-III: Laplace Transforms **12 Hrs**

Definition and basic propertiesof Laplace transform of some common functions and standard results, Laplace transform of periodic functions, Laplace transforms ofderivatives and the integral of functions, Laplace transforms of the Heaviside/Unit step function, Convolution theorem (with proof)and problems.

Unit-IV: Inverse Laplace Transforms **12 Hrs**

Inverse Laplace transforms, Properties of inverse Laplace transform, Solution of differential equations using Laplace transforms, Convolution theorem, Solution of differential equations using Laplace transforms.

Text Books:

1) John B Fraleigh, The first course in Abstract Algebra, Narosa Publishing House.
2) I N Herstein, Topics in algebra, Wiley easter.
3) G K Ranganath, Text book of B.Sc., Mathematics, Revised ed. New Delhi, India: S Chand and Co., 2011.
4) Raisinghania M D., Laplace and Fourier Transforms. New Delhi, India: S. Chand and Co. Ltd., 1995.

Reference Books:

1) S Narayanan and T K ManicavachogamPillay, Differential Equations, S V Publishers Private Ltd., 1981.
2) Erwin Kreyszig, Advanced Engineering Mathematics, 8th ed. New Delhi, India: Wiley India Pvt. Ltd., 2010.
3) Murray R, Spiegel L: Laplace Transforms (Schaum Series).

B19PC3060	**Physics in Everyday Life**	**L**	**T**	**P**	**C**
Duration:14 Wks		**4**	**0**	**0**	**4**

Prerequisites:

Basics of Physics and its importance in everyday life.

Course Objectives:

1. To have a clear understanding of the working and principles of home appliances
2. To understand phenomena of light and its application
3. To know the formation of clouds and cyclic process.
4. To implement and understand properties of smart materials for their application in various places.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

1. Postulate the basics of principles and working of electrical devices in our daily life
2. Explain the physical phenomena of sensors and electronic components
3. Analyse the formation of clouds and cyclic process
4. Compresence the properties of smart materials

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3060	**CO1**	**3**	**3**	**3**	**3**			**1**	**2**	**3**	**3**

	CO2	**3**	**3**	**3**	**3**			**2**	**2**	**3**	**3**
	CO3	**3**	**2**	**2**	**2**			**2**	**2**	**3**	**3**
	CO4	**3**	**3**	**2**	**2**			**2**	**2**	**3**	**3**

Course Contents:

UNIT-I: Gadgets in Daily Life **12 hrs**

Principle of levers, Frictional force, Electric fans, motors and bulbs, Washing Machines, Kitchen Electronics, Microwave, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart elevator, Smart floor, Smart locks, batteries. working principle of Microphone, Loud speaker, AM and FM receiver and radio, Basics of Smart phones and Digital Cameras

UNIT-II: Applications of Electromagnetic Waves **12 hrs**

Introduction to Electromagnetic waves and applications, Scattering of light in atmosphere, LASER and application, Hologram and 3D pictures, Optical fibres and communication system, RADAR & navigation and its applications, Display systems: CRT, LCD, LED and Photodiode, Mobile communication.

UNIT-III: Atmosphere **12 hrs**

Clouds: Introduction, Atmospheric thermodynamics, Vapor pressure, Formation of Cloud droplets, Lightning, electrical properties of the fair, weather atmosphere, electrical properties of a thunderstorm, Benjamin Franklin's famous kite experiment, cloud-to-ground lightning, Intra-cloud lightning, other forms of lightning, thunder, lightning rods, lightning safety.

UNIT-IV: Advanced Materials **12 hrs**

Super conductors, Semiconducting materials, physical principles of optical materials (Polaroids, goggles), dielectrics, piezoelectric, ferroelectric, pyroelectric, magnetic materials and their applications, Motion Sensors, Thermal Sensors and Image Sensors, and Water Level Sensors.

Recommended Books:

1. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2018.
2. Jordan Frith, "Smartphones as Locative Media ", Wiley. 2014
3. M. I. Skolnik —Introduction to Radar Systems, Tata McGraw Hill 2006.
4. A Short Course in Cloud Physics; R. R. Rogers
5. The Physics of Clouds; B. J. Mason
6. Dennis C Brewer, " Home Automation", Que Publishing 2013
7. T. Pratt, C. Bostian and J. Allnutt; —Satellite Communications, John Wiley and Sons, Second Edition., 2003
8. S.P Basavaraju- Engineering Physics -2016.

B19PC3070	Chemistry in daily life	**L**	**T**	**P**	**C**
Duration:14 Wks		**4**	**0**	**0**	**4**

Prerequisites:

Basic knowledge of physics, chemistry and biology. Ores and minerls, milk products, oils and fats.

Course Objectives:

1. Introduce the concept and discipline of chemistry in our daily life.

2. Acquire the knowledge of composition of milk products, beverages, additives, contaminants, flavouring agents used in day to day life.
3. Classification of pigments, dyes and drugs. Methods of application of dye to the fabrics.
4. Discuss the structure and fuctions of various drugs like paracetamol, aspirin, etc.,
5. Develop the skill of chemical processes that can be used to run our daily life.

Course Outcomes:

1. Explain the composition of dairy products, beverages, food additives and flavours
2. Classify typical pigments, Dyes, Drugs, Oils, fats and Soaps & Detergents.
3. Predict the percentage of organic matter present in the soil and deduce the factors affecting decomposition of organic matter in soul.
4. Identify the physical properties of soil and its importance in soil fertility.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3070	**CO1**	**3**	**2**	**2**	**1**		**2**		**3**	**2**	**3**
	CO2	**3**	**2**	**2**	**2**		**2**		**3**	**2**	**2**
	CO3	**3**	**2**	**2**	**1**		**2**		**3**	**2**	**3**
	CO4	**3**	**3**	**2**	**2**		**3**	**2**	**3**	**2**	**3**

Course Contents:

UNIT-I **12 Hrs**

Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk.

Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, estimation of methyl alcohol in alcoholic beverages.

Food additives, adulterants and contaminants: Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose and sodium cyclamate.

Flavours: Vanillin, alkyl esters (fruit flavours) and monosodium glutamate. Artificial food colorants: Coal tar dyes and non-permitted colours and metallic salts. Analysis of pesticide residues in food.

UNIT-II **12 Hrs**

Pigments & Dyes: a) White pigments (white lead, ZnO, lithopone, TiO2). Blue, red, yellow and green pigments. b) Colour and constitution (electronic concept) of dye. Classification of dyes. Methods of applying dyes to the fabrics. A general study of azo dyes, Mordant brown, Congo red and methyl organe.

Drugs: Classification and nomenclature. Structure and function of: Analgesics – aspirin, paracetamol. Anthelmentic drug: mebendazole. Antiallergic drug: Chloropheneramine maleate. Antibiotics: Pencillin V, Chloromycetin, Streptomycin. Anti-infalmmatory agent: Oxypheno-butazone. Antimalarials: Primazuine phosphate & Chloroquine.

Oils and fats: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like aregemone oil and mineral oils.

Soaps & Detergents: Structures and methods of use of soaps and detergents.

UNIT-III **12 Hrs**

Soil forming Rocks and Minerals: Definition of soil, definition, classification and properties of rocks and minerals. Weathering: Definition and types, factors responsible for weathering

Soil profile: Definition, soil horizons and typical diagram of soil profile. Soil components- inorganic and organic components in soil-micro and macronutrients.

Soil fertility and productivity: Definition, comparison between fertility and productivity and factors affecting them.

Soil physical properties and their importance in soil fertility: 1. Soil texture and mechanical analysis of soil. 2. Soil structure. 3. Soil density and porosity. 4. Soil color. 5. Soil temperature 6. Soil aeration.

UNIT-IV **12 Hrs**

Soil water: Importance, retention and movement of water in soil. Loss of water in soil and plants.

Soil organic matter: Sources, composition and decomposition of soil organic matter. Influence of soil organic matter. Factors affecting decomposition of organic matter.

Ion exchange properties of soil: Introduction, cation exchange process in soil. Anion exchange.

Soil reaction and buffering of soil: Definition, factors controlling soil pH. Relation of soil pH and nutrient availability. Buffer capacity of soil.

Feritlisers: Classification of Fertilizers- Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures. Manufacture and general prosperities of Fertilizer products- Urea and DAP.

Reference Books:

1. B. K. Sharma: introduction to Industiral Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry by Ashtoush Kar.
3. Drugs and Pharamaceutical Sciences Series, Marcel Dekker, Vol. II, INC, New York.
4. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E.Cox and pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998) 6. Physical Chemistry – P l Atkins and J. de Paula – 7 th Ed. 2002, Oxford University Press.
6. Handbook on Feritilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.
7. Fundamental of soil science: Forth and Turk.
8. Principles of soil science: M. M. Rai.
9. Nature and properties of soil: Bookmann and Brady.
10. A textbook of soil science: Dr. J. A. Daji.

Course Code	Course Title	Course Type	L	T	P	C	Hrs/Week
B19PC3080	**Classical Optimization**	OE	4	0	0	4	4

Course Objectives:

The objective of this course is to make students to learn principles of optimization, To implement the optimization Concepts for the structural engineering problems. To evaluate different methods of optimization.

Course Outcomes:

On completion of this course, students are able to: • Achieve Knowledge of design and development of problem-solving skills. • Understand the principles of optimization. • Design and develop analytical skills. • Summarize the Linear, Non-linear and Geometric Programming • Understands the concept of Dynamic programming

Course Content:

UNIT-I: **12 Hrs**

Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints

UNIT-II: **12 Hrs**

Unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques

UNIT-III: **12 Hrs**

Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods.

UNIT-IV: **12 Hrs**

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different techniques

Reference Books:

1. Spunt, "Optimum Structural Design"- Prentice Hall
2. S.S. Rao, "Optimization – Theory and Practice"- Wiley Eastern Ltd.
3. Uri Krisch, "Optimum Structural Design"- McGraw Hill
4. Richard Bronson, "Operation Research"- Schaum's Outline Series
5. Bhavikatti S.S.- "Structural optimization using sequential linear programming"- Vikas publishing house.

B19PC3090	Physics Lab-III	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

This is a laboratory course which covers experiments related to simple harmonic motion waves, basic theory of light and optical phenomenon like diffraction, interference and polarization.

Course Objectives:

1. To visualise simple harmonic wave motions and verify the theories that govern them.
2. To visualise interference, diffraction and polarization of light.
3. To use different optical phenomenon in different applications.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

1. Explain the phenomenon related to simple harmonic motion waves.
2. Determine the thickness of thin objects, radius of curvature of a plano-convex lens by interference and diffraction.

3. Analyse observed optical phenomenon in nature.
4. Estimate the costant values related to sound.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3090	CO1	3	3	3	3				3	3	1
	CO2	3	3	2	1				1	2	2
	CO3	3	3	2	2			1	3	2	1
	CO4	3	3	3	1				3	3	3

Course Contents:

Any **Eight** of the Following Experiments

1. Kundt's tube experiment – Velocity of sound in air at room temperature.
2. Study of stationary wave on a stretched string – Determination of speed of the transverse waves over the sonometer wire.
3. Characteristics of microphone – loudspeaker system – Determination of Velocity of sound at room temperature.
4. Newton's rings – Determination of radius of curvature of a plano-convex lens.
5. Air wedge – Determination of thickness of a thin paper/diameter of a thin wire.
6. Helmholtz resonator – Determination of frequency of a tuning fork.
7. Diffraction grating – Determination of grating constant and wave length (minimum deviation method).
8. Diffraction at a straight wire – Determination of diameter of a wire.
9. Cauchy's constants using spectrometer.
10. Polarization – Determination of unknown concentration of sugar solution by graphical method using a polarimeter.
11. Determination of refractive indices of calcite and quartz crystal using spectrometer and sodium light.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S. Sudha. D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G. L. Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.

B19PC3X10	Chemistry Lab-III	L	T	P	C
Duration:14 Wks		**0**	**0**	**2**	**2**

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	PSO1	PSO2
B19PC3X10	CO1	1	2	1	1	1	1	1	1	2	1
	CO2	2	2	1	1	1	2	1	2	2	2
	CO3	1	2	1	2	2	2	1	1	1	1
	CO4	2	1	2	2	1	2	2	2	1	2

Course Contents:

Systematic semi-micro qualitative analysis of a mixture of two simple salts (with no interfering radicals). Including ionic reactions. The constituent ions in the mixture to be restricted to the following.

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^+.

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.

B19PC3X20	Mathematics Lab-III	L	T	P	C
Duration:14 Wks		0	0	2	2

Prerequisites:

Differentiation, integration, basic concepts of differential equations, basic arithmetic and algebra.

Course Objectives:

1. Understand normal subgroups using *Maxima* .
2. Solve higher order linear differential equations using *Maxima*.
3. Apply the knowledge of Laplace transform using *Maxima* .
4. Discuss inverse Laplace transforms using *Maxima*.

Course Outcomes:

1. Acquire knowledge in using *Maxima* to verify a normal subgroup, homomorphismof a group and isomorphism of a group.
2. Acquire proficiency in using *Maxima* to study differential calculus.
3. Demonstrate the use of *Maxima* to understand and interpret the concepts in Laplace transform.
4. Exihibit the fundamentals of inverse Laplace transform using *Maxima*.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC3X20	CO1	3	2	2	1			1	1	3	2
	CO2	3	2	2	1			1	1	3	3
	CO3	3	2	2	1			1	1	3	2
	CO4	3	2	2	1			1	1	2	3

Course Contents:

1. To verify whether a given subgroup is a normal subgroupor not.
2. To verify whether a given faction is a homomorphisom or not.
3. To verify a given onto homomorphison of a group is isomorphism or not.
4. To verify Lagrange's theorem.
5. To find left and right cost (examples).
6. To find the solution to the differential equation.
7. To find the Laplace transform of given function.
8. To find the inverse Laplace Transform of given function.
9. To solve ODE using Laplace Transform.
10. To find the solution to the differential equation.

Text Books:

1. SCILAB: A Practical Introduction to Programming and Problem Solving [Print Replica] Kindle Edition by Tejas Sheth (Author).
2. The Maxima Book Paulo Ney de Souza Richard J. Fateman Joel Moses Cliff Yapp 19th September 2004.

FOURTH – SEMESTER

B19PC4011	Language-II: Kannada	L	T	P	C
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

- PÀ£ÀßqÀ ¨sÁµÉAiÀÄ §UÉÎ ¥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.

Course Objectives:

£Á®ÌÄ ¸É«Ä¸ÀÖgïUÀ¼À°è ¸ÀªÀÄUÀæ PÀ£ÀßqÀ ¸Á»vÀåªÀ£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀ GzÉÝÃ±ÀªÀ£ÀÄß ºÉÆA¢zÉ. CzÀgÀAvÉ £Á®Ì£ÉAiÀÄ ¸É«Ä¸ÀÖgï£À°è ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÀå, ¹ÛçÃªÁ¢ ºÁUÀÄ £ÀªÉÇåÃvÀÛgÀ PÁªÀå, ««zsÀ ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ PÁzÀA§j ¸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.

1. ¨sÁµÉ, ¸Á»vÀå, EwºÁ¸À ªÀÄvÀÄÛ ¸ÀA¸ÀÌøwUÀ¼À£ÀÄß PÀ£ÀßqÀ, PÀ£ÁðlPÀPÉÌ ¸ÀA§A¢ü¹zÀAvÉ ¥ÀjZÀ¬Ä¸À¯ÁUÀÄvÀÛzÉ.
2. «zÁåyðUÀ¼À ¸ÀªÀðvÉÆÃªÀÄÄR ¨É¼ÀªÀtÂUÉUÉ C£ÀÄªÁUÀÄªÀAvÉ ºÁUÀÆ CªÀgÀ°è ªÀiÁ£ÀªÀ ¸ÀA§AzsÀUÀ¼À §UÉÎ UËgÀªÀ, ¸ÀªÀiÁ£ÀvÉ ªÀÄÆr¹, ¨É¼É¸ÀÄªÀ ¤nÖ£À°è ¥ÀoÀåUÀ¼À DAiÉÄÌAiÀiÁVzÉ.
3. CªÀgÀ°è ¸ÀÈd£À²Ã®vÉ, ±ÀÄzÀÞ ¨sÁµÉ, GvÀÛªÀÄ «ªÀÄ±Áð UÀÄt, ¤gÀUÀð¼À ¸ÀA¨sÁµÀuÉ, ¨sÁµÀt PÀ¯É ºÁUÀÆ §gÀºÀ PË±À®åUÀ¼À£ÀÄß ¨É¼É¸ÀÄªÀÀzÀÄ UÀÄjAiÀiÁVzÉ
4. ¸ÀàzsÁðvÀäPÀ ¥ÀjÃPÉëUÀ½UÉ C£ÀÄPÀÆ®ªÁUÀÄªÀAvÀºÀ «µÀAiÀÄUÀ¼À£ÀÄß UÀªÀÄ£ÀzÀ°èlÄÖPÉÆAqÀÄ ¸ÀÆPÀÛ ¥ÀoÀåUÀ¼À£ÀÄß DAiÉÄÌ ªÀiÁrPÉÆ¼Àî¯ÁVzÉ.

Course Outcomes:

ºÉÆ¸ÀUÀ£ÀßqÀ ¸Á»vÀå ¥ÀæPÁgÀUÀ¼ÁzÀ £ÀªÀå-£ÀªÉÇåÃvÀÛgÀ PÁªÀå, ««zsÀ ¯ÉÃR£ÀUÀ¼ÀÄ ºÁUÀÄ PÁzÀA§j ¸Á»vÀå PÀ°PÉAiÀÄ ªÀÄÆ®PÀ PÁ®zÀ ¹ÜvÀåAvÀgÀUÀ¼À£ÀÄß CzÀgÀ M¼À£ÉÆÃl UÀ¼À£ÀÄß ¨É¼É¸ÀÄvÀÛzÉ.

1. ¸ÁªÀiÁfPÀ, gÁdQÃAiÀÄ, zsÁ«ÄðPÀ, ¸ÁA¸ÀÌøwPÀ ºÁUÀÆ °AUÀ¸ÀA§A¢ü «ZÁgÀUÀ¼ÉqÉ UÀªÀÄ£ÀºÀj¸ÀÄªÀÀzÀgÉÆA¢UÉ «zÁåyðUÀ¼À°è ZÀZÁð ªÀÄ£ÉÆÃ¨sÁªÀªÀ£ÀÄß ¨É¼ÉAiÀÄÄvÀÛzÉ.
2. fÃªÀ£ÀzÀ°è §gÀÄªÀ C©ü¥ÁæAiÀÄ ¨ÉÃzsÀUÀ¼ÀÄ, ¸ÀªÀÄ¸ÉåUÀ¼À£ÀÄß DzsÀÄ¤PÀ ¸ÀAzÀ¨sÀðzÀ°è ªÀiÁ£À«ÃAiÀÄvÉAiÉÆA¢UÉ ¤ªÀð»¸ÀÄªÀAvÉ ¥ÉæÃgÉÃ¦¸ÀÄvÀÛzÉ.
3. ¸ÁªÀiÁfPÀ CjªÀÅ ªÀÄÆr¸ÀÄvÀÛzÉ.
4. 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	PSO1	PSO2
B19PC4011	CO1					2	3				
	CO2					2	3				
	CO3						3				
	CO4							3	2		

Course Contents:

Unit I **£ÀªÀå-¹ÛçÃªÁ¢ PÀ«vÉUÀ¼ÀÄ** 12 Hrs

1.	PÀlÄÖªÉªÀÅ £ÁªÀÅ	UÉÆÃ¥Á®PÀÈµÀÚ CrUÀgÀÄ
2.	§Ä¢Þ ªÀAvÀjUÉ PÀ£À¸ÀÄ ©zÀÝgÉ	J.PÉ.gÁªÀÄ£ÀÄd£ï
3.	PÀÄjUÀ¼ÀÄ ¸Ágï PÀÄjUÀ¼ÀÄ	¤¸Ágï CºÀªÀÄzï
4.	CPÀÌ ºÉÃ½zÀÄ	¸À. GµÁ

Unit II **zÀ°vÀ-§AqÁAiÀÄ** 12 Hrs

1.	£À£Àß PÀªÀ£ÀUÀ¼À°è ºÀÄqÀÄPÀ¢gÀÄ £À£Àß	ZÀA¥Á
2.	d£À¥ÀzÀ PÀxÉUÀ¼À gÁPÀë¸À	ZÀAzÀæ±ÉÃRgÀ PÀA¨ÁgÀ
3.	zÀ°vÀgÀÄ §gÀÄªÀgÀÄ zÁj©r	¹zÀÞ°AUÀAiÀÄ
4.	PÀlÖqÀzÀ PÉ®¸ÀUÁgÀgÀÄ	JZï J¸ï ²ªÀ¥ÀæPÁ±À

Unit III **¯ÉÃR£ÀUÀ¼ÀÄ** 12 Hrs

1.	ºÀ¹gÀÄ ºÉÆ¸ÀPÀÄªÀ UÀtÂUÀ¼ÀÄ	AiÀÄ®è¥Àà gÉrØ
2.	ªÀZÀ£ÀPÁgÀgÀ «ZÁgÀ PÁæAw	f.J¸ï.J¸ï
3.	eÁUÀwÃPÀgÀtzÀ »£Éß¯ÉAiÀÄ°è UÁA¢üÃfAiÀÄ ¥Àæ¸ÀÄÛvÀvÉ	¹. £ÁUÀtÚ
4.	ZÁªÁðPÀgÀÄ : MAzÀÄ n¥ÀàtÂ	¦ J£ï gÀAUÀ£ï

Unit IV **PÁzÀA§j** 12 Hrs

1.	¸ÀA¸ÁÌgÀ	AiÀÄÄ.Dgï. C£ÀAvÀªÀÄÆwð

¥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. ºÀA¥À £ÁUÀgÁdAiÀÄå, ¸ÁAUÀvÀå PÀ«UÀ¼ÀÄ, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2010
4. gÀAeÁ£ï zÀUÁð, ±ÀgÀtgÀ ¸ÀªÀÄUÀæ PÁæAw, ¥ÀæPÁ±ÀPÀgÀÄ. ¯ÉÆÃ»AiÀÀiÁ ¥ÀæPÁ±À£À, §¼Áîj. 2015
5. ªÀ¹µÀ×., gÀvÁßPÀgÀªÀtÂðAiÀÄ ¨sÀgÀvÉÃ±À ªÉÊ¨sÀªÀ, ¥ÀæPÁ±ÀPÀgÀÄ ZÉÃvÀ£À §ÄPï ºË¸ï, ªÉÄÊ¸ÀÆgÀÄ. 1999

6. qÀ. CgÀ«AzÀ ªÀiÀ®UÀwÛ, ¸Á»vÀå ¸ÀA¸Àløw ªÀAvÀAÛ zÀ°vÀ ¥ÀææeÉÕ, ¥ÀæPÁ±ÀPÀgÀA PÀ£ÀßqÀ ¸Á»vÀå ¥ÀjµÀvÀÄÛ, ¨ÉAUÀ¼ÀÆgÀÄ. 2014
7. qÁ. F.J¸ï. DªÀÄÆgÀ, PÀ£ÀßqÀ PÀxÀ£À ¸Á»vÀå : PÁzÀA§j, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2016
8. QÃvÀð£ÁxÀ PÀÄvÀðPÉÆÃn, PÀ£ÀßqÀ ¸Á»vÀå ¸ÀAUÁw, ¥ÀæPÁ±ÀPÀgÀÄ PÀÄvÀðPÉÆÃn ªÉÄªÉÆÃjAiÀÄ¯ï læ¸ïÖ, zsÁgÀªÁqÀ. 2009
9. ±ÁªÀÄgÁAiÀÄ vÀ.¸ÀÄ., PÀ£ÀßqÀ ¸Á»vÀå ZÀjvÉæ, ¥ÀæPÁ±ÀPÀgÀÄ vÀ¼ÀÄQ£À ªÉAPÀtÚAiÀÄå ¸ÁägÀPÀ UÀæAxÀªÀiÁ¯É, ªÉÄÊ¸ÀÆgÀÄ -2014
10. ¸ÀA. qÁ! ¹. Dgï. ZÀAzÀæ±ÉÃRgï, ªÀÄÄAzÁ¼ÀÄvÀ£ÀzÀ ®PÀëtUÀ¼À£ÀÄß ¨É¼É¹PÉÆ¼ÀÄîªÀÅzÀÄ ºÉÃUÉ?, ¥ÀæPÁ±ÀPÀgÀÄ £ÀªÀPÀ£ÁðlPÀ ¥À©èPÉÃµÀ£ïì ¥ÉæöÊªÉmï °«ÄmÉqï. 2010
11. DzsÀÄ¤PÀ PÀ£ÀßqÀ PÁªÀå ¨sÁUÀ-2, PÀÄªÉA¥ÀÄ PÀ£ÀßqÀ CzsÀåAiÀÄ£À ¸ÀA¸ÉÜ, ªÉÄÊ¸ÀÆgÀÄ «±Àé«zÁå¤®AiÀÄ, ªÉÄÊ¸ÀÆgÀÄ. 2004
12. ²ªÀgÀÄzÀæ¥Àà f.J¸ï. PÀ£ÀßqÀ ¸Á»vÀå ¸À«ÄÃPÉë, ¥ÀæPÁ±ÀPÀgÀÄ ¸Àé¥Àß §ÄPï ºË¸ï, ¨ÉAUÀ¼ÀÆgÀÄ. 2013

B19PC4012	Language – II: Hindi	L	T	P	C
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

- अध्येता को, हिन्दी खंडकाव्य का संक्षिप्त ज्ञान आवश्यक है |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

1. सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |
2. साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |
3. समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |
4. साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है |

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4012	CO1					2	3	2			
	CO2					2	2	3			

	CO3					**3**	**3**	**3**			
	CO4					**3**	**2**	**3**			

Course Contents:

इकाई – 1: खंड काव्य – संशय की रात - नरेश मेहता **12 hrs.**

कवि परिचय
प्रथम सर्ग
द्वितीय सर्ग

इकाई – 2: खंड काव्य – संशय की रात **12 hrs.**

तृतीय सर्ग
चतुर्थ सर्ग

इका ई – 3: खंड काव्य – संशय की रात **12 hrs.**

पंचम सर्ग
छठा सर्ग
सप्तम सर्ग

इकाई – 4: व्याकरण : अलंकार , **सिनिमा रिव्यू** **12 hrs.**

व्याकरण : अलंकार
सिनिमा रिव्यू :
दंगल ,हिन्दी मीडियम, सत्याग्रह और चेक दे इंडिया |

सन्दर्भ ग्रन्थ :

1. संशय की एक रात – नरेश मेहता
2. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
3. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
4. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
5. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
6. भारतीय संस्कृति के आधार - विद्यानिवास मिश्रा
7. रामायण की कहानियाँ - हर्षा शर्मा
8. रस छंद और अलंकार - कृष्णदेव शर्मा और सुरेश अग्रवाल

B19PC4013	**Language-II: Additional English**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To ensure the development of the linguistic prowess of the students
2. To motivate the students to appreciate literature

3. To help students build strong language fundamentals
4. To promote an appreciable reading habit among the students

Course Outcomes:

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 vocabulary range
3. Critically analyse a piece of prose or poetry
4. Express 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	PSO1	PSO2
B19PC4013	CO1					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Contents:

UNIT – I **12 Hrs**

John W. May – Narcissus; W.B. Yeats – The Second Coming; Devdutt Pattanaik - *Shikhandi and the Other Stories They Don't Tell you* (Extracts); Iravati Karve – *Yuganta* (Extract)

UNIT – II **12 Hrs**

Nissim Ezekiel – Night of the Scorpion; Langston Hughes – Mother to Son; Vijay Dan Detha – Double Life; Kate Chopin – The Story of an Hour; Henrik Ibsen – *A Doll's House* (Extract)

UNIT – III **12 Hrs**

Edgar Allan Poe – The Raven; Bram Stoker – A Dream of Red Hands; Satyajit Ray – Adventures of Feluda (Extract); Stephen King - Gramma

UNIT – IV **12 Hrs**

The Dalai Lama – The Paradox of Our Times; Kamala Wijeratne – To a Student
Sudha Murthy – In Sahyadri Hills, a Lesson in Humility; Booker T. Washington – Extract from *Up from Slavery* (Chapter 3: The Struggle for Education); Frigyes Karinthy – *Refund*

Reference Books:

1. Finneran, Richard J. *The Collected Works of W.B. Yeats*(Volume I: The Poems: Revised Second Edition). Simon & Schuster, 1996.
2. Pattanaik, Devdutt. *Shikhandi: Ánd Other 'Queer' Tales They Don't Tell You*. Penguin Books, 2014.
3. Karve, Irawati. *Yuganta: The End of an Epoch*. Orient Blackswan, 2007.
4. Ezekiel, Nissim. *Collected Poems* (With A New Introduction By John Thieme). OUP, 2005.
5. Hughes, Langston. *The Collected Poems of Langston Hughes*. Vintage, 1995.
6. Chopin, Kate. *The Awakening and Selected Stories of Kate Chopin*. Simon & Schuster, 2004.
7. Ibsen, Henrik. *A Doll's House*. Maple Press, 2011.

8. Poe, Edgar Allan. *The Complete Poetry of Edgar Allan Poe*. Penguin USA, 2008.
9. Stoker, Bram. *Dracula*. Fingerprint Publishing, 2013.
10. Ray, Satyajit. *The Complete Adventures of Feluda* (Vol. 2). Penguin Books Ltd., 2015.
11. Lama, Dalai. *Freedom In Exile: The Autobiography of the Dalai Lama of Tibet*. Little, Brown Book Group, 1998.
12. Murthy, Sudha. *Wise and Otherwise: A Salute to Life*. Penguin India, 2006.
13. Wsahington, Booker T. *Up from Slavery*. Infinity, 2015

B19PC4020	**Communicative English-II**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Knowledge of intermediate English Grammar and LSRW skills.

Course Objectives:

1. To attune young minds to concerns and issues which have a broad and wide scope of use and application to life
2. To acquire a functional use of language in context
3. To equip students to deliver formal and informal oral presentations to a variety of audiences in multiple contexts
4. To enable students to construct effective written message in various formats and styles
5. To inculcate the habit of reading and writing leading to effective and efficient communication

Course Outcomes:

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

1. Demonstrate ethical and political responsibilities in taking cognizance of issues relating to society, environment and media
2. Develop a process-oriented approach to writing
3. Make use of grammatical skills developed during the course aptly
4. Utilize the target language effectively to focus on interpersonal skills and develop a good Command over the language

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4020	CO1					3	3	3	2		
	CO2					3	3	3	3		
	CO3					3	3	3	2		
	CO4					3	3	3	2		

Course Contents:

UNIT –I **12 Hrs**

Remedial Grammar: Questions & Negatives; Questions Tags**; Writing Skills:** Email Writing**; Activities:** Group Discussions**; Literature:** Alphonse Daudet - The Last Lesson

UNIT – II **12 Hrs**

Remedial Grammar: Past Simple & Past Perfect; **Writing Skills:** Report Writing**; Activities:** Book & Movie Reviews; **Literature:** Lord Alfred Tennyson – Ulysses

UNIT – III **12 Hrs**

Remedial Grammar: Present & Past Passive; Conditionals; **Writing Skills:** Creative Writing**; Activities:** Role Plays**; Literature:** O. Henry – The Gift of the Magi

UNIT – IV **12 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.

B19PC4030	Electricity and Magnetism	L	T	P	C
Duration:14 Wks		2	1	0	3

Prerequisites:

Basics of electricity and magnetism.

Course Objectives:

1. Describe how static electricity is produced and list examples where its effects are observed.
2. Explain electrostatic induction and polarization.
3. Describe how magnetism is produced and list examples where its effects are observed.
4. Identify the connection between electricity and magnetism.
5. Understand how to do vector calculations including: vector addition, cross products, dot (scalar) products

Course Outcomes:

On completion of this course the student will be able to:

1. Calculate the force on a charged particle
2. Explain the method of measuring voltage and frequency using CRO
3. Explain the response of LR, CR and LCR circuits frequencies.
4. Explain Anderson’s bridge, thermocouple and self-inductance of solenoid

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4030	CO1	3	2	1	1			1	3	3	2
	CO2	3	2	3	2				2	3	2
	CO3	3	3	3	3			2	3	3	3
	CO4	3	2	2	2			2	2	3	2

Course Contents:

UNIT-I **12 hrs**

Electrostatics: Mechanical force and electric pressure on a charged surface. The path traced by a charged particle in uniform electric field. The attracted disc electrometer-construction, theory and applications.

Electrical measurement: C.R.O: construction & working, Measurement of voltage and frequency using a C.R.O.

Galvanometers: Moving coil ballistic galvanometer-construction, theory and derivation, damping correction, current and charge sensitivity, Helmholtz galvanometer – Theory.

UNIT-II **12 hrs**

Alternating current: R.M.S. values. Response of LR, CR and LCR circuits to sinusoidal voltages (discussion using the complex analysis). Series and parallel resonance-half-power frequency, band-width and Q-factor. Power in electrical circuits- power factor.

Filters: High-pass and low-pass filters with LR and CR combinations. Expression for cut-off frequency. Band pass filters.

UNIT-III **12 hrs**

Inductance and Thermo-electricity: Anderson's bridge; Mutual inductance; Calculation of the mutual inductance of a pair of coils; the thermocouple, Seebeck, Peltier and Thomson effects. Thermodynamic theory of thermoelectric effect. The law of intermediate metals and the law of intermediate temperatures. Applications - Calculation of the self-inductance of a solenoid.

UNIT-IV **12 hrs**

Electromagnetism: Scalar and vector fields; the gradient of a scalar field; the divergence and curl of a vector field. The physical significance of gradient. The divergence and curl, Statement of theorems of Gauss and Stokes. Concept of dipole. Ampere's circuital law. Current loop as a dipole. The torque on a dipole. Maxwell's field equations (Quantative). Wave equation for the field vectors. Poynting vector (no derivation). Plane electromagnetic waves–Helmholtz equation, Transverse nature, intrinsic impedance, and wave equation for dielectric.

Books Recommended:

1. Halliday/Resnick/Walker: Fundamentals of Physics, 8^{th} edition, John Wiley & Sons (Asia) Pte. Ltd.

2. K. K. Tewari: Electricity and magnetism, Reprint 2007, S. Chand Co. Ltd., New Delhi. B. B. Laud: Electrodynamics, Wiley Eastern Limited, New Delhi.
3. David. J. Griffiths: Introduction to Electrodynamics, 3rd edition, Prentice-Hall of India Private limited, New Delhi.
4. W.H. Hayt and J. A. Buck: Engineering Electromagnetism, 6th edition, Tata Mc Graw Hill, New Delhi.
5. V. K. Mehta & Rohit Mehta: Principles of Electronics, 11th edition, S. Chand & Co. Ltd., New Delhi.
6. BrijLal and N. Subrahmanyam: A text book of Electricity and Magnetism, 19th edition-Ratan Prakashan Mandir, Educational and University Publishers, Agra.
7. A.B. Bhattacharya, R. Bhattacharya, Under Graduate Physics, Volume II, New Central Book Agency (P) Ltd., Kolkata.
8. D.N. Vasudeva: Fundamentals of Magnetism and Electricity, 12th edition- S. Chand and Co. Ltd., New Delhi.

B19PC4040	Chemistry –IV	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Periodic table, Organic functional groups, Thermodynamics 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	PSO1	PSO2
B19PC4040	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).

Acid Base Concepts: Introduction to HSAB concepts.

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. Liquid SO_2-reasons for the solvent properties.

Organometallic Compounds: Definition with example, organo zinc compounds – preparation of diethylzinc and its applications.

Organolithium Compounds: Preparation and synthetic applications.

UNIT-II **12 Hrs**

Ethers: Williamson ether synthesis, reactions – cleavage and auto-oxidation-Ziesel's method.

Epoxides: Synthesis by Darzen's method. Acid and base catalyzed opening of epoxides.

Crown ethers: Introduction with examples.

Carbonyl Compounds: Distinguish between aldehydes and ketones – oxidation ($K_2cr_2o_7$ and reduction (H_2Pt, $LiAlH_4$) method. Addition of alcohols- formation of hemiacetal and acetal. Condensation with NH_2OH and 2, 4-DNP.Mechanism of aldol condensation, Perkins reaction, Cannizzaro reaction, Claisen condensation, Knovenagelreaction.

Reduction: Reduction by LiAlH4 and NaBH4. Mannich reaction. Mechanisms of Clemmensen and Wolff- Kishner reductions.

Carboxylic acids: Definition, classification with examples. Synthesis by Arndt-Eistert reaction.

Hydroxy acids: Synthesis of lactic, citric and tartaric acids. One method each and their importance.

Amines: Definition, classification with example. Distinction tests for 1°, 2°, 3° amines (acetylation and Hoffmann's exhaustive methylation. Action of nitric acid on different amines. Both aliphatic and aromatic 1°, 2°, 3° amines) basicity of amines, Hoffmann-Martiusrearrangement.

UNIT-III **12 Hrs**

Second Law of Thermodynamics: Limitations of First Law of Thermodynamics – need for II Law of thermodynamics, spontaneous, non-spontaneous and equilibrium processes (definitions and examples for each), 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)

Free Energy: Helmholtz and Gibb's free energy – their definitions and their relationship, Gibb's – Helmholtz equation at constant pressure and volume (derivations), thermodynamic criteria of equilibrium and spontaneity, Claussius – Clappeyron equation(differential form to be derived), integrated form of Claussius – Clappeyron equation (to be assumed) and its applications (enthalpy of vapourization, boiling point and freezing point at different temperatures), (numerical problems on these applications), Van't Hoff's reaction isotherms and isochore equations (derivation).

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. Application of Kohlarausch's Law in calculation of conductance of weak electrolytes at infinite dilution. Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids determination of solubility product of sparingly soluble salts.

Reference Books:

1. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
2. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. B.S. Bahl, A. Bhal, G. D. Tuli, Essentials of Physical Chemsitry, S. Chand & Company
4. Edition 2006.
5. Gurudeep Raj, Advanced Physical Chemistry, Goel Publication
6. A Text book of Organic Chemistry M. K. Jain S. Chand & Company.
7. A Text book of Organic Chemistry Bhal & Bhal S. Chand & Company.
8. A Text book of Organic Chemistry P. L. Soni S. Chand & Company.
9. Principles of Inorganic Chemistry Puri, Sharma & Kalia Shobhanlal Nagin Chand Co.
10. A Text book of Inorganic Chemistry Gurudeep Raj.
11. Concise Inorganic Chemistry J. D. Lee B-Block Well Science Ltd.
12. A Text book of Inorganic Chemistry Sathya Prakash & others.

B19PC4050	**Mathematics –IV**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**1**	**0**	**3**

Prerequisites:

Differentiation, integration, basic concepts of arithmetic and algebra.

Course Objectives:

1. Familiarize with the concept of differential calculus.
2. Uunderstand the concept of sequences.
3. Uunderstand the concept of series of real numbers.
4. Familiarize with vector calculus.

Course Outcomes:

1. Apply the concept of limits, continuity, and differentiability of a function at a point.

2. Discuss the different types of sequences.
3. Discuss the nature of series of real numbers.
4. Apply the knowledge of vector calculus.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4050	CO1	**3**	**3**	**3**	**3**			**1**	**3**	**3**	**3**
	CO2	**3**	**2**	**1**	**2**			**1**	**2**	**3**	**3**
	CO3	**3**	**2**	**2**	**2**			**1**	**2**	**3**	**3**
	CO4	**3**	**3**	**3**	**3**			**1**	**3**	**3**	**3**

Course Contents:

Unit-I: Differential Calculus-4 **12 Hrs**
Limits and continuity, L-Hospital rule, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Maclaurin's series.

Unit-II: Sequences of Real Numbers **12 Hrs**
Definition of a sequences, Bounded sequences, Limit of a sequences, Convergent, Divergent and Oscillatory sequences, Monotonic sequences and their properties, Cauchy's criterion.

Unit-III: Series of Real Numbers **12 Hrs**
Definition of convergence, Divergence and oscillation of series, Properties of convergent series, Properties of series of positive terms, Geometric series, Tests for convergence of series, p-series, comparison of series, Cauchy's root test, D'Alembert's test, Raabe'stest, Absolute and conditional convergence, D'Alembert's test for absolute convergence, Alternating series, Leibnitz test, summation of binomial, Exponential and logarithmic series.

Unit-IV: Vector Calculus-1 **12 Hrs**
Velocity, Acceleration, Angle between two vectors, Tangential normal vector, Gradient, Divergence of a scalar point function and Curl of a vector point function, Directional derivative, Unit normal to a surface, Solenoidal and irrotational vectors, Physical interpretation of divergence and Curl of a vector point function.

Text Books:

1. Shanthi Narayan and P KMittal, Differential Calculus, Reprint. New Delhi: S. Chand & Company Ltd., 2011.
2. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed., New Delhi, India: S Chand and Company Ltd., 2011.

Reference Books:

1. S Narayanan &ManicavachogamPillay, Vector Algebra and Analysis, 4th ed.: S V Publishers, 1986.
2. RaisinghaniaMd, SaxenaHc, and DassHk, Simplified course in Vector Calculus, 1st ed. New Delhi, India: S. Chand and Company Ltd., 2002.
3. Maurice D Weir, Joel Hass and Frank R. Giordano, Thomas calculus, 11th Edition, Pearson Publications, 2008.

Course Code	Course Title	Course Type	L	T	P	C	Hrs/Week
B19PC4060	**Soft Skill Training**	RULO	1	1	0	2	3

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

B19PC4070	**Physics Lab - IV**	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

This is a laboratory course which covers experiments related to simple harmonic motion waves, basic theory of light and optical phenomenon like diffraction, interference and polarization.

Course Objectives:

1. Develop experimental skills and study practical applications of electricity and magnetism
2. Create and describe series and parallel LCR circuits
3. Study and analyse application of Ballistic galvanometer and CRO
4. Describe the properties of magnetism by plotting B-H Curve.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

1. Draw frequency response of circuits containing R, L and C components;
2. Verify the laws combination of capacitors
3. Design low pass and high pass filters for different frequency and quality factor.
4. Draw magnetic hysteresis and find coercive field and hysteresis loss

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4070	CO1	3	2	1	1			1	3	3	2
	CO2	3	2	3	2				2	3	2
	CO3	3	3	3	3			2	3	3	3
	CO4	3	2	2	2			2	2	3	2

Course Contents:

Any **Eight** of the Following Experiments

1. Anderson's Bridge – Determination of the self-inductance of the coil.
2. de-Sauty bridge – Verification of laws of combination of capacitances.
3. High resistance by leakage using BG or relevant method

4. BH using Helmholtz double coil galvanometer and potentiometer.
5. Capacity of a condenser using a BG.
6. LCR series circuit – Determination of L & Q factor.
7. Voltage triangle – Measurement of phase difference.
8. Low and High pass filters – Determination of the cut-off frequency.
9. LCR parallel circuit – Determination of L & Q factor.
10. To study the variation of X_C with f and determination of C.
11. Black box – Identification of L, C& R.
12. CRO – determination of voltage and frequency.
13. Determine the magnetic field at the center of the Solenoid.
14. Determine the Hall voltage.

B19PC4080	Chemistry Lab-IV	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

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**	**PSO1**	**PSO2**
B19PC4080	**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:

1. Hydrolysis of methyl Acetate or Ethyl Acetate at Constant temperature.
2. Potentiometric titration of $KMnO_4$.
3. Conductometric estimation of Strong Acid using Strong Base
4. Potentiometric titration of Fe.
5. Conductometric estimation of mixture of Acids.

6. Colorimeteric estimation of Cu^{2+} ion using NH_4OH as complexing agent.
7. Determination of percentage composition of sodium chloride solution by determining the miscibility temperature of phenol - water system.
8. Determination of disibution coefficient of iodine in water and carbon tetra chloride.
9. Determination of molecular weight of a polymer material by viscosity measurements (celluloseacetate/methyl acrylate).
10. Study of kinetics of reaction between $K_2S_2O_8$ and KI, second order, determination of rate constant.

Reference Books for Practicles

1. Khosla, B. D.; Garg, V. C. & Gulati, A. 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. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
5. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry.

B19PC4090	Mathematics Lab-IV	L	T	P	C
Duration:14 Wks		0	0	2	2

Prerequisites:

Differentiation, integration, basic concepts of arithmetic and algebra.

Course Objectives:

1. Acquire skill in solving problems on differential calculus using *Scilab*/*Maxima*.
2. Gain proficiency in using *Maxima* to solve problems of Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, and Taylor's Theorem.
3. Acquire proficiency in using *Maxima* to solve the concept of sequence and series of real numbers
4. Obtain skill in creating programs on vector calculus using *Scilab* and *Maxima*.

Course Outcomes:

1. Apply the concept of limits, continuity, and differentiability of a function at a point using *Maxima*.
2. Demonstrate the use of Maxima to understand and interpret the core concepts in sequences and series.
3. Discuss the nature of series of real numbers using *Maxima*.
4. Apply the knowledge of vector calculus.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC4090	CO1	3	2	2	1			1	1	3	2
	CO2	3	2	2	1			1	1	3	3

	CO3	**3**	**2**	**2**	**1**			**1**	**1**	**3**	**2**
	CO4	**3**	**2**	**2**	**1**			**1**	**1**	**2**	**2**

Course Contents:

1. To verify continuity of a function.
2. Evaluation of limits by L hospital's rule.
3. To verify Rolle's theorem for a given function.
4. To verify Lagrange's mean values theorem for a given function.
5. To verify Cauchy's mean values theorem for a given function.
6. To verify Taylor's theorem for a given function.
7. To verify whether given sequence is convergent divergent and oscillatory.
8. To verify whether given series is convergent, divergent and oscillatory.

Text Books:

1. SCILAB: A Practical Introduction to Programming and Problem Solving [Print Replica] Kindle Edition by Tejas Sheth (Author).
2. The Maxima Book Paulo Ney de Souza Richard J. Fateman Joel Moses Cliff Yapp 19th September 2004.

FIFTH-SEMESTER

B19PC5010	**Quantum Mechanics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**1**	**1**	**0**	**2**

Prerequisites:

Basic concept s of wave dualism and quantum mechanics.

Course Objectives:

1. To have a clear understanding of the principles of quantum mechanics
2. To understand the laws of quantum mechanics
3. To know the application of Schrodinger wave equations and quantum concepts
4. To implement and understand of vector atom model to explain the various models.

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the mathematical representations of particle Properties of Waves and analysis used in quantum mechanics.
2. Postulate the basics of quantum mechanics.
3. Apply Schrodinger wave equation for one dimensional problem like, particle in a box, hormonic oscillator etc.
4. Analyse the different atomic models by vector atom model.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5010	**CO1**	**3**	**3**	**2**	**3**	**2**				**2**	**1**
	CO2	**3**	**3**	**2**	**3**	**2**				**3**	**3**
	CO3	**3**	**3**	**1**	**3**	**2**				**3**	**2**
	CO4	**3**	**3**	**2**	**3**	**2**				**3**	**3**

Course Contents:

UNIT-I: Wave particle dualism **9 Hrs**

Introduction, Photoelectric Effect, Quantum Theory of Light, The Compton Effect; Expression, De-Broglie waves, Wave function, de Broglie Wave Velocity, Wave and Group velocities, G. P. Thomson's experiment, The Uncertainty principle and its applications, The Wave Particle Duality, problems.

UNIT-II: Schrödinger's Equation: **9 Hrs**

Introduction, Schrödinger's Equation: Time dependent form, Probability current, Expectation Values, Operators, Schrödinger's Equation: Steady-state form, Eigen values and Eigen functions and probability density, Problems.

UNIT-III: Applications of Quantum Mechanics: **9 Hrs**

Introduction, the particle in a box: energy quantization, wave functions, momentum Quantization, the Harmonic Oscillator-Energy level, the particle in a three-dimensional box quantum dots, tunneling effect; applications, problems.

UNIT-IV: Vector atom model: **9 Hrs**

Introduction to atomic models; Rutherford's; Bohr's; Sommerfeld's; vector atom model; Quantization principles; momentum and spin; Quantum numbers –Total quantum number, Orbital quantum number, Magnetic quantum number (qualitatively). Space quantization, Stern-Gerlach experiment, Zeeman effect – theories of normal and anomalous Zeeman effect, Paschen back effect-Qualitative only

Books Recommended:

1. Perspectives of Modern Physics-Arthur Beiser (McGraw-Hill Int.Edition)
2. Modern physics – R. Murugeshan (S. Chand & Co. XIth Revised edition)
3. Text Book of Quantum mechanics – Kakani & Chandaliya ((S. Chand & sons)
4. Quantum Mechanics – Chatwal and Anand (Himalaya Publishing)
5. Quantum Mechanics- Ghatak and Loknatha
6. Ghatak, A, Introduction to Quantum Mechanics, Macmillan India Ltd, 2000
7. Schiff, L. I., Quantum Mechanics, III Edition, McGraw Hill, 1968

B19PC5020	Chemistry –V	**L**	**T**	**P**	**C**
Duration:14 Wks		**1**	**1**	**0**	**2**

Prerequisites:

Knowledge of absorbate and adsorbent, polarity of solvents, Brags law, electromagnetic radiation, interaction of electromagnetic radiation with matter.

Course Objectives:

1. To impart basic knowledge about different Chromatographic techniques.
2. To introduce the principle involved in X-ray diffraction and crystallography.
3. To enhance the idea of different phase rules and diagrams of one and two component systems.
4. To introduce the basic aspects of spectroscopies such as Molecular spectroscopy (rotational spectroscopy, vibrational spectroscopy, and Raman spectroscopy) and photochemistry.

Course Outcomes:

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

1. Understand the basic principles and different types of chromatographic techniques and evaluate R_f value.

2. Define laws of crystallography and understand the importance of crystallography to solve the crystal structure.
3. Explain the Phase diagram of different component systems.
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	PSO1	PSO2
B19PC5020	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 Contents:

UNIT-I **9 Hrs**

Chromatography:

Introduction, classification of chromatographic techniques.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique.

Paper Chromatography: introduction, Principles, Rf values, experimental procedures, choice of paper and solvent systems, developments of chromatogram - ascending, descending and radial. Two-dimensional chromatography, 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. Applications.

Ion Exchange chromatography-separation of anions and cations,

HPLC: Basic principles and applications.

UNIT-II **9 Hrs**

Basics of Crystallography: Classification of solids, 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 (Numericals).

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.

UNIT-III **9 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 scattering, polarizability of the molecules, rotational Raman spectra, Comparision of Raman and IR.

UNIT-IV **9 Hrs**

Photochemistry: Beer-Lamberts law. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. Photoelectric cells.
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.
Laws of Photochemistry: Grotthuss-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. Photosensitization, photostationary equilibrium. Qualitative description of, Fluorescence, Phosphorescence, photosensitized reactions and energy transfer processes.

Reference Books:

1. Peter W. Atkins – Physical Chemistry, eighth Edition, New York, 2006, Chapters 10-15, page 320-5
2. Peter W. Atkins, Julio De Paula, Physical Chemistry for the Life Sciences, New York, 2011
3. Peter J. Larkin, IR and Raman Spectroscopy, Principles and Spectral Interpretation, Elsevier, 2011.
4. Basic concepts of Analytical Chemistry. S. M. Khopkar New Age International
5. Selected Topics in Inorganic Chemistry.Madan, Malik, Tuli S. Chand & Company.
6. Instrumental methods of Chemical analysis.B. K. Sharma Goel Publishing House.
7. Analytical Chemistry Willard, Meritind &Dean New Age Publications.
8. Instrumental methods of Chemical analysis H. H. Willard, L. L. Merrite, K. A. Dean& F. A. Kettle CBS Publishers.
9. Analytical Chemistry John.H. Chenady Saunders College, Publishing New York Tokyo.
10. Physical Chemistry R. P. Verma Pradeep Publication.
11. Kinetics of Chemical Reactions S. K. Jain Vishal publications, Jalandhar.New Delhi.
12. Physical Chemistry M. Kundan & S. K. Jain S. Chand & Company.
13. Text book of Physical Chemistry K. K. Sharma & C. K. SharmaVani Educational Books.

B19PC5030	**Mathematics –V**	**L**	**T**	**P**	**C**
Duration:14 Wks		**1**	**1**	**0**	**2**

Prerequisites:

Knowledge of trigonometry, geometry and calculus.

Course Objectives:

1. Learn to evaluate multiple integrals.
2. Learn to evaluate volume and surface integrals.
3. Understand the concepts in vector spaces and Linear Transformations.
4. Gain problems solving skills in solving vector spaces and linear transformations.

Course Outcomes:

1. Apply fundamental theorem to evaluate area, region and volume of geometrical bodies using Green's theorem, Stoke's theorem or Gauss divergence theorem.
2. Describe and manipulate vector spaces, subspaces and their bases.
3. Determine the kernel, image space and matrix representation of a linear transformation.
4. To become proficient in solving computational problems of linear algebra.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5030	CO1	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3

Course Contents:

Unit-I: Multiple Integral **9 Hrs**
Applications of Integral Calculus: Computation of length of arc, Plane area and surface area and volume of solids of revolutions for standard curves in Cartesian and Polar forms.
Evaluation of double integrals and triple integrals, Evaluation of double integrals over the given region, By changing the order of integration, By change of variables, Application to area and volume – illustrative examples.

Unit-II: Vector integration **9 Hrs**
Line integrals, Definition and problems, Surface and volume integrals, Green's Theorem, Stoke's and Gauss divergence theorem.

Unit-III: Linear Algebra – 1 **9 Hrs**
Vector spaces, General properties of vector spaces, Vector subspaces, Algebra of subspaces, and Linear combination of vectors. Linear span, linear sum of two subspaces, Linear independence and dependence of vectors, Basis of vector space.

Unit-IV: Linear Algebra – 2 **9 Hrs**
Finite dimensional vector spaces, Dimension of a vector space, Dimension of a subspace. Linear transformations, Linear operators, Range and null space of linear transformation, Rank and nullity of linear transformations.

Text Books:

1. Shanthi Narayan, Integral Calculus, Reprint. New Delhi: S. Chand and Company Ltd., 2004.
2. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed. New Delhi, India: S Chand and Company Ltd., 2011.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 8th edition. New Delhi, India: Wiley India Pvt. Ltd., 2010.
2. S Narayanan & M Pillay, Vector Algebra and Analysis, 4th edition.: SV Publisher, 1986.
3. Raisinghania Md, Saxena Hc, and DassHk, Simplified course in Vector Calculus, 1st ed. New Delhi, India: S. Chand and Company Ltd., 2002.

B19PC5040	Mathematics -VI	L	T	P	C
Duration:14 Wks		1	1	0	2

Prerequisites:

Knowledge of basics limits, continuity, differentiation, integration, matrices, determinants, and geometry.

Course Objectives:

1. Use computational tools to solve problems and applications of partial differential equations.
2. Get familiar with the theories on rings, integral domains and fields.
3. Introduce the basic concepts of abstract algebra
4. To understand the concepts of solid geometry and its applications in various fields.

Course Outcomes:

1. Formulation of PDE by eliminating arbitrary constants and functions, solve linear PDEs using Lagrange's auxiliary equation and solve nonlinear PDE's of first order by Charpit's method.
2. Familiarize with partial differential equations and its applications to standard problems like Heat, Wave and Laplace.
3. Explain the fundamental concepts of abstract algebra such as rings, fields and their role in modern mathematics and applied contexts.
4. Apply the concepts of solid geometry and to solve problems of various fields.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5040	CO1	3	3	2	3	2				3	3
	CO2	3	3	2	3	2				3	3
	CO3	3	3	2	3	2				3	2
	CO4	3	2	1	2	2				3	3

Course Contents:

Unit-I: Partial Differential Equations – 1 9 Hrs

Formation of partial differential equations by eliminating arbitrary constant and functions, Solution of non homogeneous PDE by direct integration, Solution of homogeneous PDE involving derivative with respect one independent variable only, Solution of Lagrange's linear PDE by the method of separation of variables.

Unit-II: Partial Differential Equations – 2 9 Hrs

Homogeneous linear equations with constant coefficients, Rules for finding complementary function, Rules for finding particular integral, Non homogeneous linear equations, Non linear equations of the second order.

Unit-III: Rings and Integral Domain 9 Hrs

Definition and basic properties, Fields, Integral domains, Divisors of zero and Cancellation laws, Integral domains, The characteristic of a ring, Some non – commutative rings, Examples, Matrices over a field, The real quaternions, Homomorphism of Rings – Definitionand elementary properties, Maximal and Prime ideals, Prime fields.

Unit-IV: Solid Geometry 9 Hrs

The Plane: Equation of plane in terms of its intercepts on the axis, Equations of the plane through the given points, Length of the perpendicular from a given point to a given plane, Bisectors of angles between two planes, Combined equation of two planes, Orthogonal projection on a plane.

The Line: Equations of a line, Angle between a line and a plane. The condition that a given line may lie in a given plane, The condition that two given lines are coplanar, Number of arbitrary constants in the equations of a straight line. Sets of conditions which determine a line, The shortest distance between two lines. The length and equations of the line of shortest distance between two straight lines, Length of the perpendicular from a given point to a given line, Intersection of three planes, Triangular Prism.

Text Books:

1. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.
2. Shanthi Narayan, Analytical Solid Geometry. New Delhi: S. Chand and Co. Pvt. Ltd., 2004.

Reference Books:

1. John B Fraleigh, A First course in Abstract Algebra, 3rd ed.: Narosa Publishing House., 1990.
2. R. Balakrishan and N. Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 8th ed.: New Delhi, India: Wiley India Pvt. Ltd., 2010.

B19PC5051	**Renewable Energy Resource**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Basic concept s of energy and its applications.

Course Objectives:

1. To understand the various forms of conventional energy resources.
2. To learn the present energy scenario and the need for energy conservation
3. To explain the concept of various forms of renewable energy

4. To outline division aspects and utilization of renewable energy sources for both domestics and industrial application
5. To analyse the environmental aspects of renewable energy resources.

Course Outcomes:

On completion of this course the student will be able to:

1. Compare the prospects of Solar, Wind and bio energy systems,
2. Discuss the latest developments of solar energy resources and its utilization.
3. Estimation of wind energy for energy generation
4. Describe the applications of solar energy.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5051	CO1	3	3	2	3	2				2	1
	CO2	3	3	2	3	2				3	3
	CO3	3	3	1	3	2				3	2
	CO4	3	3	2	3	2				3	3

Course Contents:

UNIT I: Sources of Renewable Energy **6 Hrs**

Solar, wind, Biomass availability, merits and demerits. Hydrogen as a source. Various forms of energy, Types of energy reservoirs, photo-thermal and photovoltaic systems, geothermal systems, wind energy

Solar cooker, Solar dryer, solar hot water systems- Principles, Working and its applications.

Solar lantern, Water Pumps and Street lights- Principles, Working and its applications.

UNIT–II: SOLAR Energy & its utilization **6 Hrs**

SOLAR Energy & its utilization: Origin of Solar Energy, Spectral distribution of Solar radiation, Attenuation of beam radiation, Basic earth solar angle and derived solar angle, GMT, LCT, LST, Day length, Estimation of average solar radiation, sunshine recorder Principle of conversion of solar energy into heat.

UNITS–III: Energy storage & Fuel cells: **6 Hrs**

Sensible heat storage liquids and solids, latent heat storage, thermo chemical storage, storage through charged batteries and its applications, Classification of solar collectors, Flat plate and concentrating collectors, construction, Thermal efficiency and coating, Heat losses, Solar cell and its efficiency, P.V. Panels.

Design and Principle of operation, Classification, Types, Advantages and disadvantages, Conversion efficiency, Types of electrodes, Work output and EMF of Fuel Cells, Applications of Fuel Cells.

UNIT–IV: Wind Energy & Ocean Energy **6 Hrs**

Estimation of energy obtainable from wind, Velocity and power duration curves, energy pattern factors, Theory of power Momentum transfer, power Coefficients, Principle of Wind turbine, Types of wind driven Machine Horizontal and vertical axis types and applications.

Energy from Sea waves, Ocean Thermal energy- temperature gradient in sea and their use for power generation and its applications.

Books Recommended:

1. J. T. MacMillan, R. Morgan & R. B. Murray: Energy Resources, 2nd edition, 2002.
2. S. P. Sukhatme: Solar Energy Principles & Thermal Collection & Storage, 2nd edn, TMH, New Delhi 2010.
3. G. D. Rai: Solar Energy Utilization, 5th edition, Khanna Publishers, New Delhi 2012.
4. G. D. Rai: Non-Conventional Energy sources, 4th edition, New Delhi 2010.
5. E. W. Golding: The Generation of Electricity (by wind) Prentice hall, New York 2007

B19PC5052	**Solid State Physics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Fundamentals of solid-state Physics.

Course Objectives:

1. To provide basic knowledge of the types of solids and their structure
2. To understand how structure effects different properties of the solids.
3. To impart the knowledge of different phenomenon's taking place in the solids.
4. To give the insight of different applications with the solids.

Course Outcomes:

On completion of this course the student will be able to:

1. Discuss the concepts of crystal structure.
2. Classify the solids based on their structure details.
3. Analyze the behavior of solids under different conditions like heat, optical and electrical treatments.
4. Compare the different models or theories.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5052	CO1	3	2	2	2	2				3	1
	CO2	3	3	2	2	1				3	2
	CO3	3	3	2	2	1				3	1
	CO4	3	3	2	2	1				3	1

Course Contents:

UNIT -I: **6 Hrs**

Statistical Physics: The Maxwell-Boltzmann. Bose-Einstein and Fermi-Dirac energy distribution formulae (no derivation). A qualitative comparison of the three distribution formulae.

Bonding in Crystals: Inter atomic forces and types of Bond in a crystal, properties and characteristics of -Ionic bond, covalent bond, Metallic bond, Molecular bond and Hydrogen bond.

UNIT -II: **6 Hrs**

Thermal properties of solids: Dulong and Petit's law and its limitations. Einstein's theory of specific heat. Debye's theory of specific heat.

Electrical properties of Metals: Band theory of solids-review, Free electron theory of metals - Classical theory and Quantum Theory. Expression for electrical conductivity-Ohm's law. Weidman-Franz law, Density of states. Expression for the Fermi energy, Hall effect and magneto resistance in metals. Expression for Hall co-efficient in metals.

UNIT -III: **6 Hrs**

Dielectric properties: Dielectric materials and its properties, Methods of determining dielectric constant for solids and liquids.

Superconductivity: Elementary ideas and experimental facts. Meissner's effect. Magnetic properties of type-I and type-II superconductors, Critical magnetic field. Influence of external agents on superconductivity, Cooper pairs, BCS theory (qualitative), Applications of superconductivity. introduction to high-temperature superconductors.

UNIT -IV: **6 Hrs**

X-rays: Bragg's law and the Bragg spectrometer. A brief mention of the different types of crystals. Miller indices, structure of NaCl and CsCl crystals. Continuous x-ray spectra, Duane and Hunt limit. Characteristic x-ray spectra. Mosley law and its significance. Compton effect- expression for Compton shift.

Lasers: General principles. Three level laser-action The He-Ne laser- construction and working, Applications of Laser - Laser Cooling, Material Processing (Lasers in Welding, Drilling, and Cutting), Medicine, Laser-induced Fusion, Laser Soldering, scribing, Laser Heat Treatment, LIDAR

Books for Reference:

1. Hugh D. Young, Roger A Freedman and A. Lewis Ford: University Physics 13th edition
2. Arthur Beiser: Concepts of modern physics,6th edition, TMH, New Delhi.2008.
3. J.B. Blackmore: Introduction to solid state physics 2nd Edition reprint, Press Syndicate of the University of the Cambridge, United Kingdom, 1998
4. M A Wahab, solid state physics 2nd Edition, Narosa Publishing House, New delhi.2009.
5. A. J. Dekkar: Solid State physics, MACMILLAN & CO LTD, Reprint, 1967
6. MN Avadhanulu, An Introductions to LASERS-Theory & Applications, S Chand & Co,
7. A.K. Saxwna, Atomic and Molecular Spectra and Lasers, 1st Edition, CBS Publishers and
1. Distributors 2009
8. B B Laud, Lasers and Non-linear optics, 2nd Edition, New age International, New Delhi.2004
9. B S Saxsena, R C Guptha and P N Saxsena, Fundamentals of Solid-State Physics, 17th edition, Pragathiprakashana, Meerut 2000.

B19PC5053	**Semiconductor Physics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Fundamentals of semiconducting devices.

Course Objectives:

1. To explain the underlying physics of semiconductor materials.
2. To explore the internal behaviour of semiconductor devices.

Course Outcomes:

On completion of this course the student will be able to:

1. Derive expressions for conductivity and energy gap in semiconductors.
2. Explain Fermi level, carrier concentration and hall effect.
3. Explain the working of semiconductor devices like Zener diode, transistor, FET
4. Explain the working of optoelectronic devices like Solar cells, Photodiode, LED.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5053	CO1	3	2	2	2	1				3	1
	CO2	3	3	2	2	1				3	2
	CO3	3	3	2	2	1				3	1
	CO4	3	3	2	2	1				3	1

Course Content:

UNIT I: Band Theory: **6 Hrs**

Concept of bands in solids, intrinsic and extrinsic semiconductor. depletion region, drift velocity, expression for electron and hole concentration in intrinsic semiconductor under thermal equilibrium, Derivation of the expression for electrical conductivity of intrinsic semiconductors, electron & hole mobilities, effective mass, Expression for the energy gap.

UNITS–II: Effect of Temperature and Doping: **6 Hrs**

Variation of conductivity with temperature Fermi level, Expression for Fermi level in extrinsic semiconductors- both P and N type. Diffusion current and total current, Life time of charge carriers, Variation of Fermi level with temperature and impurity concentration.

UNIT–III: Semiconductor Devices: **6 Hrs**

I-V Characteristics of diode, Zener diode, Transistor, working of transistor in CB, CC and CE configuration mode, Photo diode working and its applications.

UNIT–IV: Applications of Semiconductor devices: **6 Hrs**

Phenomena of Photo conductivity expression for Photo emf of P-N junction, Photo voltaic cells, LED and FET construction, working and its applications.

Books Recommended:

1. R K Puri and V K Babbar, Solid State Physics and Electronics, S Chand & Co, New Delhi 1997.

2. B S Saxsena, R C Guptha and P N Saxsena, Fundamentals of Solid-State Physics, 17th edition, P Prakashana, Meerut 2000.

B19PC5061	**Hetero Cyclic Chemistry & Chemistry of Natural Products**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

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 drugs, types of drugs and name of common drugs.

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 common drugs and its 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	PSO1	PSO2
B19PC5061	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 **6hrs**

Heterocyclic Compounds: Introduction, Nomenclature and classification 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 in furan. Pyridine: Structure- Basicity –aromaticity-comparison with pyrrole-one method of preparation and properties –reactivity towards Nucleophilic substitution reaction.

UNIT-II **6hrs**

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.

Antibiotics- Definition, structure and synthesis of streptomycin and penicillin.

UNIT-III **6hrs**

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 formule) Fischer and Haworth structures of fructose and galactose.

Conversion reactions – 1. Ascending (Kiliani's synthesis) 2. Descending (Wohl's degradation) 3. Aldose to ketose 4. Ketose to Aldose 5. Epimerization.

Disaccharides: Glycosidic bond, Structural elucidation of sucrose, structural formulae of maltose and lactose (Haworth structure).

UNIT-IV **6hrs**

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.

Reference Books:

1. Heterocyclic Chemistry Raj K. Bansal Tata Mcgraw Hill Publications.
2. A Text book of Organic Chemistry M. K. Jain S. Chand & Company.
3. A Text book of Organic Chemistry Bhal & Bhal S. Chand & Company.
4. A Text book of Organic Chemistry P. L. Soni S. Chand & Company.
5. Laboratory Manual of Organic Chemistry Raj K. Bansal New Age Publications.
6. Laboratory Manual of Organic Chemistry Jayaraman S. Chand & Company.
7. Chemistry of Natural products Aggarwal Goel Publishing House Meerut.
8. Organic Chemistry K. K. Sharma Shobhanlal & NaganCompany.
9. Organic Chemistry Puri & Sharma Shobhanlal & Nagan Company.
10. Medicinal Chemistry Ashuthosh Kar Tata Mcgraw Hill Publications.

B19PC5062	**Polymer Chemistry**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Knowledge of momomers, polymers, rubbers, cellulose, inorganic polymers, polymer processing.

Course Objectives:

1. To realize the importance of monomer concept in polymers.
2. The foundation concepts of synthesis of various polymeric compounds.
3. Vital concepts in Biopolymers and their fundamental importance.
4. Reaction kinetics and foundation 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. Have realization of polymerization foundation in various processes.
4. Appreciate the physical basis in kinetics and mechanism of chain polymerization.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5062	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 **6hrs**

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 **6hrs**

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 **6hrs**

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 **6hrs**

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. Introduction to polymer chemistry, R. Seymour, Wiley –Interscience (1981)
3. Physical chemistry of Macromolecules, by D.D. Deshpande, Vishal publications, (1985)
4. Principles of polymer chemistry by P.J. Flory.
5. Polymer Science –V R Gowarikar.
6. Principles of polymerization, G. Odian, Wiley – Interscience (1981)
7. Principles of polymerization, G. Odian, Wiley – Interscience (1981)
8. Organic polymer chemistry, K. J. Saunders, Chapman and Hall, London (1973).
9. High performance polymers, their origin and development, by Seymour R. B. and Kirshenbaum G. S. Elservier.
10. Condensation polymers by interfacial and solution methods, Paul W. Morgen, Interscience publishers.
11. Industrial plastics: Theory applications by T. L. Richardson.
12. Organic chemistry of synthetic high polymers, Robert W. Lenz, Interscience publisher

B19PC5063	Industrial Chemistry	L	T	P	C
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Knowledge of fuels, paints, glasses, alloys, fertilizers, cements, adhesives and refractories.

Course Objectives:

1. Train students to demonstrate knowledge of energy sources and lubricates.
2. Emphasis knowledge on properties of glass, ceramics, cements, additives and refractories and applications
3. Expand fundamental understanding on surface coating, properties, and application
4. Aim to provide knowledge on fertilizers, cosmetics, perfumes, and pesticides.

Course Outcomes:

1. Demonstrate knowledge of energy sources, lubricates and determination.
2. Create knowledge on properties of glass, ceramics, cements, additives and refractories and applications
3. Explore surface coating, properties, and application
4. Acquire knowledge on fertilizers, cosmetics, perfumes, and pesticides.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5063	CO1	2	1	1						1	1
	CO2	2			1	1				1	1
	CO3	2			1	1				1	1
	CO4	2			1	1				1	1

Course Contents:

UNIT-I **6hrs**

Fuel Chemistry: Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value, Bomb calorimetric estimation of calorific value.

Coal: Uses of coal (fuel and non-fuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas composition and uses.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

UNIT-II **6hrs**

Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glass, safety glass, fire and bullet proof glasses.

Ceramics: Raw materials and their roles, varieties of clay, production of ceramic ware, glazing, ceramic insulators.

Cement: Raw materials grades, manufacture of Portland cement.

Alloys: Classification of alloys, Ferrous and Non-Ferrous alloys, Specific properties of elements in alloys

Refractories: Classification, properties of refractories and its failures. Applications of refractories.

UNIT-III **6hrs**

Surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, modified oils, Pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, electrolytic and Metallic coatings (electroless), metal spraying and anodizing.

UNIT-1V **6hrs**

Fertilizers: Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphates; Polyphosphate, Super phosphate.

Cosmetics and Perfumes -A general study including preparation and uses of the following: Hair dye, hair spray, Shampoo, Sun-tan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams).

Pesticides: General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil) , Anilides (Alachlor and Butachlor).

Reference Books:

1. O. P. Vermani, A. K. Narula: Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi.
2. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel s Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.
6. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, VallabhPrakashan Pitampura, New Delhi.
7. R. Cremlyn: Pesticides, John Wiley.
8. Industrial Chemistry B. K. Sharma.

B19PC5071	**Complex Analysis**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Knowledge of linear algebra, differential equation and real analysis

Course Objectives:

1. To analyze the function of complex variable and its analytic property with a review of elementary complex function.
2. To identify and construct complex-differentiable functions.
3. To use the general Cauchy integral theorem and formula.
4. To understand the Taylor and Laurent expansion with their use in finding out the residue and improper integral.

Course Outcomes:

1. Analyze the conjugate and modulus of a complex number.
2. Apply the concepts of Cauchy-Reimann equations in Cartesian and polar forms to solve the problems.
3. Apply Cauchy integral theorem and its consequences to solve the problems.
4. Demonstrate the knowledge of the power series expansion of an analytic function and singularity and residue of complex function.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5071	CO1	3	2	2	2					3	1
	CO2	3	3	2	2					3	2
	CO3	3	3	2	2					3	1
	CO4	3	3	2	2					3	1

Course Contents:

Unit-I: Complex Analysis – 1 **6 Hrs**

Recapitulation of Complex numbers, The complexplane, conjugate, and modulus of a complex number. Polar form, Euler's formula. Hyperbolic functions - Simple problems.

Unit-II: Complex Analysis – 2 **6 Hrs**

Functions of complex variables: Limit, Continuity and Differentiability-Simple problems. Analytic functions, Cauchy-Reimann equations in Cartesian and polar forms. Sufficient conditions for analyticity (in Cartesian form). Properties- Harmonic and orthogonal system and problems. Construction of analytic function, Given real and imaginary parts.

Unit-III: Complex analysis – 3 **6 Hrs**

The complex line integral: Examples and properties (definitions of the concepts like neighborhood of a point, closed contour, etc. at appropriate places should be mentioned). Cauchy's theorem (statement) and itsconsequences. Cauchy's integral formulae for the function and derivatives (statement). Applications to the evaluation of simple line integrals. Cauchy's inequality. Liouville's theorem-Fundamental theorem of algebra.

Unit-IV: Complex analysis – 4 **6 Hrs**

Power series expansion of an analytic function, Taylor's theorem (statement) and series, Laurent's theorem (statement) and Series. Singularity and residue, Formula for the residue at a pole and Cauchy's Residue theorem (statement) -Simple problems.

Text Books:

1. S Shanthinarayan, Complex Analysis, S Chand Co. Pvt. Ltd., 2012.
2. R V Churchil& J W Brown, Complex Variables and Applications, 5th edition. TMH 1989.
3. L V Ahlfors, Complex Analysis, 3rd edition.: Mc Graw Hill. 1979.

References:

1. A R Vashista, Complex Analysis, Krishna Prakashana Mandir, 2012.
2. Richard R Goldberg, Methods of Real Analysis, Indian ed. New Delhi, India: O&IBH Publishing Co. 1970.
3. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed. New Delhi, India: S Chand Company Ltd., 2011.

B19PC5072	Fluid Dynamics	L	T	P	C
Duration:14 Wks		2	0	0	2

Prerequisites:

Knowledge of calculus and intermediate physics.

Course Objectives:

1. Explain the relative angular velocity, acceleration, rectilinear motion, work, power and energy.
2. State projectile, trajectory and inclined plane.
3. Explain conservation of linear momentum, impact of the sphere.
4. State central force and orbit, Kepler's laws on planetary motion, moment of inertia of simple bodies.

Course Outcomes:

1. Apply relative angular velocity, acceleration and solve problems on work, power and energy.
2. Analyze projectile, trajectory and solve problems on it.
3. Apply conservation of linear momentum, analyze the impact of spheres and solve problems on it.
4. Apply Kepler's laws on planetary motions and analyze the moment of inertia of different geometrical objects.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5072	CO1	3	3	3	2	1			1	3	3
	CO2	3	3	2	2	1			1	3	2
	CO3	3	2	1	2	1			1	3	2
	CO4	3	2	2	2	2			2	3	2

Course Contents:

Unit-I **06 Hrs**

Velocity, Relative velocity, Angular velocity, Aceleration, Rectilinear motion, Rectilinear motion with constant acceleration, Relative angular velocity, Work, Power, Energy.

Unit-II **06 Hrs**

Motion of a projectile, Nature of a trajectory, Results pertaining to the motion of a projectile, Range on an inclined plane, Maximum range on the inclined plane. Simple problems.

Unit-III **06 Hrs**

Impulsive force, Conservation of linear momentum, Impact of a sphere, Laws of impact, Impact of two smooth spheres, Direct impact of two smooth spheres, Direct impact of a smooth sphere on a plane, Oblique impact of a smooth sphere on a plane. Simple problems.

Unit-IV **06 Hrs**

Central force and central orbit, Equation of central orbit, finding law of force and speed for a given orbit, Determination of the orbit when law of force is given, Kepler's Laws on planetary motion. Simple problems. Moment of inertia of simple bodies, Theorems of parallel and perpendicular axes, Moment of inertia of triangular lamina, Circular lamina, Circular ring, Right circular cone, Sphere - Simple problems.

Text Books:

1. An Introduction to Fluid dynamics by G K Batcher, Cambridge University Press.
2. Elementary Fluid Dynamics by D J Acheson, Clarendon Press.

Reference Books:

1. Fluid Dynamics an introduction by Rieutord, Michel, Springer Publications.
2. Physical Fluid Dynamics by D J Tritton.
3. A First Course in Fluid Dynamics by A R Paterson, Cambridge University Press.

B19PC5073	**Number Theory**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Knowledge of abstract algebra and commutative algebra.

Course Objectives:

1. Understand the theory of congruence's.
2. Understand the functions of several variables.
3. Familiarize with graphs.
4. Familiarize with the concept of limits and continuity in higher dimensions.

Course Outcomes:

1. Discuss the theory of congruence's.

2. Discuss functions of several variables.
3. Produce and interpret graphs of functions of two and three variables.
4. Demonstrate limits and continuity in higher dimensions.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5073	CO1	3	3	2	1	1				3	2
	CO2	3	3	2	2	1				3	2
	CO3	3	3	2	2	1				3	2
	CO4	3	3	2	2	1				3	2

Course Contents:

Unit-I **06 Hrs**

The theory of congruence's, Properties of congruence's, Binary and decimal representation of integers, Linear congruence's and the chinese remainder theorem. Fermatas Theorem, Wilson's Theorem, Euler's Phi-Function, Euler's Theorem, Some properties of Phi-Function, Finite continued fractions.

Unit-II **06 Hrs**

Functions of several variables: Definition of function of *n* independent variables, Domains and ranges, functions of two variables, Definition of interior and boundary points, Definitions of open, Closed, Bounded and unbounded regions in a plane.

Unit-III **06 Hrs**

Graphs, Level curves and contours of functions of two variables, Level curves, Graph, Surface, Functions of three variables, Level surface, Interior and boundary points for space regions, Open and closed regions.

Unit-IV **06 Hrs**

Limits and continuity in higher dimensions: Limits and continuity, Two path test for non-existence of limit, Continuity of composites, Functions of more than two variables, Extreme values of continuous functions on closed and bounded sets.

Text Books:

1. Thomas calculus, by Maurice D. Weir, Joel Hass and Frank R. Giordano, 11th Edition, Pearson Publications, 2008.
2. Elementary Number theory by David M Burton, 6th Edition-Tata McGraw Hill.

Reference Book:

1. Number Theory by H.S. Hall, S.R. Knight, Maxford Books, 2008.

Course Code	Course Title	Course Type	L	T	P	C	Hrs/Week
B19PC5080	**Soft Skill Training**	RULO	1	1	0	2	3

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

B19PC5090	**Physics lab- V**	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Fundamentals of Electronics, concepts of light.

Course Objectives:

1. To make the students gain practical knowledge to co-relate with the theoretical studies.
2. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.
3. Design of circuits using new technology and latest components.
4. Develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.

Course Outcomes:

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

1. Determination of the few physical constants through experiments
2. Demonstrate the various experiments related to electronics such as Oscillators, multiplier, logic gates and Transistor.
3. Verify various theorems by experiments
4. Estimate e/m value of an electron.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5090	**CO1**	**3**	**3**	**3**	**2**	**2**		**2**	**2**	**2**	**3**
	CO2	**3**	**3**	**3**	**2**	**2**		**2**	**2**	**3**	**3**
	CO3	**2**	**2**	**1**	**3**	**2**		**2**	**3**	**3**	**2**
	CO4	**3**	**2**	**3**	**1**					**2**	**2**

Course Contents:

Any **eight** of the following experiments:

1. Ionization potential of xenon.
2. The e/m of an electron using a bar magnet (Thomson effect).
3. Estimation of mass of an electron.
4. Determination of Planck constant using a photo cell/ Solar cell.
5. Basic logic gates.
6. Hartley Oscillator.
7. Cockroft-Walton Voltage multiplier.

8. Transistor characteristics -CE mode
9. Study of Spectra of Hydrogen Spectra using Gas Discharge tube Determination of Rydberg Constant.
10. The e/m of an electron by helical coil method or Helmholtz coil method.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S.Sudha.D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G.L. Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
4. Practical Physics – S. L. Gupta &V. Kumar (PragatiPrakashan).

B19PC5X10	**Physics lab- VI**	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Fundamentals of Electronics, concepts of light.

Course Objectives:

1. To make the students gain practical knowledge to co-relate with the theoretical studies.
2. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability.
3. To develop and fabricate engineering and technical equipments.
4. Design of circuits using new technology and latest components.
5. To develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.

Course Outcomes:

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

1. Determination of the few physical constants through experiments
2. Demonstrate the various experiments related to electronics such as Oscillators, multiplier, logic gates and Transistor.
3. Verify various theorems by experiments.
4. Estimate dielectric constant of given material.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5X10	**CO1**	**3**	**3**	**3**	**2**	**2**		**2**	**2**	**2**	**3**

	CO2	**3**	**3**	**3**	**2**	**2**		**2**	**2**	**3**	**3**
	CO3	**2**	**2**	**1**	**3**	**2**		**2**	**3**	**3**	**2**
	CO4	**2**	**2**	**1**	**2**	**1**				**2**	**2**

Course Contents:

Any **eight** of the following experiments:

1. Determination of wavelength of Laser light by grating.
2. RC coupled amplifier two stage.
3. Bridge rectifier with C and Pi filter.
4. Zener diode: To study the Characteristics and Voltage regulator.
5. Energy gap of a semiconductor by four probe method.
6. Determination of range of electron in Al using GM counter.
7. Determination of Dielectric constant of given liquid.
8. To determine value of Boltzmann constant using V-I characteristic of PN diode.
9. Fermi energy of copper by Meter Bridge.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S.Sudha.D. and Krishnamohan M., “Physics for Technologists”, Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, “Practical Physics”, 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G.L. Souires, “Practical Physics:”, 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, “An Advanced Course in Practical Physics”, 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
4. Practical Physics – S. L. Gupta &V. Kumar (PragatiPrakashan).

B19PC5X20	Chemistry Lab-V	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

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. Determine amount and predict the percentage of analyte precipitate.
4. Understanding the idea of Chromatograpic technique and separation of cations using Paper chromatography.

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 Chromatography technique.
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	PSO1	PSO2
B19PC5X20	CO1	1	2	2	1			2		3	1
	CO2	1	2	1	3			3		3	1
	CO3	1	2	2	2			2		3	1
	CO4	1	1	2	1			2	2	3	1

Course Contents:

Gravimetric Estimations:

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of iron as iron (III) oxide.
3. Gravimetric estimation of copper as copper (I) thiocyanate.
4. Gravimetric estimation of nickel as nickel dimethylglyoximate.
5. Gravimetric estimation of magnesium as magnesium -8-hydroxy oxinate.
6. Gravimetric estimation of sulphate as barium sulphate.
7. Gravimetric estimation of aluminum as aluminum oxide.
8. Gravimetric estimation of zinc as zinc oxide.
9. Gravimetric estimation of calcium as calcium oxide.
10. Paper chromatographic separation of Fe^{3+} and Ni^{2+} ions.
11. Paper chromatographic separation of Na^{+} and K^{+} ions.

Reference Books

1. A Textbook Quantitative analysis A. I. Vogel ELBS.
2. Instrumental methods of Chemical analysis.B. K. Sharma Goel Publishing House.
3. Advanced Practical Inorganic ChemistryGurudeep Raj Goel Publishing House.
4. Experimental Inorganic/Physical Chemistry Mounir A. Malati Horward Series in Chemical science.

B19PC5X30	Chemistry Lab-VI	L	T	P	C
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Basic principles of conductometry, potentiometry, pH, colorimetry. Acids and bases. Chemical kinetics

Course Objectives:

1. Afford an adequate knowledge of the principles, instrumentation and applications of common analytical techniques.

2. Knowledge on various electro analytical techniques for the examination of analyte.
3. Develop the basic knowledge of potentiometry, pH metry, conductometry, Colorimetry etc.
4. Compare various factors that influence experimental values.

Course Outcomes:

1. Explain the theoretical principle, instrumental techniques and their applications.
2. Demonstrate experimental skills in laboratories.
3. Operate various electro-analytical instruments during conduction of experiments.
4. Analyze and interpret the experimental data.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC5X30	CO1	1	2	2	3			2		3	1
	CO2	1	2	2	3			3		3	1
	CO3	1	2	1	2			3	2	3	1
	CO4	1	3	3	2			2	3	3	1

Course Contents:

1. Determination of equivalent conductance of the given electrolyte (strong and weak) by using Meter Bridge.
2. Determination of solubility of sparingly soluble salt (like $BaSO_4$) by conductometric method.
3. Determination of Ka (dissociation constant of a weak acid) by conductometric method.
4. Determination of rate constant of saponification of ethyl acetate by conductivity measurements.
5. Conductometric titration of strong acid and strong base and weak acid and strong base. Determination of percentage composition of a given mixture containing two miscible liquids by Abbe's refractometer.
6. Potentiometric titration of ferrous ammonium sulphate against potassium dichromate.
7. pH titration of strong acid against strong base (by observing change in pH).
8. Potentiometric titration of mixture of HCl and CH_3COOH using NaOH solution.
9. Colorimetric estimation of Fe^{3+} ion using ammonium thiocyanate as complexing agent.
10. Colorimetric study of kinetics of oxidation of indigocarmine by chloramine-T.

References for Practicals:

1. A Textbook Quantitative analysis A. I. Vogel ELBS.
2. Instrumental methods of Chemical analysis.B. K. Sharma Goel Publishing House.
3. Advanced Practical Inorganic ChemistryGurudeep Raj Goel Publishing House.
4. Experimental Inorganic/Physical Chemistry Mounir A. Malati Horward Series in Chemical science.

SIXTH – SEMESTER

B19PC6010	Nuclear Physics	L	T	P	C
Duration:14 Wks		**1**	**1**	**0**	**2**

Prerequisites:

Basic knowledge on fundamentals of nuclear Physics.

Course Objectives:

1. Introduce students to the fundamental principles and concepts governing nuclear physics and have a working knowledge of their application to real-life problems.
2. Relate the core concepts in physics to more advanced topics in nuclear and particle physics.
3. Provide students with opportunities to develop basic knowledge and understanding of radioactivity decay.

Course Outcomes:

1. Understand the fundamental principles and concepts governing classical nuclear and particle physics and have a working knowledge of their application to real-life problems.
2. Apply knowledge of core concepts in physics to more advanced topics in nuclear and particle physics.
3. Explain radioactive decay using physics laws.
4. Apply basic knowledge of radio decay to solve nuclear physics related problems and decay systems in nuclear elements

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6010	CO1	3	3	2	2	1				3	3
	CO2	3	3	2	1	1				3	3
	CO3	3	3	2	1	1				3	2
	CO4	3	2	2		1				3	2

Course Contents:

UNIT-I **9 Hrs**

The Nucleus: Properties of nucleus, Neutron discovery and Properties. The proton-neutron hypothesis. Nuclear forces and their characteristics. Yukawa's theory (qualitative).

Radioactive decay: Successive disintegration, radioactive equilibrium radioactive series, Range and energy of alpha-particle and their measurement. Theory of alpha-decay (qualitative), Geiger-Nuttal law. Beta Decay – Pauli's neutrino hypothesis K-electron capture, internal conversion, Nuclear isomerism. Mirror nuclei, Gamma decay (qualitative).

UNIT-II **9 Hrs**

Accelerators: Cockroft-Walton voltage multiplier. LINAC, Cyclotron, Betatron.

Nuclear Detectors: Bubble chamber. G. M. counter, Principle of semiconductor detector.

Nuclear Models: Liquid-drop model, Semi empirical mass formula. Shell model and magic numbers

UNIT-III **9 Hrs**

Nuclear reactions: Q-values. Threshold energy of an endoergic reaction, Reactions induced by proton, deutron and -particles.

Nuclear Fission, Fusion and reactors: Estimation of the Fission energy on the basis of the liquid-drop model, Thermo-nuclear reactions sources of stellar energy. The C-N cycle, Magnetic bottle, Nuclear reactors-types. The four-factor formula, Pressurized Heavy water reactor.

UNIT-IV **9 Hrs**

Particle Physics and Cosmic Rays: Mention of the basic interactions in nature, Particles and anti-particles. Types of interaction between elementary particles. Conservation laws. A qualitative introduction to quarks (quark model), standard model qualitative, Big bang theory qualitative Cosmic ray Discovery, Primary and secondary cosmic rays- their composition. Cosmic ray showers. Origin of cosmic rays.

Books for Reference:

1. A. Beiser: Concepts of modern physics, 6thedition, TMH, New Delhi.2008.
2. Irving Kaplan: Nuclear Physics, 2ndedition, Narosa Publishing House, 1987(Reprint2002).
3. K. S. Kranes: Introductory Nuclear Physics, Wiley India, 2008.
4. S. N. Ghoshal: Nuclear Physics, 1st edition,
1. S. Chand and Co, 1994(Reprint 2002).
5. D.C. Tayal: Nuclear Physics, 5th edition, Himalaya Publishing House, 2008
6. Robert Eisberg, Quantum Phyiscs of Atoms molecules, solids nuclei and particles, second
2. edition, 1999
7. A K Saxena, Narosa: Principles of Modern Physics Publishers, 4th edition, 2014
8. H. Semat and I.R. Albright: Introduction to atomic and nuclear physics.
9. K. S. Kranes: Introductory Nuclear Physics, Wiley India, 2008
10. M K PAL, Theory of Nuclear Structure, East-West Press Delhi (1983).

B19PC6020	**Chemistry-VII**	**L**	**T**	**P**	**C**
Duration:14 Wks		**1**	**1**	**0**	**2**

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 focus on basic concepts organic photochemistry and generate keen interest and thinking in understanding the mechanisms of Molecular Rearrangements.
4. To make the students more inquisitive in learning the mechanistic details in Organic Chemistry through the teaching of the named reactions.
5. 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 radioactivity and nuclear chemistry.
3. Illustrate the basic concepts in organic chemistry and enhance the knowledge of molecular rearrangements mechanisms.
4. Explain and illustrate the different spectroscopic techniques in organic chemistry with examples.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6020	CO1	2	2	2	1		1		1		1
	CO2	3	2	1	1				2	1	1
	CO3	2	1	2	2		1		1	2	1
	CO4	2	3	1	2		1	1	1	1	

Course Contents:

UNIT-I **9 Hrs**

Coordination Chemistry: Ligands, classification of ligands and chelation, nomenclature of co-ordination compounds, physical methods in the study of complexes – change in conductance, colour and pH. Stability of complexes – stability constant, a brief outline of thermodynamic stability of metal complexes, factors affecting the stability of complexes. Poly nuclear complexes, inner metallic complexes.

Isomerism in co-ordination complexes: Stereo-isomerism – Geometrical and optical isomerism exhibited by co-ordination compounds of co-ordination number 4 and 6.

Metal-ligand bonding in transition metal complexes: Salient features, formation of octahedral complexes on the basis of VBT, Important features of crystal field theory, crystal field splitting of d-orbitals in tetrahedral, octahedral and square planar complexes, Evidences for metal ligand covalent bonding in complexes.

UNIT-II **9 Hrs**

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 dating (explanation). Separation of uranium isotopes – Laser irradiation method (atomic and molecular routes). Applications of Radioactive metals. Nuclear programme in India.

UNIT-III **9 Hrs**

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 systems.

Molecular rearrangements and named reactions: Classification – inter molecular and intra molecular rearrangements- Mechanisms, evidences, migratory aptitude, inter or intra molecular of the following rearrangements: Pinacol-pinacolone, Benzilic acid, Beckmann, Baeyer-Villiger Cope and Claisen (sigmatropic) rearrangement.

Named reactions: chichibabin, stark enamine, Heck reaction, Suzuki coupling, Stille coupling and Sonogashira coupling, Click reaction.

UNIT-IV **9 Hrs**

Spectroscopy of Organic compounds

UV-Visible spectroscopy: Introduction to spectroscopy, types of transitions. Electromagnetic spectrum – electron energy levels, Chromophores and auxochormes, blue shift and red shift. Conjugation and solvent effects.

IR spectroscopy: Introduction, modes of vibrations, number of fundamental vibrations, factors influence on vibrational frequencies on force constant, reduced mass, and H bonding (free and H-bonded), alkane, alkene, alkyne and OH groups.

NMR Spectroscopy: Basic principles of proton magnetic resonance spectroscopy: quantum approach- Magnetic nature of electron and nucleons, Magnetic moment, magnetic spin quantum number -I, Larmor frequency, basic NMR equation, population of nuclei, Equivalent and non-equivalent protons Chemical shift ,TMS as reference,Spectra of simple organic molecules Ethanol,ethylbromide,Acetaldehyde,Tolouene applications.

Reference Books:

1. Principles of Inorganic Chemistry Puri, Sharma & Kalia Shobhanlal Nagin Chand Co.
2. A Text book of Inorganic Chemistry Gurudeep Raj.
3. Concise Inorganic Chemistry J. D. Lee B-Block Well Science Ltd.
4. A Text book of Inorganic Chemistry Sathya Prakash & others
5. A Text book of Organic Chemistry M. K. Jain S. Chand & Company.
6. A Text book of Organic Chemistry Bhal & Bhal S. Chand & Company.
7. Organic Synthesis special techniques V. K. Ahluwalia & Renu Aggarwal Narosa ublishing

B19PC6030	**Numerical Methods**	**L**	**T**	**P**	**C**
Duration:14 Wks		**1**	**1**	**0**	**2**

Prerequisites:

Differential equations and linear algebra.

Course Objectives:

1. Provide students an introduction to the field of numerical analysis.
2. Apply problem solving skills through the introduction of numerical methods.
3. Provide a ground for applying knowledge acquired in previous mathematics courses; and give students an opportunity to develop and present an independent project.

Course Outcomes:

1. Effectively write mathematical solutions and their interpretation in a clear and concise manner.
2. Identify the steps required to carry out a piece of research on a topic within Numerical Analysis.
3. Use information and communication technology to discuss problems relevant to Numerical analysis.
4. Demonstrate the ability to study the solution of a differential equation and develop a practical interpretation of the numerical results.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6030	CO1	3	3	2	3					3	2
	CO2	3	3	3	3					3	3
	CO3	3	2	3	2					3	2
	CO4	3	2	3	3					3	3

Course Contents:

Unit-I: Numerical Solution of algebraic and system of equations **9 Hrs**

Solution of Algebraic and Transcendental Equations: Bisection method, Iteration method, the method of False Position, Newton Raphson method. Solution of linear systems – Matrix inversion method – Gaussian Elimination method – power method – Method of factorization – Iterative methods.

Unit-II: Finite Difference and Interpolation **9Hrs**

Finite differences: Forward difference, Backward difference and Shift Operators – Separation of symbols – Newton's Formulae for interpolation – Lagrange's interpolation formulae - Numerical differentiation – Numerical integration: Trapezoidal rule, Simpson's one-third rule and Simpson's three-eighth rule.

Unit-III: Numerical Solution of First order Differential Equations **9Hrs**

Numerical solution of ordinary differential equations – Taylor's series – Picard's method – Euler's method – Modified Euler's method – RungeKutta methods - second order (with proof) and fourth order (without proof).

Unit-IV: Numerical Solution of Second order **9Hrs**

Differential Equations and simultaneous DE: Numerical solution of ordinary differential equations of second order and simultaneous differential equations – Taylor's series – Picard's method – Euler's method – Modified Euler's method – RungeKutta method of fourth order.

Text Books:

1. S SSastry, Introductory methods of Numerical Analysis, 3rd ed. New Delhi, India: Prentice Hall of India, 1999.
2. Francis Scheid, Schaum's Outline of Numerical Analysis, Revised ed.: Mc. Graw Hill., 2006.
3. G K Ranganath, Text book of B.Sc. Mathematics, Revised ed. New Delhi, India: S Chand and Company Ltd., 2011.

Reference Books:

1. Erwin Kreyszig Advanced Engineering Mathematics, 8th Ed. New Delhi, India: Wiley India Pvt. Ltd., 2010.
2. M K Jain, S R K Iyengar, and R K Jain, Numerical Methods for Scientific and Engineering Computation, 4th Ed. New Delhi, India: New Age International, 2003.

B19PC6041	**Physics of Clouds**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Basic Knowledge on atmosphere.

Course Objectives:

1. To provide basic knowledge to understand the composition, formation, classification of clouds based on atmospheric thermodynamics.
2. To understand the growth rate, evaporation of droplet by Bergeron process.
3. To understand the role of Collisions and Coalescences process in the droplet growth.
4. To understand the phenomenon of Cloud electrification, precipitation and seeding.

Course Outcomes:

1. Describe the process of formation of clouds.
2. Explain the nucleation and growth of cloud particles.
3. Compare different mechanisms of droplet growth.
4. Explain the electrical phenomenon related to lightening.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6041	**CO1**	**3**	**3**	**2**	**2**	**1**				**3**	**3**
	CO2	**3**	**3**	**2**	**1**	**1**				**3**	**3**
	CO3	**3**	**2**	**2**	**1**	**1**				**3**	**3**
	CO4	**3**	**2**	**2**		**1**				**3**	**3**

Course Contents:

UNIT I: Fundamental concepts: **6 Hrs**

Clouds: Introduction, Definition, identification, classification, altitude and composition.

Atmospheric Thermodynamics: Vapor pressure, Clauius-Clapeyron equation, saturation vapor pressure, ways for reaching saturation and mechanisms for cooling the air.

Fundamental Concepts of Cloud: Liquid water content, parameters of macroscale cloud, cloud drop size distribution, actual drop size distribution.

UNIT II: **6 Hrs**

Formation of Cloud Droplets: General aspects, saturation vapor pressure over a curved droplet, saturation vapor pressure over a solution, combining the curvature and solute effect, atmospheric aerosols, cloud condensation nuclei.

Droplet Growth by Diffusion: growth of an individual droplet by diffusion of water vapor, growth rate in term of mass or radius, other questions needed to solve for growth rate, evaporation of droplet, Bergeron process.

UNIT III: **6 Hrs**

Roplet growth by Collisions and Coalescences: Droplet terminal fall speed, growth due to collection smaller, uniform droplet, collision efficiency, growth equation in terms of radius, growth due to collision with smaller droplets of non-uniform size.

Growth of Ice Crystals: Formation of ice crystals, diffusional growth of ice crystals branching versus faceting, collision-coalescence versus the Bergeron process.

UNIT IV: **6 Hrs**

Precipitation: Types of precipitation, rainfall rate and drop-size distribution. The Marshall-Palmer drop-size distribution.

Weather Modification: Examples of experiments, cloud seeding, and methodology.

Cloud Electrification: Lightning, electrical properties of the fair-weather atmosphere, electrical properties of a thunderstorm, Benjamin Franklin's famous kite experiment, cloud-to-ground lightning, Intra-cloud lightning, other forms of lightning, thunder, lightning rods, lightning safety.

Reference Books:

1. A Short Course in Cloud Physics; R. R. Rogers
2. The Physics of Clouds; B. J. Mason
3. Microphysics of Clouds and Precipitation; H. R. Fletcher and Klett.
4. Lectures on atmospheric thermodynamics.

B19PC6042	**Astro Physics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**3**

Prerequisites:

Understand the space applications.

Course Objectives:

1. To provide basic knowledge to understand the stellar Physics.
2. To understand the formation of Milky Way.

3. To understand the solar system.
4. To understand the cosmology and big bang theory.

Course Outcomes:

1. Describe the aspects of stellar Physics.
2. Explain the formation of galaxy and origin of solar system.
3. Compare different solar systems.
4. Explain the aspects of cosmology.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6042	CO1	3	3	2	1	1				3	3
	CO2	3	3	2	1	1				3	3
	CO3	2	2	2	1	1				3	3
	CO4	3	2	2		1				3	3

Course Contents:

UNIT I: Stellar physics: 6 Hrs
Electromagnetic spectrum, Transmission of radiations through atmosphere, Black body radiation and Wien's law, Physical properties of astronomical objects, Spectral classification of stars, H-R diagram, luminosity classification of stars, distance measurement by Parallax method.

UNIT–II: Milky Way Galaxy and Sun: 6 Hrs
The Milky Way galaxy, inter –stellar medium, inter-stellar molecules, origin of solar system, condensation theory, arguments for and against the theory.

UNIT–III: Solar System 6 Hrs
The Solar system, Surface of Sun, Sunspot, Sunspot cycle, The Sun: Photosphere, chromospheres and corona. Kepler's laws of Planetary motion, early history of planets, Structure, Composition and Atmosphere of our Solar system (all nine planets), Comets, Asteroids, Meteors, Meteoroids, prospectus for life on Mars.

UNIT–IV: Cosmology 6 Hrs
The Big-Bang universe, the steady state cosmology, the oscillating cosmology, the Hubble law and cosmological test.

Books Recommended:

1. Astrophysics (Stars and Galaxies) – K.D. Abhyankar (University Press Hyderabad)
2. Observational Astrophysics – Robert C. Smith (Cambridge University Press)
3. Astrophysics- A Modern Perspective- K.S. Krishna Swamy (New Age International)
4. Stars- Life, Death and Beyond – A. K. kimbhavi, J. V. Narlikar (IUCAA-Pune)
5. An Introduction to astrophysics- Baidynath Basu (PHI)
6. Astronomy – Fundamentals and Frontiers – Robert jastrow and M. H. Thompson (Chap. 9, 12, 14, 15, and 19) Edition, 2nd ed. Publication, Link New York: John Wiley & Sons.

B19PC6043	**Digital Electronics and Communication**	**L**	**T**	**P**	**C**

Duration:14 Wks		2	0	0	2

Prerequisites:

Basics of the digital electronics and communication.

Course Objectives:

1. To Convert values from decimal, binary, octal, hexadecimal, and binary-coded decimal number systems to each other and back to the other systems.
2. To Simply combinational logic circuits with K map
3. To demonstrate and compare different analog modulation schemes.
4. To provide an overview of Satellite communication and its applications in communication

Course Outcomes:

1. Convert values from decimal, binary, octal, hexadecimal, and binary-coded decimal number systems to each other and back to the other systems.
2. Implement logic circuits using universal logic gates.
3. Construct the spectrum of transmission and reception of amplitude modulated and demodulated signals.
4. Explain the block diagram of satellite and TV communication systems.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6043	CO1	3	3	2	1	1				3	3
	CO2	3	3	2	1	1				3	3
	CO3	2	2	2	1	1				3	3
	CO4	3	2	2	1	1				3	3

Course Contents:

Unit I: Number Systems and Logic Gates **6 Hrs**
Decimal numbers, Binary numbers, Binary arithmetic, Octal Numbers, Hexadecimal numbers, Inter-conversions of number systems, Binary coded decimal (BCD), Gray code, Excess-3 code.
Logic Gates: AND gate, OR gate, NOT gate, NAND gate, NOR gate, EX-OR and EX-NOR gates, Universal properties of NAND gates.

Unit II: **Boolean Algebra** **6 Hrs**
Boolean operations, logic expressions, Laws of Boolean algebra, De-Morgan's theorems, Simplification of Boolean expressions using Boolean algebra Techniques, SOP and POS form of Boolean expressions for logic network, Simplification of Boolean expressions using K-Map (up to 4variables).

Unit III: Modulation and Demodulation: **6 Hrs**
Introduction, Types of Modulation, Expression for Amplitude Modulation voltage, AM waves, Frequency spectrum of AM waves, Power Output in AM waves, Expression for frequency modulated voltage, Principle of demodulation, linear diode AM detector or demodulator.

Unit IV: Communication Electronics: **6 Hrs**

Introduction, Historical development of Satellite, Communication Satellite, system communication satellite, Orbiting Satellite, Satellite frequency band. Block diagram of Radio transmitter and TRF Radio receiver, Explanations of function of each block, Super heterodyne radio receiver, Explanations of function of each block, Physical basis of T.V., Block diagram of T.V. Receiver.

Books Recommended:

1. Modern Digital Electronics- R.P. Jain, Tata McGraw Hill Pub. Company (Third edition)
2. Digital Fundamentals-Thomas L. Floyd, Universal Book Stall
3. Digital Principles and Applications- A. P. Malvino, (MGH International Edns (Fourth Edn)
4. Digital Electronics with Practical Approach- G. N. Shinde, Shivani Pub., Nanded
5. Electronics and Radio Engineering – M. L. Gupta
6. Monochrome and Colour T. V. –Gulhati.

<table>
<tr><td>B19PC6051</td><td rowspan="2">Electro-Analytical Chemistry</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Duration:14 Wks</td><td>2</td><td>0</td><td>0</td><td>2</td></tr>
</table>

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	PSO1	PSO2
B19PC6051	CO1	1		1	1				1	3	1
	CO2	1	2	2	1					1	1
	CO3	1		2	1				3	2	1
	CO4	1		1	2				2	3	3

Course Contents:

UNIT-I **6 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 **6 Hrs**

Electro analytical methods: Potentiometry, Conductometry, Colorimetry, cyclic voltammetry and pulse voltammetry.

Electrochemical sensors: Potentiometric Sensors and voltammetric sensors, Sensors for determination of-Amino Acids, Hydrogen, Glucose and urea

UNIT-III **6 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 **6 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.

Reference Books:

1. “Fundamentals of Electroanalytical Chemistry” by Monk (recommended)
2. Engineering Chemistry B. K. Sharma
3. Engineering Chemistry Jayaprakash&Venugopal Engineering Chemistry Jain and Jain.

B19PC6052	**Chemistry of Bio Molecules**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

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 hemoglobin, myoglobin, alkali and alkaline earth metal ions 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	PSO1	PSO2
B19PC6052	CO1	3	2	2	1		2		1	2	3
	CO2	3	2	2	2		1	1		2	3
	CO3	2	3	2	1				2	2	3
	CO4	2	3	2	2			1	1	3	3

Course Contents:

UNIT-I **6hrs**

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 **6Hrs**

Amino acids and proteins:

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with 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.

UNIT-III **6hrs**

Nucleic Acids, Enzymes and Vitamins

Nucleic Acids

Purine and pyrimidine bases. Structure of nucleosides and nucleotides. Methods of formation of internucleotide bonds (DCC, phosphotriester approach). Structure of DNA (Watson-Crick model) and RNAs. Biological importances of DNA and RNAs. Protein-nucleic acid interaction chromatin and viral nuclear capsid.

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

Bioinorganic Chemistry **6 hrs**

Essential and trace elements in biological processes Metalloporphyrins with special reference to hemoglobin and myoglobin Biological role of alkali (Na^+, K^+) and alkaline earth metal ions (Mg^{2+}, Ca^{2+}). Nitrogen fixation.

Reference Books:

1. Biochemistry, J. David Rawn, Neil Pattuson publishers, North Carolina, (USA) 1989.
2. Organic Chemistry. Vol I and Vol II, I. L. Finar, 6th edn. ELBS & Longman (London), 1975.
3. Inroduction to Lipids, D. Chapman, McGraw-Hill, 1969.
4. Advanced general Organic Chemistry, S. K. Ghosh, DK and Allied publishers (UBS), Calcutta, 1998.
5. Text book o Biochemistry, E. S. West, W. R. Todd, H. S. Mason & J. T. Van Bugen, 4th Edn. Amerind publishing co. (New Delhi), 1974.
6. Medicinal Chemistry Ashuthosh Kar Tata Mcgraw Hill Publications.

B19PC6053	**Solid State Chemistry**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Knowledge of band theory of solids, valance band, conduction band.

Course Objectives:

1. Explain basic concept of electronic structure, electrical and magnetic behaviors in solids.
2. Disuses the topic related defect, superconductivity, etc., in solids.
3. Prediction of crystal structure in solids and understanding the basic concept of X-ray diffraction theory, etc.,

Course Outcomes:

1. Analyze the fundamental concepts of nature of bonding and electronic structure in solids.
2. Predict the electrical and magnetic behavior in the solid.

3. Discussion related to the defects in solid and understanding the principle and theory of superconductivity.
4. Identify the crystal structures and defects in solids using various instrumental techniques.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6053	**CO1**	**3**	**2**	**3**	**3**				**1**	**1**	**1**
	CO2	**3**	**2**	**2**	**3**				**1**	**1**	**1**
	CO3	**3**	**3**	**2**	**2**				**2**	**2**	**1**
	CO4	**2**	**2**	**1**	**2**				**1**	**2**	**1**

Course Objectives:

UNIT-I **6 Hrs**

Electronic structure of solids: Bonding in solids: Ionic, covalent, metallic and molecular solids. Free electron theory, Fermi sphere, Fermi-Dirac statistics, Ohm's law, limitations of the free electron theory. Electrons in a weak periodic potential (Independent electron model), energy levels in extended, repeat and reduced zone schemes.

Electrical and Magnetic Properties of Solids: Metals: calculation of density of states, origin of resistivity, weak paramagnetism. Semiconductors: Intrinsic and extrinsic- p and n-types, Hall effect, Junctions and their applications- metal-metal, metal-semiconductor, semiconductor-semiconductor types and transistors.

Insulators- dielectric properties, piezo and inverse piezoelectric effects, ferroelectricity, ferroelectric transitions in $BaTiO_3$, ionic conductivity applications of band theory to TiO and NiO: Limitations of the Independent electron model, modeling electron correlation.

UNIT-II **6 Hrs**

Dynamics of Atoms in a Solid: Dispersion curves of an elastic structureless medium, Longitudinal and Transverse modes, Optical and Acoustic modes of a crystal, total vibrational energy of a crystal. Case study of calcite.

Defects in Solids: Point defects, Line defects and Plane defects, Stacking faults and grain boundaries

Superconductivity: Superconductivity, Meisner effect, Type I and type II superconductors, Features of superconductors, Frolich diagram, Cooper pairs, Theory of low temperature superconductivity, Junctions using superconductors.

UNIT-III **6 Hrs**

Geometric Crystallography: Symmetry elements, Bravais lattices, Screw axes and glide planes, point groups, and space groups and nomenclature. Law of Interfacial angle (Euler's construction).

Diffraction theory and Single crystal X-ray diffraction: X-rays, Bragg's law, assignment of lines, diffraction pattern of a primitive cubic lattice, space group extinctions, Scaterring factor and structure factor, intensities from atomic positions for BCC and FCC lattices; Ewald's sphere of reflection, Reciprocal Lattice concept, Electron density function, Fourier synthesis, Fourier transform of the structure factor, Phase problem and Patterson synthesis.

UNIT-IV **6 Hrs**

Experimental Methods:

Rotation, Oscillation, Weissenberg and Precession methods. Debye-Scherrer method (Powder method), Determination of lattice parameters from these methods.
Electron diffraction: Experimental technique, Wierl equation, Radial-Distribution method.
Neutron diffraction: Principle and Theory, advantages and uses.

Reference Books:

1. Introduction to Solids, L. V. Azaroff, McGraw Hill Book Co., New York, 1960.
2. Solid State Physics, N. W. Ashcroft and N. D. Mermin, Holt Saunders International Ltd., New York (1976).
3. Physical Chemistry, G. M. Barrow, McGraw Hill (2nd ISE) (1966).
4. An Introduction to X-ray Crystallography, M. M. Woolfson, Cambridge University Press-Vikas Publishing House, New Delhi (1980).
5. Principles of the Solid State, H. V. Kheer, Wiley Eastern Ltd., New Delhi (1993).
6. Dynamics of Atoms in Crystals, W. Cochran, Edward Arnold, London, 1973. (pages 24-37)
7. Vibrational Spectroscopy of Solids, P.M.A. Sherwood, University Press, Cambridge, 1972. (pages: 1-45)
8. Phase Transitions, C.N.R. Rao and K.J. Rao, Cambridge University Press
9. X-ray Structure determination: A practical guide, George H Stout and Lyle H Jenson, Macmillan Publishing Co. Inc and Collier Macmillan Publishers.

B19PC6061	**Fuzzy Mathematics**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Basic knowledge of set theory.

Course Objectives:

1. Students will study the fuzzy sets, basic operation on fuzzy sets and inverse fuzzy operations.
2. Students will study fuzzy subsets and its properties.
3. Student will read and analyze the concept of fuzzy rings

Course Outcomes:

1. Analyze the concept of fuzzy set and fuzzy logic using fuzzy operations.
2. Apply the concept of fuzzy sum, fuzzy product and Cartesian product on real world problems.
3. Analyze the concept of algebra of fuzzy relations and logic connectives.
4. Analyze the concept of fuzzy invariant subgroups and fuzzy subrings.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6061	CO1	3	3	2	3					2	3
	CO2	3	3	2	2					3	3
	CO3	3	2	3	3					3	2
	CO4	3	3	3	2					3	3

Course Contents:

Unit – I **6 Hrs**

Introduction, Fuzzy subsets, Lattices and Boolean Algebras, L fuzzy sets, operations on fuzzy, level sets, properties of fuzzy subsets.

Unit – II **6 Hrs**

Algebraic product and sum of two fuzzy subsets-properties satisfied by Addition and Product, Cartesian product of fuzzy subsets.

Unit – III **6 Hrs**

Introduction, Algebra of fuzzy relations and logic connectives.

Unit – IV **6 Hrs**

Some more connectives, Introduction, fuzzy subgroup, homomorphic image and Preimage of subgroupoid. Fuzzy invariant subgroups and fuzzy subrings.

Text Books:

1. S. Nanda and N. R. Das Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi, 2010.

Reference Books:

1. M.Ganesh, Introduction to Fuzzy Sets & Fuzzy Logic, Prentice Hall of India Pvt. Ltd., 2006.
2. John N. Mordeson and PremchandS.Nair, Fuzzy Mathematics.

B19PC6062	**Topology**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Set theory and properties of set theory.

Course Objectives:

1. The aim of the course is to provide for the students an introduction to theory of metric and topological spaces with emphasis on those topics that are important to further studies.
2. The course focuses on Homotopy, Homology theories and Topological groups and Lie groups.

Course Outcomes:

1. Analyze different axioms of Topology.
2. Learn Homotopy Theory.
3. Analyze fundamental groups of S_1 and S_n .
4. Analyze Topological groups and Lie groups.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2

B19PC6062	**CO1**	**3**	**3**	**2**	**2**	**2**				**3**	**3**
	CO2	**3**	**2**	**3**	**2**	**3**				**2**	**3**
	CO3	**3**	**3**	**2**	**3**	**2**				**3**	**3**
	CO4	**3**	**3**	**2**	**3**	**2**				**3**	**2**

Course Contents:

Unit-I **6 Hrs**

General Topology: Introduction, metric topology, separation axioms, compactness, Connectedness, product topology, introduction to manifolds, sub manifolds.

Unit-II **6 Hrs**

Homotopy Theory. Covering spaces, homotopy maps, homotopy equivalence, Contractible spaces, deformation retraction.

Unit-III **6 Hrs**

Fundamental Groups: Universal cover and lifting problem for covering maps, Fundamental groups of S1 and Sn. Introduction to Homology Theory.

Unit-IV **6 Hrs**

Topological Groups: Introduction, integration on locally compact spaces, Haar Measure, Character groups, group action. Lie groups and lie algebras: Basic theory, linear groups.

Suggested texts:

1. C.O. Christenson and W.L. Voxman. Aspects of Topology.
2. J.R. Munkres. General Topology.
3. I.M. Singer and J.A. Thorpe. Lecture Notes in Elementary Topology and Geometry.
4. K. Chandrasekharan. A Course on Topological Groups.

Reference Books:

1. W. Fulton and J. Harris. Representation Theory.
2. F.W. Warner. Foundations of Differentiable Manifolds and Lie Groups.

B19PC6063	**Discrete Mathematics and Graph Theory**	**L**	**T**	**P**	**C**
Duration:14 Wks		**2**	**0**	**0**	**2**

Prerequisites:

Sets, relations, trees, graphs and Boolean algebra.

Course Objectives:

1. Study the set theory, logic, recurrence relations and functions and to know the application of Boolean algebra to switching theory.
2. Uunderstand and apply the fundamental concepts in graph theory.
3. Apply graph theory-based tools in solving practical problems.

Course Outcomes:

1. Apply operations on discrete structures such as sets, relations, functions and Recurrence relations.
2. Apply Boolean algebra to switching theory and their minimization techniques and Phase structure, grammars and languages, Finite State Machine, Recognition in regular languages.
3. Apply principles and concepts of graph theory in practical situations
4. Apply the theory and applications of graphs, fundamental theorems and their proofsand computer applications such as networks of communication, data organizations, computational devices and the flow of computation.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6063	CO1	3	3	2	2	3				3	3
	CO2	3	2	3	2	2				2	3
	CO3	3	3	2	3	3				3	2
	CO4	3	3	3	2	2				3	3

Course Contents:

Unit-I: Discrete numeric functions and Generating functions: 6Hrs

Introduction, Manipulation of numeric functions, Asymptoticbehavior of numeric functions, Generating functions. Recurrence relations and Recursive Algorithms. Introduction, Recurrence relations, Linear recurrence relation with constant coefficients, Homogeneous solutions, particular solutions.

Unit-II: Boolean algebra: 6 Hrs

Application of Boolean algebra to switching theory. Languages - Recognition and generation - Phase structure grammars and languages – Finite State Machine - Recognition in regular languages.

Unit-III: Grpah Theory -1 6 Hrs

Graph,finite, Infinite graphs, Incidence and degree , Isolated vertex, Pendent vertex, Null graph, Isomorphism, Sub-graphs, Walks, Paths, Circuits, Connected and disconnectedgraphs, Components, Euler graphs, Operation on graphs, Hamiltonian paths, Circuits, Trees and some properties of trees, Rootedand binary tree, Spanning tree and fundamental circuits.

Unit-IV: Grpah Theory -2 6 Hrs

Cutsets, Properties, Fundamental cut sets, Connectivity, Seperability, Planar graphs, Kuratowskiís graphs, Different representation of planar graphs, Geometric dual, Ring sum of two circuits, Subspace, Orthogonal vectors, Matrix representation, Incidence matrix, Cutset matrix, Circuit matrix, Adjacency matrix.

Text Books:

1. Elements of Discrete Mathematics 3rdedition by C.L. Liu, Tata Macgraw Hill Publishers (2008).
2. Discrete Mathematical Structures with Applications to Computer Science by J.P. Trembley and R. Manohar, TataMagrawHill Publishers
3. Kenneth H. Rosen, Discrete Mathematics and its Application, Fifth edition, Tata McGraw-Hill Publishing company PVT. Ltd., New Delhi, 2003.

Reference Books:

1. NarsingDeo: Graph Theory & Applications (PHI), India.
2. Frank Harrary: Graph Theory Narosa Publications, India.

Course Code	Course Title	Course Type	L	T	P	C	Hrs / Week
B19PC6070	**MOOC / SWAYAM/ Internship**	RULO	0	0	2	2	3

MOOC/ SWAYAM:

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 OOC courses.

A student shall register and successfully complete any of the courses available on SWAYAM. Student shall inform the MOOC/SWAYAM coordinator of the school about the course to which he/she has enrolled. The minimum duration of the course shall be not less than 40 hours and of 4 credits. The student should submit the certificate issued by the SWAYAM to the MOOC/SWAYAM coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University

Course Code	Course Title	Course Type	L	T	P	C	Hrs / Week
B19PC6080	**Soft Skill Training**	RULO	1	1	0	2	3

Note: Soft Skill Training courses are organised by the **Placement and Training Centre**. The students have to undergo Soft Skill Courses conducted by the said Centre.

B19PC6090	**Physics Lab–VII**	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Prerequisites:

Number system, combinational circuits, sequential circuits.

Course Objectives:

1. To impart the practical knowledge
2. To train the students to do the experiments in a systematic way, collect the data and analyze it.
3. To motivate the students to think in more practical way by giving the hands-on training.

Course Outcomes:

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

1. Conduct the experiments related to different Physics laws and theories.
2. Employ the different tools and techniques to get the data/readings related to the experiments.
3. Verify the fundamental physics behind many scientific discoveries through hands on experimentation.
4. Study of X-ray Photographic plates.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6090	CO1	3	2	2		1				3	3
	CO2	3	2	2	1	1				3	3
	CO3	2	2	2	1	1				3	3
	CO4	2	2	2	1	1				2	2

Prerequisites:

Any **EIGHT** of the following experiments

1. Verification of inverse square law for gamma-rays.
2. Half-life of K 40.
3. Absorption coefficient of gamma-rays.
4. Study of solar cell-I V Characteristics, F F& efficiency.
5. Phase measurement in LCR circuit using CRO.
6. Four probe- Resistivity measurements.
7. Verification of Maximum power transfer theorem.
8. Negative feed-back amplifier.
9. Study of X-ray photograph – determination of interplanar distance.
10. Characteristics of a GM-tube.

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S.Sudha.D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013
2. R. K. Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G.L. Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.

2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
4. Practical Physics – S. L. Gupta &V. Kumar (PragatiPrakashan).

B19PC6X10	Mathematics-V Lab	L	T	P	C
Duration:14 Wks		0	0	2	2

Prerequisites:

Definition of linear transformations, evaluation of double and triple integrals.

Course Objectives:

1. Interpret derivatives of vector valued functions as velocity and acceleration functions.
2. Learn to evaluate multiple integrals.
3. Explain the definition and properties of vector space and its base.

Course Outcomes:

1. Determine and apply divergence, curl and scalar potential associated with scalar and vector fields.
2. Apply Fundamental theorem to evaluate Area, Region and Volume of geometrical bodies using Green's theorem, Stoke' s theorem or Gauss divergence theorem.
3. Describe and manipulate vector spaces, subspaces and their bases.
4. Determine the kernel, image space and matrix representation of a linear transformation.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6X10	CO1	3	2	2	2					3	3
	CO2	3	2	3	2					2	2
	CO3	3	3	2	3					3	3
	CO4	3	2	2	2					3	3

Course Contents:

1. Verification of Green's theorem.
2. Verification of Gauss Divergent theorem.
3. Verification of stokes theorem
4. Expressing a vector as a linear combination of given set of vectors
5. Examples on linear dependence and independence of vectors
6. Evaluation of basis and dimension
7. Verifying whether a given transformation is linear or not

8. Finding a matrix of linear transformation
9. Finding a linear transformation of a matrix.
10. Verification of Rank nullity theorem.
11. To demonstrate the physical interpretation of gradient, divergence and curl.
12. To write gradient, divergence, curl and laplacian in cylindrical coordinates
13. To write gradient divergence, curl and laplaction in spherical co ordinates.
14. Evaluation of the line integral with constant limits.
15. Evaluation of the line integral with variable limits.
16. Evaluation of the double integral with constant limits.
17. Evaluation of the double integral with variable limits.
18. Evaluation of the triple integral with constant limits.
19. Evaluation of the triple integral with variable limits.
20. Evaluation of surface area of revolution.
21. Evaluation of volume of revolution.

Text Books:

1. SCILAB: A Practical Introduction to Programming and Problem Solving [Print Replica] Kindle Edition by Tejas Sheth (Author).

2. The Maxima Book Paulo Ney de Souza Richard J. Fateman Joel Moses Cliff Yapp 19th September 2004.

B19PC6X20	Numerical Methods – Lab	L	T	P	C
Duration:14 Wks		0	0	2	2

Prerequisites:

Basic concepts of numerical methods.

Course Objectives:

1. Provide students an introduction to the field of numerical analysis.
2. Aside from developing competency in the topics and emphases listed, the course aims to develop and apply problem solving skills through the introduction of numerical methods.
3. Provide a ground for applying knowledge acquired in previous mathematics courses and give students an opportunity to develop and present an independent project.

Course Outcomes:

1. Acquire proficiency in using *Maxima* to study Numerical analysis.
2. Use *Maxima* to solve the system of equations
3. Be familiar with the built-in functions to find the largest eigen value using power method.
4. Acquire proficiency in using *Maxima* to study the solution of integrals using interpolation.

Mapping of Course Outcomes with programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
B19PC6X20	CO1	3	3	2	2					2	3
	CO2	3	2	2	3					3	2

	CO3	**3**	**2**	**3**	**2**					**3**	**2**
	CO4	**3**	**3**	**2**	**2**					**3**	**3**

Course Contents:

1. Solving algebraic equation using the Bisection method
2. Solving algebraic equation using the Regular – Falsi method
3. Solving algebraic equation using Newton – Raphson method
4. Solving system of equation using Jacobi method
5. Solving system of equation using Gauss – Seidel method
6. Solving for largest Eigenvalue by power method
7. Solving ordinary differential equation by modified Euler's method.
8. Solving ordinary differential equation by Runge - Kutta methods of 4^{th} order.
9. Evaluating integrals using Trapezoidal Rule.
10. Evaluating integrals using Simpson's $\frac{1}{3}$rd rule.
11. Evaluating integrals using Simpson's $\frac{3}{8}^{th}$ rule.
12. Finding values of functions using interpolation.

Text Books:

1. SCILAB: A Practical Introduction to Programming and Problem Solving [Print Replica] Kindle Edition by Tejas Sheth (Author).
2. The Maxima Book Paulo Ney de Souza Richard J. Fateman Joel Moses Cliff Yapp 19th September 2004

B19PC6X30	**Project**	**L**	**T**	**P**	**C**
Duration:14 Wks		**0**	**0**	**2**	**2**

Registrar
REVA University
Bengaluru - 560 064