REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

B. TECH IN ROBOTICS & AUTOMATION

HAND BOOK: 2021-25

Rukmini Educational
Charitable Trust

Rukmini Knowledge Park
Kattigenahalli, Yelahanka,
Bengaluru – 560064, INDIA

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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

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HANDBOOK

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2021-25

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Ref: RU/BoS/ECE/CEC/June-2022/10

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

Ref: RU/BoS/ECE/CEC/June-2022/10

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. 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.

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!

Ref: RU/BoS/ECE/CEC/June-2022/10

Director's –Message

Since the inception of REVA University, School of Electronics and Communication Engineering is involved in implementing following best practices in various dimensions such as academics, research, outreach activities, student development programs, project based and research based learning, student centric learning, student competitions, industry and in-house internships, abroad internships, skill enhancement activities, motivation for competitive exams, mini projects, major projects, industry mentored projects, multidisciplinary projects, industry visits, technical talks by industry and academicians, certification programs, etc. Individual students are taken care by strong mentoring system wherein faculty members are not only allotted as mentors to students, but also they will act as local guardians and they will have constant follow up with mentees in regard to academic and personal issues till students complete the degree.

The curriculum is carefully designed to meet the current industry trends and also to provide insight into future technology developments that lead to inculcate lifelong learning abilities in students. Board of Studies (BoS) comprises people from academics, industry, alumni and current students which form the strong backbone for our programs wherein constant updates happen in contents/subjects every semester based on current industry needs. Curriculum has good mix of foundation courses, hardcore courses, softcore courses, practical and projects along with open electives on par with global education standards.

Student's welfare is given utmost priority at School of Electronics and Communication 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/video contents/quizzes are given and critical thinking questions are asked to test understanding. Experienced, well qualified and friendly faculty members always strive hard to provide best of education to students. The faculty members have number of publications in reputed national and international journals/conferences. The school is also involved in funded research projects.

I am sure the students choosing B Tech and M. Tech programs in School of Electronics and Communication Engineering in REVA University will enjoy the curriculum, teaching and learning environment, well equipped laboratories, digital classrooms infrastructure and the experienced teachers involvement and guidance.

Ref: RU/BoS/ECE/CEC/June-2022/10

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 43 Undergraduate Programmes, 33 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands-on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous

Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Sensor 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 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.

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

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

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

Mission

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

Objectives

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

ABOUT SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

The School of Electronics and Communication Engineering headed by a highly experienced Professor and is supported by well qualified faculty members. The school has the state-of-art class rooms and well-equipped laboratories. It offers B. Tech. and M. Tech. and PhD programs in various specialized streams. The curriculum of both the graduate and the post graduate degree programs have been designed to meet the current industry trends. The school of ECE offers 3 UG programs: B. Tech in Electronics and Communication engineering, B. Tech in Electronics and Computer Engineering and B. Tech in Robotics and Automation. These programs offer numerous choices of study for the students based on interest in the current state of art technology. Apart from fundamental courses in Electronics and Communication Engineering, the school facilitates to study in four streams such as Circuits and Devices, Communication Engineering, Signal Processing and Programming, Robotics and Automation. Students are at liberty to choose from these streams in higher semesters. This is reflected in various core subjects offered within the program.

The Master degree programs focus on research and design in the core and IT industries, building and marketing the next generation of product development. These programs provide an opportunity to explore newer dimensions in cutting edge technologies like Electronic Circuits and Communication, Signal Processing and Computer Networks, VLSI and Embedded Systems and pursue research in interested domains for doctoral degree.

Vision

The School of Electronics and Communication Engineering is envisioned to be a leading center of higher learning with academic excellence in the field of electronics and communication engineering blended by research and innovation in tune with changing technological and cultural challenges supported with leadership qualities, ethical and moral values.

Mission

- Establish a unique learning environment to enable the students to face the challenges in the field of Electronics and Communication Engineering and explore multidisciplinary which serve the societal requirements.
- Create state-of-the-art laboratories, resources and exposure to the current industrial trends to enable students to develop skills for solving complex technological problems of current times and also provide a framework for promoting collaborative and multidisciplinary activities.
- Promote the establishment of Centers of Excellence in niche technology areas to nurture the spirit of innovation and creativity among faculty and students.
- Offer ethical and moral value-based education by promoting activities which inculcate the leadership qualities, patriotism and set high benchmarks to serve the society.

Programme Overview- B. Tech in Robotics and Automation

B. Tech in Robotics and Automation is an interdisciplinary branch of Electronics & Communication Engineering, Mechanical Engineering, Electrical Engineering, and computer science engineering. Robotics and Automation is an engineering field that deals with the construction, design, application, and operation of robots and automated systems. Recent developments in the field of robotics have helped in bringing forth a new era of technology and myriad career opportunities.

Robotics engineers work with the science of robotics and make these programs or self-sufficient machines (also known as ROBOTS) for multiple functions and businesses such as production, automotive, automation and autonomous systems and services, and a lot more! The primary agenda behind this is to program machines to do outdated, risky, or undesirable jobs. A robotics engineer usually works in the designing of these models, assembles, and tests machines, and maintains the software that controls them. Robotic engineers are responsible for planning, testing, and building robots that are profitable, safe, and also easy to buy and maintain. Robotics research engineers plan robotic systems and research strategies to make them practical.

As per the statistics, coming decade will witness highest transition in the workforce because of robotics and automation. Many of the routine and risky jobs will be replaced by robots, while many new creative jobs will be created. Considering the industry requirements and Ongoing demand, School of ECE, REVA University offers a program “BTech in Robotics and Automation”.

This newly launched interdisciplinary program covers:

- Advances in artificial intelligence and sensor technologies will allow robots to cope with a far greater degree of task-to-task variability.
- The ability to adapt robotic actions in response to changes in their environment will create opportunities for automation in areas such as agriculture, industrial automation, healthcare, transportation, and defense sectors.
- Simultaneous Localization and Mapping (SLAM) integrated by Computer Vision technologies are the future industry trends that are achieved through robotics and automation.

The benefits of choosing **B. Tech in Robotics and Automation** are as follows.

- Ample opportunities exist in the field of Robot design and Programming, Industrial automation, Automotive electronics, Aerospace engineering, defense sectors and core electronics jobs including the IT sector. Flexibility to choose various fields upon graduation
- Great number of opportunities also exists in the field of defense to work in the areas of Aerospace and Aviation engineering.
- Provides a platform to venture into a startup and establish as an entrepreneur.
- Provides a platform to focus on the research and innovation which leads to socio-economic reforms.
- In addition to core electronics and mechanical jobs, graduates can get opportunities in the various sectors like Manufacturing plants, Agriculture engineering, Gaming industry and medical research etc.

Program Educational Objectives (PEOs)

After few years of graduation, the graduates of B. Tech. (Robotics and Automation) will be:

- **PEO-1:** To have successful professional careers in industry, government, academia and military as innovative engineers.
- **PEO-2:** To successfully solve engineering problems associated with the lifecycle of Robotics and Automation Systems by communicating effectively either leading a team or as a team member
- **PEO-3:** To continue to learn and advance their careers through activities such as participation in professional organizations, attainment of professional certification for lifelong learning and seeking higher education.
- **PEO-4:** To be active members ready to serve the society locally and internationally and will take up entrepreneurship for the growth of economy and to generate employment.

Program Outcomes (POs)

On successful completion of the program, the graduates of B. Tech. (Robotics and Automation) program will be able to:

- **PO-1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals for the solution of complex problems in Robotics and Automation Engineering.
- **PO-2: Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
- **PO-3: Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO-4: Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO-5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO-6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO-7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO-8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO-9: Individual and teamwork:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
- **PO-10: Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations and give and receive clear instructions.
- **PO-11: Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
- **PO-12: Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

On successful completion of the program, the graduates of B. Tech. (Robotics and Automation) program will be able to:

- **PSO-1:** Design and Development of robotic systems that are cost effective, environment friendly to solve engineering and societal problems using advanced tools and techniques.
- **PSO-2:** Model, program and build an error free, safe, and productive automation systems for various manufacturing processes.
- **PSO-3:** Apply domain knowledge of robotics and automation to provide solutions in interdisciplinary areas to meet current industrial challenges.

REVA UNIVERSITY
Bengaluru, India

REVA University Academic Regulations

B. Tech., (4 years) Degree Programs

(Applicable for the programs offered from 2020-21 Batch)

Ref: RU/BoS/ECE/CEC/June-2022/10

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

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – B. Tech., Degree Program 2021-22 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

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

2. The Programs:

These regulations cover the following B. Tech., Degree programs of REVA University offered during 2021-22

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
Robotics and Automation

3. Duration and Medium of Instructions:

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

3.2 The medium of instruction shall be English.

4. Definitions:

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

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

L	**Lecture**
T	**Tutorial**
P	**Practice**

Where:

L stands for **Lecture** session consisting of classroom instruction.

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

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

4.2 Classification of Courses

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

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

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

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

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

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

4.2.5 Open Elective Course (OE):

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

4.2.6 Mandatory Non-Credit Course (MC): These courses are mandatory for students joining B.Tech. Program and students have to successfully complete these courses before the completion of degree.

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

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

5. Eligibility for Admission:

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

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B Tech)	4 Years (8 Semesters)	Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry,

			Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subject obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together.
2	Bachelor of Technology (B Tech)	Lateral entry to second year	A. Passed Diploma examination from an AICTE approved Institution with at least 45% marks (40% in case of candidates belonging to SC/ST category) in appropriate branch of Engineering / Technology. B. Passed B. Sc Degree from a recognized University as defined by UGC, with at least 45% marks (40% in case of candidates belonging to SC/ST category) and passed XII standard with mathematics as a subject. C. Provided that in case of students belonging to B. Sc. Stream, shall clear the subjects of Engineering Graphics / Engineering Drawing and Engineering Mechanics of the first year Engineering program along with the second-year subjects. D. Provided further that, the students belonging to B. Sc. Stream shall be considered only after filling the seats in this category with students belonging to the Diploma stream. E. Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized University as defined by UGC, shall also be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first-year class in case the vacancies at lateral entry are exhausted. However, the admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above.
	Bachelor of Technology	Lateral entry to fourth year	Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to

	(B Tech)	(final year)	the respective semester in the concerned branch of study, provided he/she fulfils the University requirements.
4	B. Tech. in Bioelectronics		Pass in PUC / 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry / Biotechnology / Biology / Computer Science / Electronics / Technical Vocational subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC / ST category) in the above subjects taken together of any board recognized by the respective State Government / Central Government / Union Territories or any other qualification recognized as equivalent there to.

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

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

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

6.3 The credit hours defined as below:

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

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

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

The following table describes credit pattern

Table -2: Credit Pattern

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

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

7. Different C**ourses of Study**:

Different C**ourses of Study** are labeled as follows:

a. Core Course (CC)
b. Foundation Course (FC)
c. Hard Core Course (HC)
d. Soft Core Course (SC)
e. Open Elective Course (OE)
f. Mandatory Non Credit Course(MC)
g. Project Work / Dissertation:
h. A project work carrying **TWO, FOUR or SIX** credits is called Minor Project work / Dissertation. A project work of **EIGHT, TEN, TWELVE or SIXTEEN** credits is called Major Project work / Dissertation. A Project work may be a hard core or a Soft Core as decided by the BoS / concerned.

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

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

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

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

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

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

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

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

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

8.7 Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimum of

4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B Tech Degree program**.**

8.7.1. Add on Proficiency Diploma / Minor degree/ Honor Degree:

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

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

9 Assessment and Evaluation

9.1 The Scheme of Assessment will have two parts, namely;

i. Internal Assessment (IA); and
ii. Semester End Examination (SEE)

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

9.3 The 50 marks of internal assessment shall comprise of:

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

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

- 1st test is conducted for 15 marks during **6th week** of the Semester;
- 2nd test is conducted for 15 marks during **12th week** of the of the Semester;

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

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

- Question paper of the **2nd test should be based on second 40 %of the total syllabus**;
- An assignment must be designed to cover the last **20% of the Syllabus**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

9.23 Online courses may be offered as per UGC norms.
For online course assessment guidelines would be as follows:

1. If the assessment is done by the course provider, then the school can accept the marks awarded by the course provider and assign the grade as per REVA University norms.
2. If the assessment is not done by the course provider, then the assessment is organized by the concerned school and the procedure explained in the regulation will apply
3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

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

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

9.25 Utilization of one or two credit online courses would be:

4-week online course – 1 credit

8-week online course / MOOC – 2 credits

12-week online course / MOOC – 3 credits

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

Summary of Internal Assessment and Evaluation Schedule

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

10 Assessment of Students Performance in Practical Courses

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

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

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

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

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

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

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

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

For > 3 credit courses

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

For 1 & 2 credit courses

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

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

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

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

12. Evaluation of mandatory courses: Students should maintain minimum of 75% attendance to appear for SEE of Mandatory course. The SEE should be conducted in MCQ pattern and students should get minimum pass grade to obtain the degree. There is no internal assessment

13.Requirements to Pass a Course:

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

marks) in Semester End Examination (SEE) which is compulsory.

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

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

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

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

a. Computation of SGPA and CGPA

The Following 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	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21

Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
Course 7	3	O	10	3X10=30
	19			159

Thus, **SGPA = 159 ÷ 19 = 8.37**

Illustration No. 2

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

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

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

Thus**, SGPA = 199 ÷ 24 = 8.29**

b. Cumulative Grade Point Average (CGPA):

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

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

Illustration:

CGPA after Final Semester

Semester	**No. of Credits**	**SGPA**	**Credits x SGPA**

(ith)	(Ci)	(Si)	(Ci X Si)
1	19	6.83	19 x 6.83 = 129.77
2	21	7.29	21 x 7.29 = 153.09
3	22	8.11	22 x 8.11 = 178.42
4	22	7.40	22 x 7.40 = 162.80
5	22	8.29	22 x 8.29 = 182.38
6	22	8.58	22 x 8.58 = 188.76
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**160**		**1288.36**

Thus, **CGPA** = $\frac{19x6.83+21x7.29+22x8.11+22x7.40+22x8.29+22x8.58+22x9.12+10x9.25}{160}$ = 8.05

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.05 x 10=80.5

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

14.Classification of Results

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

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

Overall percentage=10*CGPA

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

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

Attendance Requirement:

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

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

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

15. Re-Registration and Re-Admission:

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

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

16. Absence during Internal Test:

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

17. Provision for Appeal

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

i. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances.

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

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

18. Eligibility to Appear for Semester End Examination (SEE)

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

19. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination

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

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

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

Case 1: A student who has failed in a maximum of 4 courses in 1st and 2nd semester together shall move to the 3rd semester of the succeeding year.

Case 2: A student who has failed in a maximum of 4 courses from semester 1 to 4 together shall move to the 5th semester of the succeeding year.

Case 3: A students who has failed in a maximum of 4 courses from semester 1 to 6 together shall move to the 7th semester of the succeeding year.

21. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

b. The answer scripts (in whatever form) for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

22. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-

Chancellor shall be final.

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

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

Approved scheme and syllabus

(2021-25 Batch)

B. Tech. Robotics and Automation

2021-25

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Ref: RU/BoS/ECE/CEC/June-2022/10

B. Tech in Robotics and Automation
Scheme of Instructions 2021-25 Batch

I SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21AS0102	Calculus and Differential Equations	FC	3	0	0	3	3
2	B21AS0104	Engineering Chemistry	FC	3	0	0	3	3
3	B21CI0101	Introduction to Python Programming	HC	2	0	1	3	4
4	B21EN0101	Principles of Electrical and Electronics	HC	3	0	1	4	5
5	B21ME0103	Elements of Mechanical and Civil Engineering	HC	3	0	0	3	3
TOTAL				**14**	**0**	**2**	**16**	**18**
Practical /Term Work / Sessional								
6	B21AS0109	Biology for Engineers	FC	1	0	0	1	1
7	B21ME0102	Design Thinking	FC	1	0	1	2	3
TOTAL				**2**	**0**	**1**	**3**	**4**
TOTAL SEMESTER CREDITS				**19**				
TOTAL CUMULATIVE CREDITS				**19**				
TOTAL CONTACT HOURS				**22**				

II SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21AS0203	Integral Transforms	FC	4	0	0	4	4
2	B21AS0202	Engineering Physics	FC	3	0	1	4	5
3	B21CS0101	Introduction to Data Science	HC	2	0	1	3	4
4	B21EO0201	Analog and Digital Electronics	HC	3	0	1	4	5
TOTAL				**12**	**0**	**3**	**15**	**18**
Practical /Term Work / Sessional								
5	B21EC0101	IoT and Applications	HC	1	0	1	2	3
6	B21ME0104	Entrepreneurship	HC	1	0	0	1	1
7	B21ME0101	Computer Aided Engineering Drawing	HC	2	0	1	3	4
TOTAL				**4**	**0**	**2**	**6**	**8**
TOTAL SEMESTER CREDITS				**21**				
TOTAL CUMULATIVE CREDITS				**40**				
TOTAL CONTACT HOURS				**26**				

III SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21AS0305	Linear algebra and Partial Differential Equations	FC	3	0	0	3	3
2	B21EO0301	Fundamentals of Robotics and Applications	HC	3	0	0	3	3
3	B21EO0302	Sensors and Actuators for Robotics	HC	3	0	0	3	3
4	B21EO0303	Strength of Materials	HC	3	0	1	4	5
5	B21EN0304	Problem Solving Using C Programming	HC	1	1	0	2	3
TOTAL				**13**	**1**	**1**	**15**	**17**
Practical /Term Work / Sessional								
6	B21EO0304	Fundamentals of Robotics and Applications Lab	HC	0	0	1	1	2
7	B21EN0308	Problem Solving Using C Programming Lab	HC	0	0	1	1	2
8	B21EO0305	Course based project on Sensors and Actuators for Robotics	HC	0	0	1	1	2
9	B21AS0303	Environmental Science	FC	2	0	0	2	2
10	B21MG0301	Management Science	FC	2	0	0	2	2
11	B21AHM301 or B21AHM302	Advanced Kannada or Basics of Kannada	MC	0	0	0	0	1
TOTAL				**4**	**0**	**3**	**7**	**11**
TOTAL SEMESTER CREDITS				**22**				
TOTAL CUMULATIVE CREDITS				**62**				
TOTAL CONTACT HOURS				**28**				

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21AS0402	Probability and Random Process	FC	3	0	0	3	3
2	B21EO0401	Robot Kinematics and Dynamics	HC	3	0	0	3	3
3	B21EO0402	Microcontrollers for Robotics	HC	3	0	0	3	3
4	B21EO0403	Signal Conditioning and Data Acquisition systems	HC	3	0	1	4	5
5	B21EO0404	Process Control Automation	HC	3	0	0	3	3
TOTAL				**15**	**0**	**1**	**16**	**17**
Practical /Term Work / Sessional								
6	B21EO0405	Microcontrollers for Robotics Lab	HC	0	0	1	1	2
7	B21EO0406	Process Control Automation Lab	HC	0	0	1	1	2

8	B21EO0407	Course Based Project on Microcontrollers for Robotics	HC	0	0	1	1	2
9	B21AH0301	Communication skills	FC	2	0	0	2	2
10	B21LS0301	Indian Constitution and Professional Ethics	FC	2	0	0	2	2
11	B21AHM401	Universal Human Values	MC	0	0	0	0	1
			TOTAL	**4**	**0**	**3**	**7**	**11**
				TOTAL SEMESTER CREDITS		**23**		
				TOTAL CUMULATIVE CREDITS		**85**		
				TOTAL CONTACT HOURS		**28**		

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21EO0501	Classical Control Systems	HC	3	0	0	3	3
2	B21EO0502	AI and ML for Robotics	HC	3	0	0	3	3
3	B21EO0503	Hydraulics and Pneumatics	HC	3	0	1	4	5
4	B21EOS51X	Professional Elective-1	SC	3	0	0	3	3
5	B21EOS52X	Professional Elective-2	SC	3	0	0	3	3
6	B21XXO5XX	Open Elective-1	OE	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B21EO0504	Classical Control Systems Lab	HC	0	0	1	1	2
8	B21EO0505	AI and ML for Robotics Lab	HC	0	0	1	1	2
9	B21EN0506	Technical Documentation	HC	1	0	0	1	1
10	B21EO0506	Research Based Project	HC	0	0	2	2	4
			TOTAL	**1**	**0**	**4**	**5**	**09**
			TOTAL SEMESTER CREDITS			**24**		
			TOTAL CUMULATIVE CREDITS			**109**		
			TOTAL CONTACT HOURS			**29**		

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21EO0601	ROS and Robot Programming	HC	3	0	0	3	3
2	B21EO0602	Computer Vision and Image Processing	HC	3	0	0	3	3
3	B21EO0603	Automation System Design in Manufacturing	HC	1	1	1	3	5
4	B21EO0604	Field and Service Robots	HC	3	0	0	3	3
5	B21EOS63X	Professional Elective-3	SC	3	0	0	3	3
6	B21XXO6XX	Open Elective-2	OE	3	0	0	3	3

TOTAL				**16**	**1**	**1**	**18**	**20**
Practical /Term Work / Sessional								
7	B21EO0605	ROS and Robot Programming Lab	HC	0	0	1	1	2
8	B21EO0606	Computer Vision and Image Processing Lab	HC	0	0	1	1	2
9	B21EO0607	Mini project/Internship	HC	0	0	2	2	4
10	B21PA0501	Indian Tradition and Culture	FC	1	0	0	1	1
TOTAL				**1**	**0**	**4**	**5**	**9**
TOTAL SEMESTER CREDITS				**23**				
TOTAL CUMULATIVE CREDITS				**132**				
TOTAL CONTACT HOURS				**29**				

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21EO0701	Autonomous Robot Systems	HC	3	0	0	3	3
2	B21EO0702	Aerial Robots and Drone Technology	HC	3	0	0	3	3
3	B21EOS74X	Professional Elective-4	SC	3	0	0	3	3
4	B21EOS75X	Professional Elective-5	SC	3	0	0	3	3
5	B21XXO7XX	Open Elective-3	OE	3	0	0	3	3
TOTAL				**15**	**0**	**0**	**15**	**15**
Practical /Term Work / Sessional								
6	B21EO0703	Autonomous Robot Systems Lab	HC	0	0	1	1	2
7	B21EO0704	Aerial Robots and Drone Technology Lab	HC	0	0	1	1	2
8	B21EO0705	Major Project Phase – 1	HC	0	0	1	1	2
TOTAL				**0**	**0**	**3**	**3**	**6**
TOTAL SEMESTER CREDITS				**18**				
TOTAL CUMULATIVE CREDITS				**150**				
TOTAL CONTACT HOURS				**21**				

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B21XXO8XX	Open Elective-4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessional								
6	B21EO0801	Major Project Phase – 2	HC	0	0	0	7	14
TOTAL				**0**	**0**	**0**	**7**	**14**

TOTAL SEMESTER CREDITS	**10**
TOTAL CUMULATIVE CREDITS	**160**
TOTAL CONTACT HOURS	**17**

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credits	**19**	**21**	**22**	**23**	**24**	**23**	**18**	**10**	**160**

Professional Electives

PE		Domain 1: Electronics	Domain 2: Mechanical	Domain 3: Electrical	Domain 4: Computers
PE-1 / 5TH SEM	Course Code	B21EOS511	B21EOS512	B21EOS513	B21EOS514
	Course Name	ARM Processors and Application	Manufacturing Process	Power Electronics	Object Oriented Programming using C++
PE-2 / 5TH SEM	Course Code	B21EOS521	B21EOS522	B21EOS523	B21EOS524
	Course Name	Signals and Networks	Computer Integrated Manufacturing Systems	Electrical Drives and Motor Control	Computer Organization and Operating Systems
PE-3 / 6TH SEM	Course Code	B21EOS631	B21EOS632	B21EOS633	B21EOS634
	Course Name	Automotive Electronics	Design of Machine Elements	Advanced Control Systems	Java Programming
PE-4/ 7TH SEM	Course Code	B21EOS741	B21EOS742	B21EOS743	B21EOS744
	Course Name	Computational Cybernetics and Information Theory	Product Design and Development	Electric Vehicles	Neural Networks and Deep Learning
PE-5 / 7TH SEM	Course Code	B21EOS751	B21EOS752	B21EOS753	B21EOS754
	Course Name	Flexible Electronics	Human Robot Interaction	Battery Management Systems	Augmented and Virtual Reality

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE							
5TH SEM /OE1		**6TH SEM /OE2**		**7TH SEM /OE3**		**8TH SEM /OE4**	
Course code	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**
B20ECO501	PCB Fabrication	B20ECO601	Principles of Analog and Digital Communication	B20ECO701	Introduction to CMOS VLSI	B20ECO801	Automotive Electronics
B20ECO502	Embedded Systems	B20ECO602	Sensors and Instrumentation	B20ECO702	Microprocessors and Microcontrollers	B20ECO802	Robotics and Automation

Semester-1

Course Title	Calculus and Differential Equations				Course Type		HC	
Course Code	B21AS0102	Credits	3		Class		I Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW:

This is a fundamental course of applied Mathematics which is useful in understanding the concepts of Electronics and electrical communication engineering students. This course begins with understanding concepts of calculus like Taylors and McLaurin's series. Further it covers reduction formulae which are useful in evaluating standard integrals. Further it enables students to understand and solve linear differential equations.

COURSE OBJECTIVE:

This course enables Engineering students to identify the requirement of applied Mathematics and their applications.

COURSE OUTCOMES: (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of differential calculus in the field of wave theory and communication systems.	1, 2	1
CO2	Analyse and apply the knowledge of Partial differentiation to solve problem in Electronics Engineering.	1, 2	1
CO3	calculate rate of change of multivariate functions using partial differential equations and solve problems related to composite functions and Jacobian.	1, 2	1
CO4	Apply multiple integrals to determine area, volume, etc.	1, 2	1
CO5	Use the knowledge of linear differential equations in modeling.	1, 2	1
CO6	Recognize and model differential equations, apply analytical techniques to compute solutions.	1, 2	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyse	Evaluate	Create
CO1			✔			
CO2				✔		
CO3		✔				
CO4		✔				
CO5			✔			
CO6			✔			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

Contents
UNIT - 1
Calculus-I Successive differentiation- nth derivatives (no proof and simple problems only), Leibnitz Theorem (without proof) and problems. Mean value theorem theorems-Rolle's theorem (no proof), Lagrange's mean-value theorems, Cauchy's mean-value theorem problems, and mean value theorem of integral calculus (no proof). Taylor's series and McLaurin's series expansion for function of one variable (only problems).
UNIT - 2
Calculus-II Partial Differentiation: Partial derivatives-Euler's theorem-problems, Total derivative and chain rule. Jacobians-definition and problems (only to find J and illustrative example to verify $JJ' = 1$). 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). Lagrange's multiplier method.

UNIT - 3

Calculus-III

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, properties, Relation between beta and gamma functions and simple problems.

UNIT - 4

Differential equations

Differential equations of first order: solution of linear equations, Bernoulli's equations, Exact equations. (reducible to exact not included)

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.

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.

JOURNALS:

1. https://www.ajol.info/index.php/jorind/cart/view/50976/39662
2. https://www.academia.edu/Documents/in/Multivariable_Calculus

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/111/104/111104085/
2. https://nptel.ac.in/courses/111/107/111107108/
3. https://nptel.ac.in/courses/111/107/111107108/

PROBLEM BASED LEARNING

1.	If $z = log(x^2+y^2)\ find\ \frac{\partial z}{\partial x}\ and\ \frac{\partial z}{\partial y}$
2.	If $x + y + z = logz\ find\ \frac{\partial z}{\partial x}\ and\ \frac{\partial z}{\partial y}$
3.	If $u = x^3 - 3xy^2 + x + e^x cosy + 1$, show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$
4.	If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ show that $xu_x + yu_y = 1$
5.	Verify $u_{xy} = u_{yx}$ for the following functions, i. $u = \sin^{-1}(y/x)$ ii. $u = x^y$ iii. $u = log\left(\frac{x^2+y^2}{x+y}\right)$
6.	If $u = log\sqrt{x^2 + y^2 + z^2}$, show that $(x^2 + y^2 + z^2)\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right) = 1$
7.	State and prove Euler's theorem for Homogeneous functions.
8.	If $u = \frac{x^3+y^3}{\sqrt{x+y}}$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{5}{2}u$
9.	If $u = sin^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, show that $xu_x + yu_y = 2tanu$
10.	Find the Jacobian of u, v, w w.r.t x, y, z given $u = x + y + z,\ v = y + z,\ w = z$
11.	If $x = rsin\theta\ cos\varphi,\ y = rsin\theta\ sin\varphi,\ z = rcos\theta$ show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2 sin\theta$
12.	If $x = rsin\theta\ cos\varphi,\ y = rsin\theta\ sin\varphi,\ z = rcos\theta$ show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2 sin\theta$
13.	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy\ dy\ dx$
14.	Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y\ dx\ dy$
15.	Evaluate $\iint y$ dxdy over the region bounded by the 1st quadrant of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
16.	Evaluate $\iint xy\ (x + y)$dxdy taken over the area between $y = x^2 and\ y = x$
17.	Evaluate by change of order of integration $\int_0^1 \int_x^1 \frac{x}{\sqrt{x^2+y^2}}\ dy\ dx$
18.	Evaluate by change of order of integration $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y}\ dx\ dy$
19.	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\ dx\ dy$ by changing to polar coordinates.
20.	Evaluate $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x + y + z)$ dx dy dz
21	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz$ dx dy dz
22	Express $\int_0^1 x^m\ (1 - x^n)^p dx$ in terms of β function and evaluate $\int_0^1 x^5\ (1 - x^3)^{10} dx$
23	Given that $\int_0^\infty \frac{x^{m-1}}{(1+x)}\ dx = \frac{\pi}{\sin m\pi}$ by data. $\Gamma(m)\Gamma(1 - m) = \frac{\pi}{\sin m\pi}$ for $0 < m < 1$
24	Solve $\frac{dy}{dx} = e^{3x-2y} + x^2 e^{-2y}$
25	Solve $e^x tany\ dx + (1 - e^x)\ dy = 0$
26	Solve $\frac{dy}{dx} = \frac{y}{x-\sqrt{xy}}$
27	Solve i. $y^2 + x^2\frac{dy}{dx} = xy\frac{dy}{dx}$ ii. $\frac{dy}{dx} = \frac{y}{x} + sin\left(\frac{y}{x}\right)$
28	Solve $(y^3 - 3x^2 y)dx - (x^3 - 3xy^2 dy = 0)$
29	Solve y $e^{xy}dx + (xe^{xy} + 2y)dy = 0$
30	Solve $\left(x^2 + y^2 + x\right)dx + xydy = 0$
31	Solve i. $\left(x^3 + y^2\right)dx - 2xydy = 0$ ii. $\left(x^2 + y^2 + 2x\right)dx + 2ydy = 0$
32	Solve: $\frac{dy}{dx} + y\cot x = \cos x$
33	Solve $\frac{dy}{dx} + 3x^2 y = x^5 e^{x^3}$

34	Solve $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$
35	Solve $x\frac{dy}{dx} + y = x^3y^6$
36	Solve: $\frac{dy}{dx} + y\cot x = \cos x$
37	Solve $\frac{d^2y}{dx^2} + 10\frac{dy}{dx} + 25y = 0$
38	Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 3y = 0$
39	Solve $\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 3\frac{dy}{dx} - y = 0$
40	Solve $\frac{d^2y}{dx^2} - 4y = cosh2x + 3^x$
41	Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 6e^{3x} + 7e^{-2x} - log2$
42	Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 12y = sin2x + e^{-4x}$
43	Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 12y = 2x + x^2$
44	Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 4y = e^x$cosx
45	Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xcosx$
46	Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = e^{2x} - 4$
47	Solve by the method of variation of parameters $(D^2 + 4)y = tan2x$
48	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = e^x tanx$
49	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + y = secx\ tanx$
50	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$
51	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + a^2y = secax$
52	Solve $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = logx$
53	Solve $(1+2x)^2\frac{d^2y}{dx^2} - 2(1+2x)\frac{dy}{dx} - 12y = 6x + 5$
54	Solve $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + 2y = x\sin(logx)$
55	Solve $(1+x)^2\frac{d^2y}{dx^2} + (1+x)\frac{dy}{dx} + y = 2\sin[log[1+x]]$
56	Solve $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = logx\sin(logx)$

Course Title	**Engineering Chemistry**			**Course Type**	**HC**
Course Code	**B21AS0104**	**Credits**	**3**	**Class**	**I/II Semester**

Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Lecture	3	3	3			
	Tutorial	-	-	-	Theory	CIE	SEE
	Practical	-	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

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

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

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the phenomenon of light and matter interaction to study the materials	1**,2,3**	1
CO2	Illustrate the method of preparation of solar grade silicon and effect of dopant in photovoltaic devices.	1**,2,3**	1
CO3	Describe Corrosion phenomenon and precautions to be taken in the selection of materials in controlling corrosion. Methods of fabrication of printed circuit boards (PCB) and industrial applications.	1**,2,3**	1
CO4	Illustrate the properties of polymers, nano materials, composite materials and their applications in various fields.	1**,2,3**	1
CO5	Explore the light interaction with matter, modern materials and their composites for technological applications	1**,2,3**	1
CO6	Suggest the advanced materials for electrochemical energy storage, conversion, and environmental remedies.	1**,2,3**	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

UNIT – 1

Light and Matter Interaction

Electro-magnetic spectrum-Applications in Engineering, Interaction of EM radiation with matter, work function of matter, Electrons in matter. Bonding theories: MOT, Band structure of matters HOMO-LUMO. Photochemical and thermal reactions: Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram – photo physical and photochemical processes, photo-sensitization, photo- polymerization and commercial application of photochemistry.

UNIT – 2

Clean Energy Storage and Conversion Devices

Introduction to electrochemistry, basic concepts of Batteries and characteristics. Classification: Primary (Dry cell, Li-MnO2) and Secondary (Pb-acid, Li-ion) batteries. Super capacitors: classification, construction and applications in hybrid **vehicles**. Fuel cells: Alkaline fuel cells, Solid oxide fuel cells and phosphoric acid fuel cell. Photo-conversion devices: Photovoltaic cell, antireflective coating, panels and arrays. Production of single crystal semiconductor by Crystal pulling technique (Czochralski technique), zone refining process of Si.

Problems: Calculation of energy **and** power density, capacity of a Battery and capacitance of super capacitors for electric vehicle applications.

UNIT – 3

Corrosion and Metal Finishing

Electrochemical theory of corrosion, types of Corrosion- differential metal corrosion, differential aeration corrosion, boiler corrosion, and grain boundary corrosion, Corrosion studies on Al, Fe with pourbiax diagram, Factors affecting rate of corrosion-Primary, secondary. Corrosion control: Galvanizing & tinning, cathodic protection & Anodic Protection.

Metal Finishing: Theory of electroplating, Factors required to study electroplating Effect of plating variables in electroplating process, Electroplating of gold (acid, neutral and alkaline cyanide bath). Electro less plating of copper and PCB manufacture by Electro less plating of copper.

UNIT – 4

Chemistry of Engineering Materials

Polymer composites: Carbon fiber, Kevlar synthesis and applications, Conducting polymers: synthesis, electron transport mechanism and applications in poly acetylene and poly aniline. Liquid crystals: **Introduction** classification and applications in electronic display devices. Nano materials: Introduction, classification based on dimensionality, quantum confinement. Size dependent properties- surface area, magnetic properties (GMR phenomenon), and thermal properties. Synthesis, Properties and applications of Fullerenes, CNT and Graphene.

Sensors: Physical and chemical sensors, Biosensors for bio electronic applications.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASED LEARNING

Sl. No.	Problems
1	Calculation of wavelength and frequencies of the radiations

2	Calculation of band structure by HOMO and LUMO
3	Determination of cell potentials
4	Calculation of energy density and power density of a battery.
5	Determination of capacitance of a super capacitor
6	Crystal field stabilization energy

PROJECT BASED LEARNING

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

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

Course Title	**Introduction to Python Programming**				**Course Type**		**HC Integrated**	
Course Code	B21CI0101	**Credits**	**3**		**Class**		**I/II Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practical	1	2	2				
	Total	**3**	**4**	**4**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of python programming language constructs and their applications.

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of language constructs to solve real world problems using python programming.	1,2,3	1
CO2	Develop programs for text processing and other application domains by making use of regular expressions.	1,2,3	2
CO3	Apply features of object oriented and NumPy package to develop computationally intensive programming to analyse and interpret the data.	1,2,3,4	2-3
CO4	Create data science solutions with the help of files, Pandas and Data Visualization.	1-4,5	1-3
CO5	Develop sustainable solutions/projects for the needs of society, organizations and other sectors.	7,11	1-3
CO6	Recognize the need and engage in learning new libraries and tools in python.	12	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

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

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on list.
	b)."TUPLE1" and "TUPLE2" are two tuples that contain "N" values of different data types read using the user defined function "READ" with the help of input() function. Elements of "TUPLE1" and "TUPLE2" are to be read one at a time and the "larger" value among them should be placed into "TUPLE3". Display all tuples.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on Tuples.
2.	a).SET1 and SET2 are two sets that contain unique integers. SET3 is to be created by taking the union or intersection of SET1 and SET2 using the user defined function Operation (). Perform either union or intersection by reading choice from user. Do not use built in functions union () and intersection () and also the operators "|" and "&".	Windows/Linux OS, IDE, Jupyter	Create and perform Union and Intersection, Operations on Sets.
	b).The Dictionary "DICT1" contains N Elements and each element in dictionary has the operator as the KEY and operand's as VALUES. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.
3.	a).A substring "Substr" between index1 and index2 is to be extracted from the given input string "Str1", which is read using input(). Display the substring "Substr" using a user defined function if available in string "Str1", otherwise display NULL.	Windows/Linux OS, IDE, Jupyter	String operations.
	b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. Convert all the strings to uppercase and display Split the words of a string using space as the separation character and display.		
4.	a).Consider the text file, "Std.txt", with the details of students like SRN, NAME, SEMESTER, SECTION AND AVG_MARKS. Read the file, "Std.txt" and display the details of all the students of 4th Semester " A" Section who have scored more than 75%.	Windows/Linux OS, IDE, Jupyter	File Handling.

	b).Consider the text file “Emp.txt”, with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: TOTAL_DEDUCTIONS= (LIC+PF) GROSS_SALARY= BASIC_SALARY+ DA NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of “Emp.txt” and display the details of each employee		File Handling.
5.	a). A “CAR” has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for “CAR” to store the above attributes and perform the following operations: Get the details of “CAR” object from user and store into Array of objects Display the details of “CAR” object based on “COMPANY”, “MODEL” and “PRICE”.	Windows/Linux OS, IDE, Jupyter	Classes and objects usage.
	b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for “Airlilne” with the above attributes and perform the following operations: Get the details of “Airline” object from user and store into Array of objects List details of all the passengers who travelled From “Bengaluru to London”. List details of all the passengers who travelled From “Chicago to Beijing” on 10th of Feb, 2020.		
6.	a). “Arr_1” is an integer array of size M x N. Size and content of the array is to be read using input() by using the user defined function READ_DATA(). It is required to display the Diagonal elements of ”Arr_1” Elements of mth row (row no should be entered by user) Elements of nth column (column no should be entered by user)	Windows/Linux OS, IDE, Jupyter	NumPy arrays usability.
	b).The dictionary “DICT1” contains the pass percentage of each semester of B. Tech in CSE, where, ” Semester” acts as the key and “Pass Percentage” acts as the value. A Python Pandas dataframe is required to be created using the dictionary “DICT1” and display it using a user defined function.		Pandas Series usability.
Part-B (Mini Project: Library Management System)			
1.	Develop a program to create the class “USER” with the attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add user (), delete user (), edit user (), search user () should be part of the class. Instantiate “User” class with 10 objects. Read the attributes of each “User” object using input () and store them in the file “User_File.txt”.	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes of user and store them in a file.

2	Develop a program to get the name of the “User” object whose details are to be deleted. Read the “User_File.txt” and delete the “User” object if found. Display the contents of “User_File.txt” after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes and delete the object.
3	Develop a program to get the name of the “User” object whose details are to be edited (modified). Edit the details of the user object in the file “User_File.txt” and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
4	Develop a program to create the class “BOOK” with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add book(), delete book(), edit book() and search book(). Instantiate “Book” class with 10 objects. Read the attributes of each “BOOK” object using input () and store them in the file “Book_File.txt”.	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes of user and store them in a file.
5	Develop a program to get the name of the “BOOK” object whose details are to be deleted. Read the “Book_File.txt” and delete the “BOOK” object whose details match with the data entered. Display the contents of “Book_File.txt” after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes and delete the object.
6	Develop a program to get the name of the “BOOK” object whose details are to be edited (modified). Edit the details of the “Book” object in the file “Book_File.txt” and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
7	Develop a program to create the class “TRANSACTION” with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue book(), return book() and search book(). Instantiate “Transaction” class with 10 objects. Read the attributes of each “Transaction” object using input () and store them in the file “TransactionFile.txt”. Develop a program to issue the book as requested by the user. Update the attributes in “Transaction _File” and display the contents of file.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operations.
8	Develop a program to return the book. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in “TransactionFile.txt” and display the contents after modification. Compute the fine amount to be paid if return date is not same as due date. If both return date and due date are same and put zero in fine amount.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operation.
9	Develop a program to search for a book using its “author”. Display the message “available” if search is successful otherwise display the message “not available”.	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
10	Develop a program to get a list of users by referring to “User_File.txt” and “Transaction_File.txt”.	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
11	Develop a program to get List of Books in stock by referring to “Book_File.txt” and “Transaction_File.txt”.	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.

12	Develop a program to get List of Books Issued by referring to “User File”, “Book File” and “Transaction File”.	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
13	Develop a project by integrating User, Books, Transaction and Reports Modules.	Windows/Linux OS, IDE, Jupyter	Module integration and project development.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES

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

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNING EXERCISES:

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

Course Title	Principles of Electrical and Electronics				Course Type		HC Integrated	
Course Code	B21EN0101	Credits	4		Class		I Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**4**	**5**	**5**	**39**	**26**	**50 %**	**50 %**

COURSE OVERVIEW:

The Basic Electrical and Electronics typically deals with the study of Electrical parameters like AC and DC voltage and current and behaviour of voltage and current in passive elements also in active elements like: BJT, Diodes and FET. The concepts of Electromotive force and Magneto motive force generated in motors, generators and transformers are explained. The concepts of electrical circuits and electromagnetism are applied to analyse the complex problems arise in the power system networks. Through this course Students will get extensive exposure to digital and analog electronics basics.

COURSE OBJECTIVES:

The objectives of this course are:

1. Make the students to understand basics of electrical circuits.
2. Study the working principle and construction details of electrical machines.
3. Understand the diode characteristics and its applications.
4. Understand the working principle and characteristics of BJT, FETs
5. Familiarize the students with the number systems
6. Carry out validation of logical expressions using Boolean algebra.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe basic composition of electrical circuits and their behavior.	1,2,3	1,2,3
CO2	Analyze the working principle and construction details of electrical machines	1,2,3	1,2,3
CO3	Assess the outcomes of various diode circuits.	1,2,3,	1,2,3
CO4	Analyze working principle and characteristics in three configurations of BJT	1,2	1,2
CO5	Analyze working principle and characteristics of FET.	1,2	1,2
CO6	Design the digital circuits using various logic gates	1,2,3,	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents

UNIT - 1

Basics of Electrical Engineering : Introduction to electrical engineering, AC, Sinusoidal voltage and currents, Magnitude and phase, polar and rectangular representation R-L, R-C and R-L-C series and parallel circuits(both admittance and impedance method), power factor, phasor diagrams(lead and lag circuits), Kirchhoff's Current Law, Kirchhoff's Voltage law, Mesh and Nodal analysis, Source transformation, Star-delta transformation (for DC Circuits only).

UNIT - 2

Magnetic Circuits, Motors and Transformers: Definition of magnetic circuit and basic analogy between electric and magnetic circuits, Faradays laws, permittivity, permeability, EMF, MMF equations, Reluctance, Energy and power, 3 phase AC (introduction), Comparison between 1 phase and 3 phase AC.

Principle of operation, Construction and EMF equations: DC Generator, DC Motors, Transformers, types of transformer. Numerical examples as applicable.

UNIT - 3

Semiconductor Diodes and Transistors: P-N junction diode, V-I Characteristics, Half-wave rectifier, Full-wave rectifier, Bridge rectifier, Capacitor filter circuit, Zener diode voltage regulators, Clipping and clamping circuit, Numerical examples as applicable. Bipolar junction Transistors BJT configuration: BJT Operation, Common Base, Common Emitter and Common Collector Characteristics, Numerical examples as applicable, SCR, Introduction to FETs.

UNIT - 4

Digital Electronics and Number Systems: Introduction, Switching and Logic Levels, Digital Waveform. Number Systems and its conversions: Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System. Binary addition, Binary subtraction. Boolean Algebra Theorems, De Morgan's theorem. Digital Circuits: Logic gates, Algebraic Simplification, Realization of all logic and Boolean expressions

PRACTICE SESSION:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	To verify KCL and KVL	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
2	Testing of Lead & Lag networks by using R-C components.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
3	To Study and test the working of DC motor	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
4	Study and analysis of V-I Characteristics of Silicon, Germanium and Zener PN Junction diodes (Both Forward and Reverse Characteristics).	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
5	To find the Voltage regulation of Zener diode	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
6	Design half wave, Full wave-center tap and Bridge rectifier with and without capacitive filter and measure efficiency and ripple factor.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
7	Design of Clippers and clampers with reference voltages	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
8	Study and analysis of V-I Characteristics of SCR.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
9	Study and analysis of input output characteristic of CE configuration of BJT.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
10	Verification of basic logic gates using discrete components	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team

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, 5th Edition, 2008.
3. D.P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill Education (India) Private Limited, 2014.

REFERENCE BOOK:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://www.electricaleasy.com/p/electrical-machines.html
2. https://www.aast.edu/pheed/staffadminview/pdf_retreive.php?url=45_24985_EE328_2016_1__2_1_Lecture2all.pdf&stafftype=staffcourses
3. https://www.sciencedirect.com/topics/engineering/magnetic-circuits
4. https://cnx.org/contents/FOAgj46E@1.1:CF55C3SF@1/chapter-1-Magnetic-Circuits-and-Magnetic-Materials
5. https://circuitglobe.com/what-is-a-magnetic-circuit.html
6. https://blog.oureducation.in/analysis-of-magnetic-circuits-of-transformer/
7. https://www.learncbse.in/semiconductor-diodes-and-transistors/#:~:text=The%20devices%20whose%20action%20is,is%20called%20an%20electronic%20devices.&text=The%20electronic%20devices%20are%20two,pentode%20(five%20electrodes)%20etc.
8. https://www.sciencedirect.com/science/article/pii/B9780128114070000027
9. https://www.renesas.com/us/en/support/technical-resources/engineer-school/electronic-circuits-02-diodes-transistors-fets.html
10. https://circuitglobe.com/difference-between-diode-and-transistor.html

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://nptel.ac.in/courses/108/105/108105053/
3. https://nptel.ac.in/courses/108/104/108104139/
4. https://nptel.ac.in/courses/108/102/108102097/

Course Title	ELEMENTS OF MECHANICAL ENGINEERING AND CIVIL ENGINEERING				Course Type		HC	
Course Code	B21ME0103	Credits	3		Class		I sem	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	0	0	0	Theory	Practical	CIE	SEE
	Practical	0	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW:

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

COURSE OBJECTIVE:

The objectives of this course are to:

1. Develop the basic knowledge of IC engines, refrigeration-air conditioning and power transmission systems.
2. incorporate the concepts of manufacturing processes using different machine tools, welding techniques, CNC and 3D printing technology.
3. learn basics of civil engineering and concepts of idealization.
4. Develop knowledge and problem solving capability on different system of forces and concepts of Friction, Centroid and Moment of Inertia.

COURSE OUTCOMES (COs)

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

CO1	Describe the fundamentals of IC engines, refrigeration-air conditioning and power transmission systems.	1,2	3
CO2	Explain the manufacturing processes using lathe, drilling, welding, CNC machines and 3D printing technology	1,2	3
CO3	Calculate the speed ratio of belt drives and Gear Drives.	1,2	3
CO4	Explain the basics of Civil Engineering and concepts of idealization.	1,2	1,2
C05	Comprehend the action of forces and compute the numerical problems	1,2	1,2
CO6	Solve numerical problems on composition of coplanar concurrent and non-concurrent force system.	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			✓			
CO4		✓				
C05			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2													1
CO2	3	2													1
CO3	3	2	3												1
CO4	3	3											3	2	
C05	3	3	3										2	2	
CO6	3	3	3										3	2	

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

COURSE CONTENTS

THEORY

Contents
UNIT – 1 **Introduction to Mechanical Engineering:** Overview of Mechanical Engineering, Importance and applications of Mechanical Engineering in different fields. **Thermal Energy Systems:** Introduction to IC Engines, Classification, parts of IC Engine, working of 4-stroke Petrol engine with PV-diagram. Simple numerical on calculation of IP, BP and Mechanical efficiency, Introduction to refrigeration system, working of vapour compression refrigeration and window spit air conditioning system. Applications of refrigeration systems
UNIT – 2 **Power Transmission System:** Introduction to drives, classification, belt drives (open and crossed-No derivations) and gear drives and types of gear, Numerical on gear drives. **Mechanical Machine Tools:** Introduction- lathe, classification, major parts of engine lathe, operations, Drilling machine, classification working bench drilling machine and operations, CNC Machines-Block diagram and applications. Introduction to 3D Printing technology **Joining processes**-Welding: Working of electric arc welding and soldering, Differences between welding and soldering, Applications and safety tools

UNIT – 3

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

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

UNIT – 4

Equilibrium of Forces: Types of forces acting on the body, free body diagrams, Equations of Equilibrium, Resolution and composition of forces, Lami's theorem.

Coplanar Concurrent Force System: Parallelogram Law of forces, principle of resolved parts, composition of concurrent forces, Resultant of Concurrent forces, Equilibrium of Concurrent Coplanar Force System- Simple Numerical.

Coplanar Non – concurrent Force System: Varignon's principle of Moments, Resultant of Non – Concurrent force systems, Equilibrium of Non – concurrent Coplanar force system - Simple Numerical.

Support Reaction and Basics: Types of loads, supports and beams, Basic concepts of Friction, Centroid and Moment of Inertia.

TEXT BOOKS:

1. K.R. Gopalkrishna (2012)" Elements of Mechanical Engineering", 12th Edition, Subhash Publishers, Bengaluru.
2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, Mumbai, 2000.
3. Mikell P Groover : Automation, Production Systems, and Computer Integrated Manufacturing , Pearson India, 2007, 4th Edition
4. BK Kolhapure, "Elements of Civil Engineering", Eastern Book Promoters
5. S. S. Bhavikatti, "Elements of Civil Engineering", New Age International Publisher, New Delhi, 3rd edition 2009.

REFERENCE BOOKS:

1. SKH Chowdhary, AKH Chowdhary, Nirjhar Roy(2001),"The Elements of Workshop Technology - Vol I & II, 11th edition, Media Promotors and publisher, Mumbai
2. Avikshit Saras, "3D Printing-Made Simple", BPB Publications-New Delhi
3. M.N.Shesha Prakash and Ganesh.B.Mogaveer,"Elements of Civil Engineering and Engineering Mechanics", PHI Learning, 3rd Revised edition
4. B C Punmia, "Elements of Civil Engineering", Laxmi publications

JOURNALS/MAGAZINES

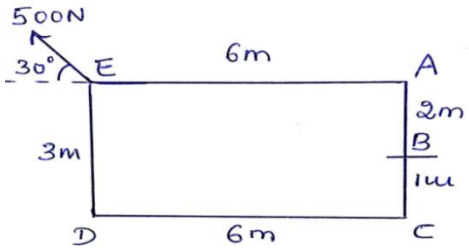
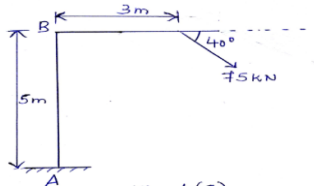
1. International Journal of Machine Tools and Manufacture
2. International Journal of Refrigeration.
3. Civil Engineering and Construction Review-Magazine

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/103/112103262/#
2. https://www.my-mooc.com/en/mooc/fundamentals-manufacturing-processes-mitx-2-008x/
3. https://www.coursera.org/learn/3d-printing-applications

PROBLEM BASED LEARNING

Sl. No.	Problem
1	4 Cylinder, four stroke petrol engine of Volkswagen Polo has a piston diameter 300 mm and stroke 500 mm . The mean effective pressure is 8 bar and speed is 350 rpm. The net load on the brake drum is 1080 N The effective diameter of the brake 1.5 m. Find I.P, B.P, and mechanical efficiency

Sl. No.	Problem
2	A Toyota FORTUNER car having 4 stroke and 4 cylinder running at 450 rpm, has bore diameter 100 mm and stroke length 120mm. The details of the indicator diagram are as follows. Area of indicator diagram = 4 cm^2 Length of the indicator diagram = 6.5 cm, and the spring value of the spring used is 10 bar/cm. Calculate the indicated power.
3	A TATA Zest car having four stroke petrol engine has a piston diameter 300 mm and stroke 500 mm. The mean effective pressure is 5 bar and speed is 250 rpm. The net load on the brake drum is 1000 N The effective diameter of the brake 1.5 m. Find I.P, B.P, and mechanical efficiency
4	KIA Carnival engine has the following details i.Number Cylinder = 8 ii.Cylinder diameter = 25 cm iii.Stroke of the piston = 40 cm iv.Crankshaft speed = 250 rpm v.Brake load = 70 kg vi.Brake drum diameter = 2 m vii.Mean effective pressure = 6 bar Calculate (i) I.P (ii) B.P (iii) Mechanical Efficiency
5	Find the moment of 500N force about points A,B,C and D as shown in fig 
6	Determine the magnitude, X and Y intercepts to the resultant of the force system acting on the laminar.
7	Find the X and Y intercepts of the resultant of the system of coplanar forces acting on the laminar. Each square has a side of 10mm
8	Find the moment about A and B as shown in fig 

PROJECT BASED LEARNING:

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

Sl. No.	Suggested Projects

1.	Demo Model for 4-Stroke Petrol Engines
2.	Preparation of metallic Shoe stand using electric ARC welding
3.	Illustrate the road network connection on Indian map
4.	Demo Model of different types of beams

Course Title	**BIOLOGY FOR ENGINEERS**				**Course Type**		**Theory**	
Course Code	**B21AS0109**	**Credits**	**1**		**Class**		**I sem**	
BIOLOGY FOR ENGINEERS	LTP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50%**	**50%**

COURSE OVERVIEW

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

COURSE OBJECTIVES

The objectives of this course are to:

1. Inculcate the basic concepts of biology from engineering perspective among students
2. Understand the interplay between biology and engineering disciplines
3. Conceptualize the engineering design/process/product for life science challenges

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand and explain the concepts regarding origin and evolution of life.	1,7	1

CO2	Demonstrate the structure and functions of various biomolecules in living system.	1	1
CO3	Comprehend the organization of cell structure in prokaryotes and eukaryotes.	1	1
CO4	Describe the process of cell division involving mitosis and meiosis	1	1
CO5	Predict the inheritance pattern of genes from parents to offspring	1	1
CO6	Apply the principles of Biology either for the process/product development from the engineering perspective.	1	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES

Current Sciences

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASED LEARNING

Sl. No.	
1	Case Study: Biobased electrical engineering for sustainable society.
2	Case Study: Biosensors and its applications in agriculture/Medicine electrical mechanical
3	Case Study: Computational biology in Health care.

Course Title	DESIGN THINKING				Course Type		Integrated	
Course Code	B21ME0102	Credits	2		Class		I/II Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	1	1	1				
	Tutorial	0	0	0				
	Practical	1	2	2	Theory	Practical	IA	SEE
	Total	**2**	**3**	**3**	**13**	**26**	**50 %**	**50 %**

COURSE OVERVIEW

Today, innovation is everyone's business. At every level, in every kind of organization, design thinking provides the tools that one needs to become an innovative thinker and uncover creative opportunities. For example, companies like Procter, Gamble and GE have incorporated Design Thinking into their strategy and marketing. The course draws on methods from engineering and design, and combines them with ideas from the arts, tools from the social sciences, and insights from the business world.

In this course, students start in the field, where they discover the needs of the target audience. They then iterate ideas on teams to develop a range of promising possible solutions, create rough prototypes to take back out into the field, and learn to test with real people in the target audience.

Course Objectives

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

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

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

Course Outcomes (CO's):

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the problems that fall under the purview of human centered design process for creative problem solving.	1,2 , 9,10,12	2
CO2	Develop empathy maps to visualize user needs and to get insights of the problem.	1,2,9,10,12	2
CO3	Define the problem from user's perception.	1,2,9,10,12	1,2
CO4	Apply Ideation techniques to ideate innovative ideas for the problem	1,2,9,10,12	1,2
CO5	Develop simple prototypes for problems using feasible idea.	1,3, 5,9,10,12	1,2
CO6	Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.	1,4,8,9,10,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO4	1	2							3	2		2	1	2	
CO5	2		3		2				3	3		2	2	3	
CO6	2			2				1	3	2		2	2	3	

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

Course Content

Unit-1 :

Design Thinking Process: Types of the thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking. Problem Exploration, Case Studies from Embrace-Stanford Innovation Challenge, IDEO, GE Healthcare, The Good Kitchen- Denmark Program etc, identifying the target users for the problem selected, Survey on existing solutions for the problem identified.

Empathizing: Powerful Visualizing tool – a method to connect to the user, Creating Empathy maps – Case studies.

Unit-2 :

Defining the problems: POV statements from User perspective. Idea generation: Methods to spark the innovative ideas – Brainstorming, Mind map, Story board, Provocation etc

What is a prototype? - Prototyping as a mind set, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping- Minimum Viable prototype

Prototyping for digital products: What's unique for digital, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users.

PRACTICE:

Sl.No	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	Identifying the problem that can be solved using Design Thinking approach	Observation and survey	Develop identifying human centered problems
2	Build the empathy maps for simple problems like single user	Visualization	Develop ability to understand other's emotions
3	Build the detailed empathy maps for problem identified in the teams formed	Visualization	Develop ability to understand other's emotions

4	Presentation by student teams	PPT	Develop ability to express their views
5	Obtain the insights into user's problems and make PoV statement	Understanding	Develop making problem statements from user perception
6	Presentation by student teams	PPT	Develop ability to express their views
7	Carry out Brain storming between the groups and generate as many as ideas possible	Ideation tools	Develop innovative mind set
8	Prototype for best 3 ideas selected	Sketching, simple model making etc	Develop prototyping techniques
9	Presentation by student teams	PPT	Develop ability to express their plan
10	Test the developed prototype with set of identified users	Google forms , cold calls, social media etc.	Develop understanding of various testing methods
11	Pitching final solution	PPT	Develop ability to express their views

Text Books:

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

Reference Books:

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

Journals/Magazines/Additional Sources

1. Leonard, D., and Rayport, J. F. 1997. Spark Innovation through Empathic Design. In Harvard Business Review, November-December 1997,102-113.
2. https://www.ideo.com
3. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
4. https://www.ibm.com/design/thinking/page/toolkit

5. https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we
6. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking
7. https://youtu.be/M66ZU2PCIcM
8. https://thisisdesignthinking.net/2017/07/innogy_energy_ecarsharing/

SWAYAM/NPTEL/MOOCs:

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

Detailed Syllabus
Semester 2

Title	Integral Transforms				Course Type		HC	
Course Code	B21AS0203	Credits	4		Class		II semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	4	4	4				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**4**	**4**	**4**	**52**	**0**	**50%**	**50%**

COURSE OVERVIEW:

This course is an essential one for electrical and electronics engineering students. This course covers the concept of Laplace transforms, Fourier series, Fourier transforms and z- transforms.

COURSE OBJECTIVE

This course enables graduating students to understand applications of the concepts Laplace, Z-Transforms and Fourier transforms in signal processing, communications, circuit design.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	POs	PSOs
CO1	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	1, 2	1
CO2	Evaluate - transforms of periodic, discontinuous and discrete functions, develop Fourier series of various type of functions.	1, 2	1
CO3	Create and students will be familiar with Fourier series and their applications and be notionally aware of their convergence.	1, 2	1
CO4	Analyze the spectral characteristics of signals using Fourier analysis.	1, 2	1
CO5	Apply the knowledge of Z-transform in the areas like signal processing, control engineering etc.	1, 2	1
CO6	Apply - transform techniques to solve Differential equations and difference equations which results in engineering problems.	1, 2	1

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
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) no verification and only evaluation of problems, solution of linear differential equation using Laplace transforms.

UNIT – 2
Convergence and divergence of infinite series of positive terms - definition, 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. Illustrative examples from engineering field.
UNIT – 3
Infinite Fourier Transform-Fourier sine and cosine transforms, Finite Fourier sine and cosine transforms, properties of Fourier transforms, Convolution theorem for F-transforms, Parseval's identity for F-transform. Applications of F-transforms to boundary value problems.
UNIT - 4
Z-transforms - Definition, standard Z-transforms, damping rule, shifting rule, initial value and final value theorems (proof), inverse Z-transform, application of Z-transform to solve difference equations.

TEXT BOOKS:

1. Higher Engineering Mathematics by B.V. Raman Publisher: TMH
2. Advanced Engineering Mathematics by E. Kreyszig Publisher: Johnwilley &SonsInc- 8th Edition

REFERENCE BOOKS:

1. Advanced Engineering Mathematics by P.V. O'Neil Publisher: Thomson
2. Mathematical Methods by Potter & Goldberg; Publisher: PHI.

JOURNALS/MAGAZINES

1. https://www.researchgate.net/publication/323218108_A_review_on_applications_of_laplace_transformations_in_various_fields
2. https://www.researchgate.net/journal/1069-5869_Journal_of_Fourier_Analysis_and_Applications

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/111/106/111106139/
2. https://nptel.ac.in/courses/111/106/111106111/
3. https://nptel.ac.in/courses/111/106/111106111/

PROBLEM BASED LEARNING:

1.	Find the Laplace transform of $f(t) = \begin{cases} t, & 0 < t < 4 \\ 5, & t > 4 \end{cases}$
2.	Find the Laplace transform of $f(t) = \begin{cases} sin2t, & 0 < t < \pi \\ 0, & t > \pi \end{cases}$
3.	Show that $\int_0^\infty t^3 e^{-t} sint\ dt = 0$
4.	Show that $\int_0^\infty te^{-2t} sin4t\ dt = \frac{1}{25}$
5.	Find the value of $\int_0^\infty te^{-3t} cos2t\ dt$ using Laplace Transform
6.	Evaluate $\int_0^\infty \frac{e^{-t} sint}{t} dt$ using Laplace transforms
7.	Evaluate $\int_0^\infty \frac{cos6t - cos4t}{t} dt$ using Laplace transforms
8.	Evaluate $\int_0^\infty \frac{e^{-at} - e^{-bt}}{t} dt$ using Laplace transforms
9.	If $f(t) = t^2,\ 0 < t < 2$ and $f(t+2) = f(t)$ for $t > 0$, find $L\{f(t)\}$
10.	A periodic function of period $2a$, is defined by $(t) = \begin{cases} E & for\ 0 \le t \le a/2 \\ -E & for\ a/2 \le t \le a \end{cases}$, then show that $L\big(f(t)\big) = \frac{E}{S} tanh\left(\frac{as}{4}\right)$
11.	If $L\big(f(t)\big) = F(s)$ then prove that $L\{f(t-a)U(t-a)\} = e^{-as}F(s)$
12.	Find inverse Laplace transform of the following (i) $\frac{s+5}{s^2-4s+13}$ (ii) $\frac{s^2}{(s+1)^3}$ (iii) $\frac{7s+4}{4s^2+4s+9}$
13.	Find inverse Laplace transform of the following (i) $log\left(\frac{s+a}{s+b}\right)$ (ii) $log\left(1 - \frac{a^2}{s^2}\right)$
14.	Using convolution theorem find inverse LT of the following functions (i) $\frac{s}{(s^2+a^2)^2}$ (ii) $\frac{s^2}{(s^2+a^2)(s^2+b^2)}$
15.	Solve by using Laplace transforms $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}$ given $y(0) = y'(0) = 0$
16.	Solve by using Laplace transforms $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = 5e^{2x}$ given $y(0) = 2, y'(0) = 1$

17.	Solve by using Laplace transforms $x'' - 2x' + x = e^{2t}$ with $x(0) = 0,\ x'(0) = -1$
18.	Obtain the Fourier series of $f(x) = x - x^2$ in $-\pi < x < \pi$. Hence deduce that $\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} - - - -$
19.	Sketch the graph of the function $f(x) = \lvert x \rvert \quad in\ -\pi < x < \pi$ and hence obtain Fourier series. Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} - - - -$
20.	Obtain the Fourier series for the function $f(x) = x$ in the interval$(-3,3)$.
21	Obtain the Fourier series expansion for the function $f(x) = \begin{cases} 1 + 2x & in \quad -3 < x < 0 \\ 1 - 2x & in \quad 0 < x < 3 \end{cases}$
22	Obtain the Fourier series for the function $f(x) = 2x - x^2$ in the interval$(0,3)$.
23	Obtain the sine half range Fourier series of $f(x) = x^2$ in $0 < x < \pi$
24	Find a cosine series for $f(x) = (x-1)^2, \quad 0 \le x \le 1$.
25	Find the complex Fourier transform of the function $f(x) = \begin{cases} 1, & for \quad \lvert x \rvert \le a \\ 0, & for \quad \lvert x \rvert > a \end{cases}$ Hence evaluate $\int_0^\infty \frac{\sin x}{x} dx$
26	Find the complex Fourier transform of the function $f(x) = \begin{cases} x, & for \quad \lvert x \rvert \le \alpha \\ 0, & for \quad \lvert x \rvert > \alpha \end{cases}$ where α is a positive constant.
27	Find the inverse Fourier sine transform of $\hat{f}_s(\alpha) = \frac{1}{\alpha} e^{-a\alpha}, \ a > 0$.
28	Solve the integral equation $\int_0^\infty f(\theta) \cos \alpha\theta \, d\theta = \begin{cases} 1 - \alpha, & 0 \le \alpha \le 1 \\ 0, & \alpha > 1 \end{cases}$ and hence evaluate $\int_0^\infty \frac{\sin^2 t}{t^2} dt$

29	Solve the integral equation $\int_0^\infty f(\theta)\, cos\, \alpha\theta\, d\theta = \begin{cases} 1-\alpha, & 0 \le \alpha \le 1 \\ 0, & \alpha > 1 \end{cases}$ and hence evaluate $\int_0^\infty \frac{sin^2 t}{t^2} dt$
30	Property: Prove that $Z_T(n^k) = -z\, \frac{d}{dz}\, Z_T(n^{k-1})$, where k is a positive integer.
31	$Z_T(u_n) = \bar{u}(z)$ then $Z_T(u_{n+k}) = z^k\left[\bar{u}(z) - u_0 - u_1\, z^{-1} - u_2\, z^{-2} - \cdots - u_{k-1}\, z^{-(k-1)}\right]$
32	Find the z-transforms of the following. (i) $k^n n$ (ii) $k^n n^2$ (iii) e^{-an} (iv) $e^{-an}\, n$
33	Obtain Z-transform of $cosn\theta$ and $sinn\theta$. Hence deduce Z-transforms of the following. $k^n\, cosn\theta$ (ii) $k^n\, sinn\theta$ (iii) $e^{-an}\, cosn\theta$ (iv) $e^{-an}\, sinn\theta$
34	Find the Z-transform of $(n+1)^2$
35	Find the Z-transform of $2n + sin\left(\frac{n\pi}{4}\right) + 1$
36	Initial value theorem Statement: If $Z_T(u_n) = \bar{u}(z)$ then $\lim_{z\to\infty} \bar{u}(z) = u_0$
37	Initial value theorem Statement: If $Z_T(u_n) = \bar{u}(z)$ then $\lim_{z\to\infty} \bar{u}(z) = u_0$
38	Find the inverse Z-transform of $\frac{z}{(z-1)(z-2)}$
39	Find ${Z_T}^{-1}\left[\frac{5z}{(2-z)(3z-1)}\right]$
40	Compute the inverse Z-transform of $\frac{3z^2+2z}{(5z-1)(5z+2)}$
41	Solve by using Z-transforms: $y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = 0 = y_1$.
42	Solve by using Z-transforms: $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = 0 = y_1$.

Course Title	Engineering Physics				Course Type		HC Integrated	
Course Code	B21AS0202	Credits	4		Class		I/II semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	1				
	Total	**4**	**5**	**4**	**39**	**26**	**50%**	**50%**

COURSE OVERVIEW

Engineering Physics is very important and necessary basic subject for all branches of engineering students. It provides the fundamental knowledge of basic principles of Physics which is required for basic foundation in engineering education irrespective of branch. This course introduces the basic concepts of Physics and its applications to Electronics Engineering courses by emphasizing the following concepts: electrical properties, semiconductor physics, dielectrics, and optical properties. This course has basic laws expressions and theories which helps to increase the scientific knowledge to analyze upcoming technologies. The course also consists of real time and numerical examples which makes subject interesting and attractive.

COURSE OBJECTIVES:

This course enables graduating students to

1. Understand the basic concepts and principles of Physics to analyze practical engineering problems and apply its solutions effectively and efficiently.
2. Gain the knowledge of different physical phenomena, electrical/magnetic/optical properties and semiconductor physics.
3. Understand design issues, practical oriented skills and problem solving challenges.

COURSEOUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the properties of the materials and classify them into various categories.	1,2,4,	1,2,3
CO2	Extract various semiconducting parameters like carrier concentration, drift velocity, effective mass, etc.	1,2,3,4,	1,2,3
CO3	Understand the origin of magnetism and its applications	1,2,	1,2,3
CO4	Demonstrate the properties of dielectric materials.	1,2	1,2,3

C05	Explain the light matter interaction, carriers generation and recombination in materials	1,2	1,2,3
CO6	Explore the nano-materials properties and its applications.	1,2,	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

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

COURSE CONTENT
THEORY

Contents

UNIT – 1 **ELECTRICAL PROPERTIES OF MATERIALS** Classical free electron theory – Expression for electrical conductivity – Thermal conductivity, expression – Wiedemann-Franz law – Quantum free electron theory-Success and failures – electrons in metals – Schrodinger Wave Equation(qualitative)- Particle in a one dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states(qualitative) – metals and insulators – Electron effective mass.
UNIT – 2 **SEMICONDUCTOR PHYSICS** Intrinsic Semiconductors – Energy band diagram – concept of hole-direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport – Einstein's relation – Hall effect and devices.
UNIT – 3 **MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS** Magnetism in materials – magnetic field and induction – magnetization – magnetic permeability and susceptibility–types of magnetic materials – microscopic classification of magnetic materials – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown – high-k dielectrics.
UNIT – 4 **OPTICAL PROPERTIES OF MATERIALS** Classification of optical materials – carrier generation and recombination processes – Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) – photocurrent in a P- N diode – solar cell –photo detectors – LED – Organic LED – Laser diodes – excitons – **NANOELECTRONIC DEVICES** Introduction – electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures – Density of states in quantum well, quantum wire and quantum dot structures, Carbon Nano Tubes and their properties.

Text Books

1. M.N. Avadhanulu and P.G. Kshirsagar, "A Text book of Engineering Physics", S. Chand & Company Ltd, New Delhi, 10th revised Ed
2. Gaur and Gupta, "Engineering Physics", Dhanpat Rai Publications2017

REFERENCE BOOKS:

1. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill Edu Pvt Ltd- New Delhi, 6 th Ed 2006
2. S O Pillai,"Solid State Physics", New Age International Publishers, 8th Ed
3. S M Sze, Physics of Semiconductor devices, Wiley, 2004

PRACTICE SESSION:

Sl. No.	Title of the Experiment	Tools and Techniques	ExpectedSkill /Abilit y
1.	Variation of Resistivity of intrinsic Semi-conductor crystal using four probe method	Four probe apparatus, oven, Ge crystal with non-conducting bottom surface	Circuit connections, mathematical calculations
2.	Determination Value of Planck's constant by using light emitting diode	4-5 different LED's, voltmeter and	Circuit connections, mathematical calcultions, analysing

		powersupply, Planck's constant apparatus set up, patch cards	the results
3.	Attenuation and propagation characteristics of optical fiber cable.	Diode laser, digital dc micrometer (0-200μA), two OFC (1.5m &2.5m), optical sensor mounted on a stand and fitted to chunk.	Analysing and mathematical skills
4.	Determination of numerical aperture of a given optical fiber.	Optical Trainer Kit, Fiber Cable, NA Measurement JIG,	Mathematical and analysing skills
5.	To find the laser parameters–wavelength and divergence of laser light by diffraction method.	Light detecting microscope, relative intensity meter, laser light	
6.	Photo Diode Characteristics (Study of I–V characteristics in reverse bias and variation of photocurrent as a function of reverse voltage and intensity	A battery eliminator, voltmeter, millimeter, experimental board and power supply, photodiode	Analysing and mathematical calculations, circuit connections
7.	Dielectric constant of a capacitor by charging and discharging of a capacitor	Dielectric constant apparatus kit (consisting of capacitor, power supply and resistor,	Analysing skills and mathematical calculations, circuit
8.	Determination of particle size using laser.	Laser source, lycopodium particles, glass plate, screen	Analysing skills and mathematical
9.	Band gap of intrinsic Semi-conductor	Four probe apparatus, oven, Si crystal with non-conducting	Circuit connections, mathematical
10	Series and parallel LCR Circuits (Determination of resonant frequency and quality factor)	Function generator, series resonance kit (power supply, resistor, inductor, ammeter),	Analysing skills and mathematical calculations, circuit

PROJECT BASED LEARNING

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

Sl. No.	Suggested sample Projects
1.	Build a model of different types of sensors.(smoke detectors, water level detectors,)
2.	Preparation of graphene from graphite using a battery.
3.	Collect different type of materials and compare their mechanical and magnetic properties.
4	Demo and presentation of different types of LED's available in the market

Course Title	Introduction to Data Science				Course Type		HC Integrated	
Course Code	B21CS0101	Credits	3		Class		I/II Semester	
Course Structure	LTP	Credits	Contact Hours	WorkLoad	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**3**	**4**	**4**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

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

.

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the basic concepts of Data Science in developing the real world applications.	1 to 5, 8 to 10	1,2,3
CO2	Apply the SQL commands in developing the real-world applications.	1 to 5, 8 to 10	1,2,3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1 to 5, 8 to 10	1, 2, 3
CO4	Create the real world AI based solutions using different machine learning algorithms	1 to 5, 8 to 10	1, 2, 3
CO5	Illustrate modeling Error in Linear Regression	1 to 5, 8 to 10	1, 2, 3
CO6	Demonstrate applications of Data Science	1 to 5, 8 to 10	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to Microsoft Excel:

Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Filters, Grouping. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.

UNIT – 2

Introduction to Data Science:

What is Data Science? Probability theory, bayes theorem, bayes probability; Cartesian plane, equations of lines, graphs; exponents.

Introduction to SQL:

SQL: creation, insertion, deletion, retrieval of Tables by experimental demonstrations. Import SQL Database Data into Excel

UNIT – 3

Data science components:

Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Description of linear regression and Logistic Regression. Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression.

UNIT – 4

Data visualization using scatter plots, charts, graphs, histograms and maps:

Statistical Analysis: Descriptive statistics- Mean, Standard Deviation for Continuous Data, Frequency, Percentage for Categorical Data

Applications of Data Science

Data science life cycle, Applications of data science with demonstration of experiments either by using Microsoft Excel.

PRACTICE:

sl.no	Title of the Experiment	Tools and Techniques	Expected Skill/Ability

<table>
<tr>
<td>1.</td>
<td>The height (in cm) of a group of fathers and sons are given below, Find the lines of regression and estimate the height of son when the height of father is 164 cm.
<table>
<tr><td>Plot the graph. Hgt of Fathers</td><td>158</td><td>166</td><td>163</td><td>165</td><td>167</td><td>170</td><td>167</td><td>172</td><td>177</td><td>181</td></tr>
<tr><td>Hgt of Sons</td><td>163</td><td>158</td><td>167</td><td>170</td><td>160</td><td>180</td><td>170</td><td>175</td><td>172</td><td>175</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Create and perform operations on Excel data set by applying Linear regression</td>
</tr>
<tr>
<td>2.</td>
<td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES, perform the following:
i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trendline feature).
iv) Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
v) Compute the coefficient of determination and the coefficient of correlation</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>3.</td>
<td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.
i) Plot a scatter diagram.
ii) Determine the regression equatine (hint: use MS Excel's Add Trendline feature).
iii) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
iv) Compute the coefficient of determination and the coefficient of correlation</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
</table>

<table>
<tr>
<td>4.</td>
<td>Apply multiple linear regression to predict the stock index price which is a dependent variable of a fictitious economy based on two independent / input variables interest rate and unemployment rate.
<table>
<tr><th>year</th><th>month</th><th>interest rate</th><th>unemployment rate</th><th>stock index price</th></tr>
<tr><td>2020</td><td>10</td><td>2.75</td><td>5.3</td><td>1464</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>5.</td>
<td>Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10,00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for a loan availed of Rs.10,00,000 during 3 years.
<table>
<tr><th>Sl No.</th><th>A</th><th>B</th></tr>
<tr><td>1</td><td>Principal</td><td>Rs.10,00,000</td></tr>
<tr><td>2</td><td>Annual interest rate</td><td>5.20%</td></tr>
<tr><td>3</td><td>Year of the loan</td><td>3</td></tr>
<tr><td>4</td><td>Starting payment number</td><td>1</td></tr>
<tr><td>5</td><td>Ending payment number</td><td>36</td></tr>
<tr><td>6</td><td>total interest paid during period</td><td>?</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Create Excel data and perform EMI estimator</td>
</tr>
<tr>
<td>6.</td>
<td>Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO, should not be NULL.</td>
<td>SQL</td>
<td>Creating Tables</td>
</tr>
<tr>
<td>7.</td>
<td>Create the customer database of a big Market with CUSTOMER_ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_CODE. Store at least twenty customers details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.</td>
<td>SQL</td>
<td>Creating and retrieving Tables</td>
</tr>
<tr>
<td>8.</td>
<td>Apply linear regression to find the weather (temperature) of a city with the amount of rain in centimeters. Create your own database with following details.
<table>
<tr><th>CITY</th><th>Temperature in Centigrade</th><th>Rain in Centimeters</th></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Apply Linear regression</td>
</tr>
</table>

9.	Use the linear regression technique to compare the age of humans with the amount of sleep in hours. Name | Age in Years | Sleep in hours Create your own database with above details.	MS Excel	Apply Linear regression
10.	Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/ recorded in the matches. Assume your own database.	MS Excel	Apply Linear regression
11.	Design the ER diagram and create schema of the REVA library management system.	Entity Relationship	Entity Relationship diagrams
12.	Design the ER diagram and create schema for Hospital Management system.	Entity Relationship	Schema design

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNING EXERCISES:

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

Course Title	Analog and Digital Electronics				Course Type		HC Integrated	
Course Code	B21EO0201	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**42**	**28**	**50%**	**50 %**

COURSE OVERVIEW:

The course introduces analysis of elementary analog and digital circuits. It will give a basis for understanding and constructing simple systems of analog and digital electronic circuit elements. In this course basic and simple analog electronics circuits like biasing, amplifiers, oscillators, and operational amplifier circuits are introduced. Students will gain the basic electronic components and circuits knowledge required in the field of robotics and automation. Digital electronic circuits like multiplexers, ALU, registers, counters are very much essential for any robotics and automation engineer. This course provides an opportunity for the first-year level robotics engineering students to design and analyze simple analog and digital electronics circuits.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand and apply concepts of biasing operation of Bi-polar Junction Transistor to design amplifiers and oscillator circuits.
2. Understand and design amplifiers and comparators using operational amplifiers.
3. Provide the basics behind the digital circuit design using k-map simplification technique.
4. Introduce the basic concepts of combinational and sequential logic circuit design.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop the capability to analyze and design simple amplifier and oscillator circuits containing non-linear elements such as transistors using the concepts operating point and biasing.	1,2,3,4	2,3

CO2	Differentiate various feedback circuits in transistor applications	1,2,3,4	
CO3	Design and analyze amplifier and comparator circuits using op-amps.	1,2,3,4	2,3
CO4	Realize any combinational logic circuits using K-map simplification technique	1, 2, 3, 10,11	1,3
CO5	Design and realize the sequential logic circuits from the basic concept of a latch and flip-flop.	1,2,3,4,5,10, 11	1,3
CO6	Design and realize the Counter circuits using flip-flop	1,2,3,4,5,10, 11	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents

UNIT – 1 (11hrs)

BJT biasing and Feedback amplifiers: BJT operating point, Fixed Bias, Voltage-Divider Bias, Emitter-Follower, Two-Port Systems Approach, Cascaded Systems, Darlington Connection, Feedback Concepts, Feedback Connection Types, Practical Feedback Circuits- Voltage Series Feedback and Current-Series Feedback, Numerical on each topic.

UNIT – 2 (10 Hrs.)

Oscillators: Condition for oscillation, Phase Shift Oscillator, Colpitts, Hartley and Crystal Oscillators
Operational amplifiers: Basic characteristics of Op-amp, inverting/non-inverting amplifiers, voltage follower, summers, differential amplifiers, peak detectors, waveform generator circuits, Crossing detectors, Schmitt trigger circuits, Numerical on each topic.

UNIT – 3 (10 Hrs.)

Combinational digital circuit design: Basic Logic gates, K-map representation, SOP, POS, Adders, Subtractors, BCD arithmetic, carry look ahead adder, digital comparator, code converters, Multiplexer, De-Multiplexer, encoders and decoders, Logic design examples on each topic.

UNIT – 4 (11 Hrs.)

Sequential digital circuit design: Latches and Flip-Flops: Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop, SR Flip Flop, J K Flip Flop, T Flip Flop, shift registers, serial to parallel converter, parallel to serial converter, Counters: Ripple up/down counters, design of synchronous counters using flip-flops, Introduction to Mealy and Moore Model circuits, sequence generator design, Logic design examples on each topic.

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Design a single stage BJT common emitter fixed bias amplifier and obtain its frequency response and bandwidth.	Measuring instruments and design equations	Design and circuit debugging, working in a team
2	Design a single stage BJT CE voltage divider bias amplifier and obtain its frequency response and bandwidth.	Measuring instruments and design equations	Design and circuit debugging, working in a team
3	Rig-up an R-C Phase Shift oscillator for fo ≤ 10 KHz & Crystal oscillators for fo>1MHz.	Measuring instruments and design equations	Design and circuit debugging, working in a team
4	Design an active inverting and non-inverting amplifier using 741 op-amp for the specified gain.	Measuring instruments and design equations	Design and circuit debugging, working in a team
5	Design and implement a zero-crossing detector and a Schmitt trigger circuit for specified trigger points using 741 op-amp	Measuring instruments and design equations	Design and circuit debugging, working in a team

6	Realize any given Boolean expression using basic gates/exclusive gates: a. 3-bit adder/subtractor b. Digital comparator	Digital trainer kits, K-map	Design and circuit debugging, working in a team
7	Test and verify the working of a. 4:1 MUX using IC74153. b. 1:4 DEMUX using 74139.	Digital trainer kits, K-map	Design and circuit debugging, working in a team
8	Test and verify the truth-table of the following flip-flops using IC7476: a. JK flip-flop b. D flip-flop c. T flip-flop	Digital trainer kits, truth- table	Design and circuit debugging, working in a team
9	Design and realize a 4- bit, right shift register using JK flip-flops and also verify the SISO, SIPO operations..	Digital trainer kits, Truth-table	Design and circuit debugging, working in a team
10	Design and realize a 3-bit synchronous counter using JK flip-flops to count the given specific range of values in a particular direction.	Digital trainer kits, state table	Design and circuit debugging, working in a team

TEXT BOOKS:

1. Charles H Roth and Larry L Kinney, "Analog and Digital Electronics", Cengage Learning, 2019.
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education, 11th edition, 2015.
3. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 1st Edition, 2001.
4. Donald D Givone, "Digital Principles and Design", McGraw Hill, 1st edition, 2003.

REFERENCE BOOKS

1. David A Bell, "Operational amplifiers and Linear ICs", PHI/Pearson, 2nd edition, 2004.
2. B. S. Sonde, "Introduction to System Design Using Integrated Circuits", New Age International, 1992.

<table>
<tr><td>Course Title</td><td colspan="4">IoT and Applications</td><td colspan="2">Course Type</td><td colspan="2">HC Integrated</td></tr>
<tr><td>Course Code</td><td>B21EC0101</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">I/II Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
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<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">CIE</td><td rowspan="3">SEE</td></tr>
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</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the architecture of Internet of Things.
2. Inculcate knowledge of IoT devices, Sensors and Communication Protocols in various application domains.
3. Gain expertise in interface of various sensors to IoT Boards.
4. Discuss the various applications of IoT .

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the architecture of IoT eco-system	1	1,2
CO2	Identify IoT devices, architecture, sensors and Communication protocols	1	1,2
CO3	Demonstrate the interface of sensors to IoT board	1,5, 12	1,2
CO4	Realize various Applications of IoT through case studies	1,5, 12	1,2
CO5	Develop simple IoT projects and modules	1,5,9, 12	1,2
CO6	Identify technologies used to develop IoT based applications	1, 5, 9,10,11,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

CO1	3												3	3	
CO2	3												3	3	
CO3	3				3							3	2	2	
CO4	3				3							3	1	1	
CO5	3				3				2			3	3	3	
CO6	3				3				2	2	2	3			

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

Course Content Theory:

Contents
UNIT – 1 **IoT Basics**: Introduction to IoT, How does Internet of Things Works, Features of IoT, Advantages and Disadvantages of IoT, Embedded Devices in IoT, IoT eco-system,IoT Architecture and IoT Devices: Components of IoT architecture, Stage of IoT solution architecture, Smart Objects, IoT Devices.
UNIT – 2 **IoT boards in Market: Arduino, Arduino UNO, ESP8266 ,Raspberry Pi,IoT Platform:** Amazon Web Services (AWS) IoT platform, Microsoft Azure IoT platform, Google Cloud Platform IoT, IBM Watson IoT platform, ThingWork IoT platfor Technologies Used in IoT: Bluetooth, Wi-Fi, Li-Fi, RFID ,Cellular ,Z-Wave

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	Introduction to IoT Board a. Arduino UNO b. Arduino Nano c. Node MCU d. Ethernet Shield	Hardware	• Identifications of various parts of Arduino and Node MCU boards • Study of Ethernet shield and connection to the board

2.	Working with Arduino IDE (Integrated Development Environment)	Open source Arduino IDE	• Download specified software • Modify code as per the application
3.	a) Demonstration of Multimeter usage Demonstration of Breadboard connection for Voltage, Ground, series and parallel connections Exercise to read the value of resistor using Colour code chart	Multimeter Breadboard Resistor packs	• Measurement of voltage at various points in IoT boards • Choose the value of Resistor for an application
4.	Reading photo resistor sensor value connected to Arduino Board	Arduino UNO Arduino IDE LDR , Multimeter, Resistor	• Interface of photo sensor to IoT board for light measurement applications
5.	Reading temperature sensor value connected to Arduino Board	Arduino UNO , Arduino IDE, Temperature sensor, Multimeter	• Interface of Temperature sensor to IoT board for temperature measurement
6.	Reading motion detector sensor value connected to IoT board	Arduino UNO , Arduino IDE, pyro-dielectric sensor, Multimeter	• Interface of Motion detector sensor to IoT board for motion detection detection.
7	Reading distance measurement using Ultrasonic sensor Connected to IoT board	Arduino UNO , Arduino IDE, Ultrasonic sensor, Multimeter	Interface of Motion detector sensor to IoT board for motion detection
8	Interface relay to IoT board	Arduino UNO , Arduino IDE, relay Multimeter	Interface relay to IoT board for Switching applications
9	Connect Wifi-ESP8266 to Arduino UNO board , Send and receive data through smart phone.	Arduino UNO ESP8266, Arduino IDE Smart phone	Connect IoT board to Wifi network
Part-B (Case Study projects- Samples)			

	Automated lighting system *IoT and Cloud Server Based Wearable* Health Sensor's Monitoring System intelligent Traffic system *Motor Controlling with Android App* *A Smart System connecting E-Health Sensor's and the Cloud* *IoT based Garbage Management System ,* *IoT based submersible motor pumps on/off* *IoT Based Electronic Door Opener,* *IoT Based Garbage Monitoring* *Building Automation System Using GRPS IoT,* *Implementation of Industrial Data Acquisition, management and Guiding using IoT* *Distance based Accident Avoidance System using CAN protocol & Tracking through IoT ,* *Swachh Bharat Waste Collection Management System using IOT*	Smart Parking Smart healthcare *IoT - Industrial Internet of Things Monitoring Of Sensor's Data on Android App* *Integrated Smart Health Care Monitoring System* *Smart E-Agriculture Monitoring Using Internet Of Things* *Smart Home Automation using IOT* *Monitoring of Highway Hybrid Parameter & Controlling Highway Light Through IoT* *IoT Based Smart Agriculture Monitoring System* *IoT Based Agriculture Crop - Field Monitoring System and Irrigation Automation* *Multiple Garbage Box Monitoring & Collection system* *IoT Based Garbage Monitoring System*	Smart water management IoT for smart cities Remote Patient Monitoring ,E Agriculture Monitoring on Webpage *Air Pollution & Water Quality Monitoring System* *An IoT Based Patient Monitoring System using Raspberry Pi ,Underground Cable Fault Detection Over Internet Of Things (Iot) Google Map* *IoT Air & Water Quality Monitoring System,IoT Based Automatic Vehicle Accident Detection and Rescue System* *Patient Health Status Observing Based On IoT and Email Alert* *IoT Based Vehicle Accident Detection and Tracking System on google map webpage* *Data Logger System for weather monitoring using WSN ,Smart intelligent security system for women*

PART C (Mini Project)

1	**Arduino Controlled Light intensity**: design and build a simple , effective circuit called Auto Intensity Control of Street Lights using Arduino	ArduinoUNO,DS3231 RTC Module, LDR 16×2 LCD Display ,LED,10KΩ Potentiometer,10KΩ Resistor, Push Button, Connecting Wires, Breadboard	Design and Implementation of IoT project to solve Engineering Problems.
2	**Thermometer**: build an LCD thermometer with an Arduino UNO and a LM35/36 analog temperature sensor.	Arduino Uno, Temperature Sensor, LCD display, Breadboard and Connecting wires	Design and Implementation of IoT project for Engineering applications.

3	Motion activated light lamp: build an automated project that It switches on and off when there's motion.	Arduino Uno, PIR Motion sensor, breadboard, connecting wires, LED generic.	Design and Implementation of IoT project for Engineering applications

TEXT BOOKS:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On- Approach" Second edition 2014, ISBN: 978 0996025515.

REFERENCE BOOKS:

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

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNING EXERCISES:

a) Create Arduino project hub

<table>
<tr><td>Course Title</td><td colspan="4">Entrepreneurship</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B21ME0104</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">I/II semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>13</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVE:

1. To understand the basic terms, concepts in Entrepreneurship Development

2. To analyze and apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES (COs)

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

CO	Course Outcomes	POs	PSOs
CO1	Define the keywords and concepts used in entrepreneurship development	1	
CO2	Describe the characteristics and types of an entrepreneur	1,6	
CO3	Explain the new generations of an entrepreneurship and skills of an entrepreneur	1,2,6,7,10,12	1,3
CO4	Differentiate between the industrial park and special economic zone	1,2,7	1,3
CO5	Classify the tender process and exemptions from income tax.	1,2,5,8,10-12	1,3
CO6	Choose the suitable government agencies to support his/her idea to become an entrepreneur	1-4,6-12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT THEORY

Unit-1

Introduction to Entrepreneurship:

Evolution of term 'Entrepreneurship', Factors influencing entrepreneurship', Psychological factors, Social factors, Economic factors, Environmental factors. Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc., Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving.

Unit-2

Institutional Support for Entrepreneurship:

Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) license, Environmental Clearance, National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs

TEXT BOOK:

1. K. Ramachandran, "Entrepreneurship Development", Tata Mc. Graw Hill, 2008

2. Sangeeta Sharma, "Entrepreneurship Development" PHI Publications, 2016

REFERENCE BOOKS:

1. Baringer and Ireland, “Entrepreneurship”, Pearson, 11th Edition, 2020.

2. P. Narayana Reddy, “Entrepreneurship – Text and Cases, Cengage Learning India”, 1st Edition, 2010

3. Corporate Entrepreneurship: Building the Entrepreneurial Organization" by Paul Burns published by Palgrave Macmillan.

4. Drucker F Peter: “Innovation and Entrepreneurship”, 1985.Heinemann, London.

5. Doanld F Kuratko & Richard M Hodgeth, “Entrepreneurship in the New Millennium”, India Edition - South-Western, Cengage Learning

JOURNALS/MAGAZINES

1. International Small Business Journal: **https://journals.sagepub.com/home/isb**

2. Journal of Development Entrepreneurship: **https://www.worldscientific.com/worldscinet/jde**

SWAYAM/NPTEL/MOOCs:

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

<table>
<tr><td>Course Title</td><td colspan="4">Computer Aided Engineering Drawing</td><td colspan="2">Course Type</td><td colspan="2">HC Integrated</td></tr>
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<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>26</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

The objectives of this course are to

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Construct the simple 2D drawings manually and also by using CAD software	1,5,10	1
CO2	Draw orthographic projection of point, line, plane surfaces and simple solids	1,3,5, 10	1
CO3	Draw orthographic projection of simple solids	1,3,5, 10	1
CO4	Draw sectional views of a prisms, pyramids, cone and cylinder	1,3,5, 10	1
CO4	Develop the lateral surfaces of the solids	1,2, 3,5,10	1,2,3
CO6	Create isometric view of the solids	1,3,5,10	1

BLOOM'S LEVELOF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO4	3		2		3					3			3		
CO5	3	2	2		3					3			3	3	2
CO6	3		2		3					3			3	2	1

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

COURSE CONTENT

THEORY

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

PRACTICE:

Sl. No.	Practice	Tools and Techniques	Expected Skill /Ability
1.	Use of solid edge software and familiarization of tools	Solid Edge Software	Use of commands to draw the drawings
2.	Draw the projection of point locating in first and third quadrant	Solid Edge Software	Analyzing and software skill
3.	Draw the projection of lines locating in first quadrant	Solid Edge Software	Draw the views of the line and software skill
4.	Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	interpretation and software skill

Sl. No.	Practice	Tools and Techniques	Expected Skill /Ability
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	interpretation and software skill
9	Draw the projection of section of solids in simple position	Solid Edge Software	analyzing and software skill
10	Develop the lateral surface of prisms and cylinder	Solid Edge Software	Creative and software skill
11	Develop the lateral surface of pyramids and cone	Solid Edge Software	Creative and software skill
12	Draw the isometric projection of simple plane surface and simple solids	Solid Edge Software	Analyzing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analyzing and software skill

TEXT BOOKS:

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

REFERENCE BOOKS:

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

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASEDLEARNING

Sl.	Problems
1	A point 30 mm above XY line is the front view of two points A and B. The top view of A is 40 mm behind VP and the top view of B is 45 mm in front of VP. Draw the projections of the points and state the Quadrants in which the points are situated.
2	A point 'A' is 30 mm in front of VP & 40 mm above HP. Another point B is 20 mm behind VP & 35 mm below HP. The horizontal distance between the points measured parallel to XY line is 60 mm. Draw the three projections of the points. Join their front and top views.
3	A point P is on HP and 35 mm in front of VP. Another point Q is on VP and below HP. The line joining their front views makes an angle of 300 to XY line, while the line joining their top views makes an angle of 450 with XY line. Find the distance of the point Q from HP.
4	A point is 35 mm below HP, 20 mm behind VP and 25 mm behind / in front / from RPP. Draw its projections and name the side view.

5	A line AB 80 mm long is inclined to HP at 30 degree and inclined to VP at 45degree. Draw front and top views of line and determine their lengths. Also, measure the perpendicular distance of end B from both HP & VP.
6	A line AB has its end A 20 mm above the HP and 30 mm in front of VP. The other end B is 60 mm above HP and 45 mm in front of VP. The distance between end projectors is 70 mm. draw its true length and apparent inclinations.
7	The top view pq of a straight line is 70 mm and makes an angle of 60 degree with XY line. The end Q is 10 mm in front of VP and 30 mm above HP. The difference between the distances of P and Q above HP is 45 mm. draw the projections. Determine its true length and true inclinations with HP and VP.
8	The top view of a line 75 mm long measures 50 mm. The end P is 30 mm in front of VP and 15 mm above HP. The end Q is 15 mm in front of VP and above HP. Draw the projections of the line and find its true inclinations with HP and VP.
9	The distance between the end projectors through the end points of a line AB is 60 mm. the end A is 10 mm above HP and 15 mm in front of VP. The end B is 35 mm in front of VP. The line AB appears 70 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.
10	The point B of a line AB is on the horizontal plane, the top view of the line makes an angle of 30 degree with XY line, being 80 mm. the point A is on the vertical plane and 50 mm above the horizontal plane. Draw the top and front views of the line and obtain the true length of the line. Also find the inclinations of the line with two planes.
11	The end A of a line AB is in HP and 25 mm in front of VP. The end B is 10 mm in front of VP and 50 mm above HP. The distance between the end projectors when measured parallel to the line of intersection of HP and VP is 80 mm, Draw the projection of the line AB and determine its true length and true inclination with HP and VP.
12	Find the true length and true inclination of a line AB with HP having one of its ends 20 mm in front of VP and 30 mm above the HP. The line is inclined at 40 degree to VP and left side view of the line is 60 mm long and inclined at 60degree to the x1y1 line. Draw all the three views of the line.
13	An equilateral triangular lamina of 25mm side lies with one of its edges on HP such that the surface of the lamina is inclined to HP at 60degree. The edge on which it rests is inclined to VP at 60degree. Draw its projections.
14	A 30 degree-60degree setsquare of 60mm longest side is kept such that the longest side is in HP, making an angle of 30 degree with VP. The set square itself is inclined at 450 to HP. Draw the projections of the setsquare.
15	A square lamina ABCD of 40mm side rests on corner C such that the diagonal AC appears to be at 45 degree to VP. The two sides BC and CD containing the corner C make equal inclinations with HP. The surface of the lamina makes 30 degree with HP. Draw its top and front views.
16	A mirror 30 mm x 40 mm is inclined to the wall such that its front view is a square of 30 mm side. The Longer sides of the mirror appear perpendicular to both HP and VP. Find the inclination of the mirror with the wall.
17	A pentagonal lamina of sides 25 mm is resting on one of its edges on HP with the corner opposite to that edge touching VP. This edge is parallel to VP and the corner, which touches VP, is at a height of 15 mm above HP. Draw the projections of the lamina and determines the inclinations of the lamina with HP and VP and the distance at which the parallel edge lies from VP.
18	A pentagonal lamina of sides 25 mm is having a side both on HP and VP. The corner opposite to the side on which it rests is 15 mm above HP. Draw the top and front views of the lamina.

19	Draw the top and front views of a hexagonal lamina of 30mm sides having two of its edges parallel to both vertical and horizontal planes and one of its edges is 10 mm from each of the planes of projection. The surface of the lamina is inclined at an angle of 60° to the HP.
20	A hexagonal lamina of sides 30 mm has one of its comers in VP and its surface inclined at an angle of 30° with VP. The diagonal passing through that corner which is in VP appears to be inclined at 45° to HP. Draw the projections of the lamina.
21	A hexagonal lamina of sides 25 mm rests on one of its corners on HP. The corner opposite to the corner on which it rests is 35mm above HP and the diagonal passing through the corner on which it rests is inclined at 30° to VP. Draw its projections. Find the inclination of the surface with HP.
22	Draw the projections of a circular plate of negligible thickness of 50 mm diameter resting on HP on a point A on the circumference, with its plane inclined at 45° to HP and the top view of the diameter passing through the resting point makes 60° with VP.
23	A circular lamina inclined VP appears in the front view as an ellipse of major axis 30 mm and minor axis 15 mm. The Major- axis is parallel to both HP and VP. One end of the minor axis is in both the HP and VP. Draw the projections of the lamina and determine the inclination of the lamina with the VP.
24	A square prism 35mm side of base & 60mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the prism when the axis is inclined to HP at 45º
25	A pentagonal prism 25mm sides of base & 60mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 40º & VP at 30º
26	A Hexagonal prism 25mm sides of base and 50mm axis length rests on HP on one of its edges. Draw the projections of the prism when the axis is inclined to HP at 45º & appears to be inclined to VP 40º.
27	A cone 40 mm diameter and 50 mm axis is resting on one generator on HP which makes 30º inclination with VP. Draw it's projections.
28	A pentagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º .Draw the projections of the pyramid when the axis is inclined to HP at 45º
29	A hexagonal pyramid 30mm sides of base and axis 70mm long is resting on its base on HP with one of the edges of the base parallel to VP. It is cut by sectional plane, perpendicular to VP, inclined at 30° to HP and bisects the axis. Draw the front view, sectional top view & true shape of the section.
30	A vertical cylinder of base diameter 50 mm and axis 65 mm long rests on HP. It is cut by a section plane perpendicular to VP, inclined at 45 degree to HP and at a height of 30mm from the base. Draw its sectional top view and true shape of the section.
31	A hexagonal pyramid 30mm sides of base and axis 70mm long is resting on its base on HP with one of the edges of the base parallel to VP. It is cut by sectional plane, perpendicular to VP, inclined at 30° to HP and bisects the axis. Draw the front view, sectional top view & true shape of the section.
32	A square pyramid base 40mm side and axis 65mm long has its base on HP and all the edges of the base are equally inclined to VP. It is cut to with an inclined plane so as the truncated surface at 45 degree to axis, bisecting it. Draw the development of the truncated pyramid.
33	A Hexagonal prism of base side 30mm and axis length 60mm resting on HP in such a way that two of its edges are parallel to VP. The prism is cut by a section plane which is perpendicular to the VP and inclined at 30º to the HP at a height of 35mm from the base. Draw the development of the lateral surface of the prism.

34	A pentagonal prism, 30 mm base side & 50 mm axis is standing on HP on its base whose one side is perpendicular to VP. It is cut by a section plane 45 degree inclined to HP, through mid-point of axis.
	Draw FV, sectional top view& sec. Side view. Also draw true shape of section and Development of surface of remaining solid.
35	A hexagonal pyramid 25mm side of base and axis 65mm long is resting on its base on HP with one of the edged of the base parallel to VP. It is cut by a section plane inclined at 60º to HP and perpendicular to VP and intersecting the axis at 30mm above the base. Draw the development of the remaining portion of the pyramid.
36	A cone of base diameter 40 mm and height 50 mm is placed centrally on the top of a square slab side 60 mm and height 25 mm. Draw the isometric projection of the combination.
37	A sphere of diameter 45mm rests centrally over a frustum of cone of base diameter 60mm,top diameter 40mm and height 50mm.Draw its isometric projections.
38	A cube of 35 mm placed centrally on a square slab of 50 mm and thickness 30 mm. Draw the isometric projection of the combination.
39	Draw the isometric projection of the combination. Draw isometric projection of a hexagonal prism of side of base 40mm and height 60mm with a right circular cone of base 40mm as diameter and altitude 50mm, resting on its top such that the axes of both the solids are collinear.
40	A rectangular pyramid of base 40mmx25mm and height 50mm is placed centrally on a rectangular slab side 100mmx60mm and thickness 20mm.Draw the isometric projection of the combination.

PROJECT BASED LEARNING

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

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

Detailed Syllabus
Semester III

Course Title	Linear Algebra and Partial Differential Equations				Course Type		HC	
Course Code	B21AS0305	Credits	3		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-			IA	SEE
	Practice	-	-	-	Theory	Practical		
	Total	**3**	**3**	**3**	**42**	**0**	**50 %**	**50 %**

COURSE OVERVIEW:

Linear algebra is the study of linear systems of equations, vector spaces and linear transformations. Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in Science and Engineering. The objective of the course is to give introduction to Partial Differential Equations for undergraduate students.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the concepts of linear algebra and solving of system of equations Y = AX**.**
2. Understand the concepts of basis, dimension and linear transformation.
3. Understand vector differentiation, div, grad and curl.
4. learn about formation and solving partial differential equations

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of Linear Algebra in Image processing and digital signal processing.	1,2,3,4	1,2,3
C02	Solve Engineering problems using Rayleigh Power method to find largest Eigen value and Eigen vector	1,2,3,4	1,2,3
CO3	Apply the knowledge of vector spaces in engineering like digital communication.	1,2,3,4	1,2,3
CO4	Find Surface integral and volume integral of given function to prove Stokes and Divergence theorem	1,2,3,4	1,2,3
CO5	Apply the knowledge of vector calculus in engineering like field theory.	1,2,3,4	1,2,3

CO6	Apply the knowledge of PDE in solving heat equation, wave equation and Laplace equation	1,2,3,4	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT - 1 **Linear Algebra**: 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. Linear and Inverse transformation. Diagonalization of a matrix, Reduction of a quadratic form to canonical form by orthogonal transformation

UNIT - 2
Vector Space: Introduction to vector spaces and sub-spaces, definitions, illustrative examples and simple problems. Linearly independent and dependent vectors-definition and problems. Basis vectors, dimension of a vector space. Linear transformations-definition, properties and problems. Rank- Nullity theorem (without proof). Matrix form of linear transformations-Illustrative examples
UNIT - 3
Vector Calculus: 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 - 4
Partial differential equations: Formation of Partial differential equations by eliminating arbitrary constants and arbitrary variable Equations solvable by direct integration , Solution of Lagrange's linear PDE. Method of variable separable-D heat equation, 1-D wav equation. Non-linear equations of the first order. Charpits method.

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.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://www.journals.elsevier.com/linear-algebra-and-its-applications/most-downloaded-articles
2. https://www.researchgate.net/publication/304178667_A_Study_on_the_Linear_Algebra_Matrix_in_Mathematics
3. https://www.sciencedirect.com/journal/linear-algebra-and-its-applications/vol/1/issue/1
4. http://vmls-book.stanford.edu/vmls.pdf
5. https://www.researchgate.net/publication/317685719_A_Study_of_General_First-order_Partial_Differential_Equations_Using_Homotopy_Perturbation_Method
6. https://www.journals.elsevier.com/partial-differential-equations-in-applied-mathematics/

SWAYAM/NPTEL/MOOCs:

1. https://www.youtube.com/watch?v=LJ-LoJhbBA4&list=PLbMVogVj5nJQ2vsW_hmyvVfO4GYWaaPp7
2. https://www.youtube.com/watch?v=9h_Q-R6sXbM&list=PL7oBzLzHZ1wXQvQ938Wg1-soq09GywgOw
3. https://www.youtube.com/watch?v=Kk5SEzASkZU&list=PL9m2Lkh6odgKbfY03TFRhwjOqW79UdzK8
4. https://www.youtube.com/watch?v=W3HXK1Xe4nc&list=PLbPn3CUduj5TPQtrwfI70F1SW4LvPf90d
5. https://www.youtube.com/watch?v=Nonfmx0-LQQ

Course Title	Fundamentals of Robotics and Applications				Course Type		HC	
Course Code	B21EO0301	Credits	3		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	**42**	**-**	**50%**	**50 %**

COURSE OVERVIEW:

Robotics is an interdisciplinary branch of electronic engineering and mechanical engineering. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design machines that can help and assist humans. Robotics integrates fields of mechanical engineering, electrical engineering, information engineering, mechatronics, electronics, bioengineering, computer engineering, control engineering, software engineering, mathematics, etc.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Discuss the fundamental concepts of Robotics.
2. Provide insight into different types of robots
3. Explain intelligent module for robotic motion control.
4. Illustrate the working of innovative robotic devices

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the significance, social impact and future prospects of robotics and automation in various engineering applications.	1,2,6,8	1,2,3
CO2	Identify and describe the components and anatomy of robotic system.	1,2,3	1,2,3
CO3	Analyze the different motions of robotics system	1,2,3	1,2,3
CO4	Use the suitable drives and end-effectors for a given robotics application.	1,2,3	1,2,3
CO5	Apply robotics concepts to automate the monotonous and hazardous tasks in real world scenarios.	1,2,3	1,2,3
CO6	Differentiate and categorize the various types of robots based on the design and applications.	1,2,3	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1 **Introduction to Robotics:** Introduction to Robotics and Automation, laws of robot, a brief history of robotics, Robotics market and the future prospects, advantages and disadvantages of robots, social impact, human system and robotics, basic components of robot, robot specifications, classification of robots, safety measures in robotics.
UNIT – 2 **Robot anatomy and Motion analysis:** Anatomy of a Robot, Robot configurations: polar, cylindrical, cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.

UNIT – 3

Robot Drives and End Effectors:

Robot drive systems: Hydraulic, Pneumatic and Electric drive systems**,** classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.

UNIT – 4

Robotics applications: Material handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, ariel and underwater applications, robotic for computer integrated manufacturing.

Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Cobots, Autonomous robots, Swarm robots.

TEXT BOOKS:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009
2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012)
3. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rd edition, 2017.

REFERENCE BOOKS

1. *Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.*
2. *Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987*
3. *https://www.robots.com/applications*
4. *https://www.asme.org/engineering-topics/articles/bioengineering/top-6robotic-applications-in-medicine.*

<table>
<tr><td>Course Title</td><td colspan="4">Sensors and Actuators for Robotics</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B21EO0302</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

Sensors are at the base of any modern engineering system, for example, control systems in robotics. This course provides the basic knowledge to understand sensors and actuators. After an introduction on sensors and types of sensors, this course introduces the main characteristics such as accuracy, precision, resolution, sensitivity, linearity, static and dynamic properties. Classification of Actuators based on the purpose of application is provided to students. Introduction to micro sensors and actuators is given in the end of the course.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand basic laws and phenomena on which sensors and actuators operate
2. Understand operation of sensors to measure various physical parameters
3. learn the working principle of actuators used to perform various physical movements in robots

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the principles of various sensors and transducers for measurement and instrumentation.	1,2,3	1,2,3
CO2	Demonstrate the working principle and characteristics of proximity, force and pressure sensors	1,2,3	1,2,3
CO3	Use the suitable sensors for Robotics and automation applications	1,2,3	1,2,3
CO4	Categorize and choose the suitable sensor to measure position, motion, and range of the obstacles.	1,2,3	1,2,3
CO5	Select the appropriate actuators for the given application.	1,2,3	1,2,3
CO6	Describe the working principle of micro sensors and actuators	1,2,3	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

CO1	3	2	2									2	1	2
CO2	3	2	2									2	1	2
CO3	3	2	2									2	1	2
CO4	3	2	2									2	1	2
CO5	3	2	2									2	1	2
CO6	3	2	2									2	1	2

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

Course Content:

Contents
UNIT – 1 **Introduction:** Transducers and sensors- Static and Dynamic Characteristics: Static characteristics: Accuracy, repeatability, reproducibility, range/span, linearity, threshold, sensitivity, resolution, hysteresis, precision, drift, Dynamic characteristics: Speed of response, settling time, fidelity, lag. Errors: Types of errors, statistical analysis, probability of errors, limiting errors, performance measures of sensors Classification of sensors, Sensor calibration techniques. Displacement Sensors- Linear and Rotary displacement sensors-Potentiometer, Capacitive and Inductive type displacement sensor- position sensors- Optical encoder, Photoelectric sensor, Hall Effect Sensor
UNIT – 2 **Sensors-1:** **Proximity, Force and Pressure sensors:** Proximity sensor- Eddy current proximity sensor, Inductive Proximity sensor, Capacitive Proximity sensor, Pneumatic Proximity sensors, Force Sensor, Piezoelectric Sensor, Tactile sensor- Touch Sensor/Contact Sensor. **Temperature Sensors:** Resistance Vs Temperature characteristics for different materials, Thermistors, Thermocouples - thermoelectric effects for thermocouples, thermocouple tables, RTD, Radiation temperature sensors, Pyro-electric type Temperature Sensor.
UNIT – 3 **Sensors-2:** **Motion, Range and optical sensors:** Motion sensor: Encoder sensors, LVDT, Accelerometer, gyroscope, PIR sensor, Range Sensors: RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR), optical sensors: Photo conductive cell, photo voltaic, Photo resistive, Photodiodes, Phototransistors. Special sensors: Acoustic Sensors, vision and imaging sensors, micro and nano sensors.
UNIT - 4 **Actuators:** Introduction: classification-Electric, Hydraulic, Pneumatic actuators; their advantages and disadvantages; Ideal characteristics of Actuators, Electric actuators: Stepper motors, DC motors, DC servo motors and their drivers, AC motors, Linear actuators, Hydraulic actuators: Components and typical circuit, advantages

and disadvantages Pneumatic Actuators: Components and typical circuit, advantages and disadvantages. Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuators, introduction to micro actuators.

Text Books:

1. De Silva, Clarence W. **Sensors and actuators**: Engineering system instrumentation. CRC Press, 2015.
2. Rangan & Mani "Instrumentation: Devices and Systems", McGraw Hill
3. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall India

Reference books:

1. Ida, N. "**Sensor, Actuators and their Interfaces: A Multidisciplinary Introductions**. (1st eds)." SciTech, Edison, NJ (2014).
2. Robert. J. Schilling, "Fundamentals of robotics – Analysis and control", Prentice Hall of India-1996.

Course Title	**Strength of Materials**				**Course Type**		**HC (Integrated)**	
Course Code	**B21EO0303**	**Credits**	**3**		**Class**		**III Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	**CIE**	**SEE**
	Practical	1	2	2				
	Total	4	5	5	**42**	**28**	**50%**	**50 %**

COURSE OVERVIEW:

Strength of materials course deals with behavior of materials subjected to various types of loadings. This course explores the topic of solid objects subjected to stress and strain. The methods taught in the course are used to predict the response of engineering structures to various types of loading, and to analyze the vulnerability of these structures to various failure modes. This course introduces students to the fundamental principles and methods of structural mechanics. Topics covered include: static equilibrium, force resultants, support conditions, analysis of determinate planar structures, stresses and strains in structural elements, states of stress (shear, bending, torsion), statically indeterminate systems, displacements and deformations, elastic stability, and approximate methods. Design exercises are used to encourage creativity in students.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To understand the principles, capabilities, limitations and applications of commonly used advanced materials.
2. To develop the basic knowledge on different stress & strain in materials under various loading conditions.
3. To incorporate the concept of transformation of Stress and Strain and to understand the concepts of torsion and its application to design of shafts.
4. To incorporate the concept of Shear Force, Bending Moment Diagram, Bending stress and deflection of beams.

COURSE OUTCOMES (COs):

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

CO	Course Outcomes	POs	PSOs
CO1	Select appropriate advanced materials for the specific applications.	1,2,3	1,2
CO2	Compute various types of stresses and strains, elastic constants for given load conditions.	1,2,3,6	1,2
CO3	Analyze bodies subjected to two-dimensional stress systems.	1,2,3,6	1,2
CO4	Plot Shear Force and Bending Moment Diagrams for various types of beams under different loading and boundary conditions.	1,2,3,6	1,2
CO5	Derive general torsion and bending equations and compute torque, bending moment, shear stress, bending stress.	1,2,3,6	1,2
CO6	Evaluate slope and deflection in beams subjected to different loads and boundary conditions.	1,2,3,6	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:
THEORY:

Contents
UNIT – 1
Metals and Alloys: Classification and characteristics of Metals, Ceramics, Polymers and composites. **Smart Materials**: Review of Composite Materials, Definition and classification of Smart Materials, Smart Materials (Physical Properties) Piezoelectric Materials, Electro strictive Materials, Magneto strictive Materials, and Self-Healing Polymers. **Nano materials**: Introduction to Nano science, Nano materials. Synthesis of nanomaterial's using bottom-up method (Arc Method), Top-Down method (ball milling method), properties and applications of carbon Nano tubes.
UNIT – 2
Simple Stress and Strain: Types of Loading, Axial, Shear, Concept of stress, Strain, Stress-strain diagram, Hooke's law, Young's modulus, Application to the Analysis and Design of Simple Structures, deformation in statically determinate problems, Elastic Constants, complementary shear stress, lateral strain and Poisson's ratio, Thermal Stresses.
UNIT – 3
Transformation of Stress and Strain: Transformation of plane stress, Principal Stresses, Maximum Shearing Stress, Mohr's Circle for Plane Stress. **Torsion:** Torsion in Solid & Hollow Circular Shafts, Torque and Power Transmitted by Solid and Hollow Shafts, Strength of Shafts.
UNIT - 4
Analysis of Beams: Shear force and bending moment diagrams of cantilevers, simply supported beams under concentrated, uniformly loaded, varying loads and externally applied moments with and without overhangs. **Stresses in beams:** beam of uniform strength, bending equation and numerical. **Beam Deflection:** slope and deflection at a section for cantilevers under concentrated and uniformly distributed loads using MaCaulay's method.

Practical Sessions:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Identification of Microstructure	Polishing Machine and Metallurgical Microscope	Material Identification
2	Tensile Test	Universal Testing Machine	Hands on Experience
3	Compression Test	Universal Testing Machine	Hands on Experience
4	Bending Test	Universal Testing Machine	Hands on Experience
5	Shear Test	Universal Testing Machine	Hands on Experience
6	Torsional Test	Torsion Testing Machine	Hands on Experience
7	Hardness Test	Torsion Testing Machine	Hands on Experience

8	Impact Test	Pendulum type impact testing machine	Hands on Experience

TEXT BOOKS:

1. William D. Callister, “Materials Science & Engineering -an introduction”, 4th edition. John Wiley & Sons.
2. S. H. Crandall, “An Introduction to Mechanics of Solids (In SI Units)”, McGraw-Hill. Third Edition, 2017.
3. Singer, F.L. Strength of Materials, 3rd Edition, Harper and Row Publishers, New York, 1980.

REFERENCE BOOKS

1. R.C.Hibbeler,"Mechanics of Materials", Printice Hall. Pearson Edu., 2005
2. S.S.Bhavikatti,"Strength of Materials", Vikas publications House -1 Pvt. Ltd., 2nd Edition, 2006.
3. Timoshenko.S.P "Strength of Materials", Part1, D.Van Nostrand Company, Inc. Newyork
4. R K Bansal, “Engineering Mechanics and Strength of Materials”, Laxmi Publications-New Delhi, 2004.

<table>
<tr><td>Course Title</td><td colspan="3">Problem Solving Using C Programming</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B21EN0304</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>1</td><td>2</td><td>2</td><td rowspan="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">IA</td><td rowspan="3">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>3</td><td>3</td><td>14+28</td><td>-</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

C is a general-purpose, high-level language that was originally developed by Dennis M. Ritchie to develop the UNIX operating system at Bell Labs. C programming is a general-purpose, procedural programming language used to develop software like operating systems, databases, compilers, and so on. The main features of C language include low-level access to memory, a simple set of keywords, and clean style. Many later languages have borrowed syntax/features directly or indirectly from C language. Like syntax of Java, PHP, JavaScript, and many other languages are mainly based on C language.

COURSE OBJECTIVES:

The objectives of this course are:

1. Provide exposure to problem solving through C programming
2. Explore the structure and syntax of C programming language
3. illustrate the applications of data types, operators, arrays, and control flow statements in problem solving.
4. Demonstrate the usage of procedure-oriented programming.

Ref: RU/BoS/ECE/CEC/June-2022/10

5. Provide insight into concepts like pointers, structures, and unions

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop an algorithm/flowchart to solve the computational problems	1,2,3,4,5	1,2,3
CO2	Solve data processing applications using appropriate data types, operators, and flow control statements.	1,2,3,4,5	1,2,3
CO3	Write C programs using derived data types like arrays and strings to operate on block of data.	1,2,3,4,5	1,2,3
CO4	Solve complex problems using procedure-oriented (modular) programming approach	1,2,3,4,5	1,2,3
CO5	Design and develop computer programs using the concept of pointers, structures, and unions	1,2,3,4,5	1,2,3
C06	Demonstrate the creation of file and file operations in C-language	1,2,3,4,5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO6	3	3	3	1	2								3	2	3

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Introduction to C-language:** Algorithms and flowcharts with some conceptual examples. Program development: Editor, compiler, interpreter, loader, linker, Integrated Development Environment (IDE). C language and its features, Structure of C program, C tokens, Keywords and Identifiers, Variables, constants, Data types, Input / output functions. Operators and Expressions: Arithmetic Operators, Operators Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional, Special Operators, Evaluation of expressions, Precedence of arithmetic operators.
UNIT - 2 **Flow control statements and Arrays:** Conditional branching: if, if-else, nested if, else if, switch statements. Unconditional branching: break, continue, goto, and return statements. Looping statements: while, do-while and for loops, Loops with break and continue. Arrays: Single dimensional and two-dimensional arrays, Strings as array of characters, String operations using library functions.
UNIT - 3 **Functions, Structures & Union**: Function declaration, definition, and calling, Parameter passing mechanisms, call by value & call by reference, Recursion and related examples, Scope of variables: Global, local, and static variables. Structures & Union: Introduction, Structure definition, declaring and initializing Structure variables, accessing structure members, Arrays of structures, Arrays within structures, Structures and functions, Unions.
UNIT - 4 **Pointers and** File **Operations:** Introduction to pointers, Accessing the address of variable , Declaring, and initializing pointers, Accessing a variable through its pointer , Pointer types, Pointer expressions, Accessing arrays through pointers. File Operations: Open, close, read, write, and append operations, reading from file and writing into files using programs, File positioning and built-in file handling functions.

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, Pentice Hall Software Series, 2005.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata McGraw Hill, 2000.
3. Nanjesh Bennur, Dr. C. K. Subbaraya, “Programming in C”, 2nd Edition, Excellent Publishing House, 2015.

REFERENCE BOOK:

1. E. Balaguruswamy,” Programming in ANSI C”, 4th edition, Tata McGraw Hill, 2008.
2. Donald Hearn, Pauline Baker, “Computer Graphics C Version”, second edition, Pearson Education, 2004.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

- *Web:* https://www.tutorialspoint.com/cprogramming/index.htm
- *Journal:* “The C programming language and a C compiler“, by IBM;

link: https://ieeexplore.ieee.org/document/5387762

- Journal: "Research and Development of C Language Programming Experiment Assistant Management Platform Based on Hybrid Architecture", by Elsevier;
  link: https://www.sciencedirect.com/science/article/pii/S1877705811020534

SWAYAM/NPTEL/MOOCs:

- SWAYAM/NPTEL: "Introduction to Programming in C";
  link: https://onlinecourses.nptel.ac.in/noc19_cs42/preview
  link: https://nptel.ac.in/courses/106/104/106104128/
- MOOC: "Introductory C Programming"
  link: https://www.coursera.org/specializations/c-programming

<table>
<tr><td colspan="2">Course Title</td><td colspan="4">Fundamentals of Robotics and Applications Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td colspan="2">Course Code</td><td>B21EO0304</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

This course facilitates participants to develop technical expertise in the areas of Robotics, Humanoids, 3D Printing, Control Systems, Internet of Things (IoT). FDP includes hands on sessions on robotics mechanical assembly, 3D printing design and prototyping, hardware and software development for robotics, Installation and configuration of robots.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Discuss the fundamental concepts and anatomy of Robotics.
2. Provide insight into different types of robots
3. Introduce 3D modeling and printing of robotic parts
4. Demonstrate the working, control and operation of different robots

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Design 3D models of Robotics arm using Autodesk inventor/suitable software.	1,2,3,5	1,2,3
CO2	Configure the Id, baud rate and goal position for the servo motors.	1,2,3,5	1,2,3

CO3	Assemble the robotic arm/spider robot/dog robots and operate using Android app	1,2,3,5	1,2,3
CO4	Interface suitable sensors and actuators for various robotics application	1,2,3,5	1,2,3
CO5	Conduct the experiment for the given design parameters individually (and in team) within the stipulated time.	9	-
CO6	Analyse the results, take the measurements and document the results in the form of report.	10	-

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

Course Contents:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability

1	Introduction to robotics and components of robots, Introduction on required tools and technologies.	NA	NA
2	3D design and modeling of robotic ARM: ARM Part1: Base	CATIA/Autodesk inventor/free cad/Ultimaker Cura	CAED, Basics of robotics
3	3D design and modeling of robotic ARM: ARM Part2: Links	CATIA/Autodesk inventor/free cad/Ultimaker Cura	CAED, Basics of robotics
4	3D design and modelling of robotic ARM: ARM Part3: Joints and gripeers	CATIA/Autodesk inventor/free cad/Ultimaker Cura	CAED, Basics of robotics
5	Configuration of servo motors: Dynamixel AX motors	Roboplus, AX motors	Basic concepts of robotics, servo motors
6	Configuration of ds servo : RDS3115MG	Arduino kits and Arduino studio	Basic concepts of robotics, servo motors
7	Assembly of robotic ARM/perro/spider	Robo models/hardware	Basic concepts of robotics
8	Operation and controlling of Arm/spider/Perro	Tabs, android studio	Basic concepts of robotics
9	Arduino based robotics experiment 1: Light following robot	Arduino kits, Arduino studio,sensors	C programming Skils
10.	Arduino based robotics experiment 2: Obstacle avoiding robot	Arduino kits, Arduino studio,sensors	C programming Skils
11	Arduino based robotics experiment 3: Simple home automation	Arduino kits, Arduino studio,sensors	C programming Skils

Challenging Experiments:

- Autonomous car explanation and demonstration
- Demonstration of forward and Inverse Kinematics
- Android studio: Sending signals to motors from android app via wifi.

TEXT BOOKS:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009

2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012)
3. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rd edition, 2017.

Course Title	**Problem Solving Using C Programming Lab**				**Course Type**		**HC**	
Course Code	**B21EN0308**	**Credits**	**1**		**Class**		**III Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-				
	Practical	1	2	2	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**1**	**2**	**2**		**28**	**50 %**	**50 %**

COURSE OVERVIEW:

C is a general-purpose, high-level language that was originally developed by Dennis M. Ritchie to develop the UNIX operating system at Bell Labs. C programming is a general-purpose, procedural programming language used to develop software like operating systems, databases, compilers, and so on. The main features of C language include low-level access to memory, a simple set of keywords, and clean style. Many later languages have borrowed syntax/features directly or indirectly from C language. Like syntax of Java, PHP, JavaScript, and many other languages are mainly based on C language.

COURSE OBJECTIVES:

The objectives of this course are:

1. Provide exposure to problem-solving through C procedural programming
2. Explore the structure and syntax of the C programming language
3. illustrate the applications of data types, operators, arrays, and control flow statements in problem-solving.
4. Provide insight into concepts like pointers, structures, unions and records.

COURSE OUTCOMES(COs)

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

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Develop algorithms/flowcharts to solve computational problems.	1,2,3,5	1,2,3
CO2	Solve data processing applications using appropriate data types, operators, and control flow statements.	1,2,3,5,10	1,2,3

CO3	Write C programs using derived data types like arrays and strings to operate on block of data.	1,2,3,5,10	1,2,3
CO4	Solve complex problems using procedure-oriented (modular) programming approach	1,2,3,5,10	1,2,3
CO5	Design and develop computer programs using the concept of pointers, structures, unions, and records.	1,2,3,5,10	1,2,3
C06	Demonstrate the creation of file and file operations in C-language	1,2,3,5,10	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability

Ref: RU/BoS/ECE/CEC/June-2022/10

1	Write a Program to calculate and display the volume of a CUBE by reading its height, width and depth from keyboard.	Algorithm, Flowchart, C compiler.	Reading values from input device, calculating and writing results on output device.
2	Write a program to take input of name, rollno and marks obtained by a student in 4 subjects of 100 marks each and display the name, rollno with percentage score secured. NOTE: Also write same program for three students.	Algorithm, Flowchart, C compiler.	Reading values from input device, calculating and writing results on output device.
3	a. Write a program to print whether a given number is even or odd. b. Write a program to print even numbers from 1 to 10.	Algorithm, Flowchart, C compiler.	Writing program skills with conditional statements.
4	a. Write a Program to Check Whether a Number is Prime or not. b. Write a program to find the factorial of a number.	Algorithm, Flowchart, C compiler.	Writing program skills with conditional & looping statements.
5	a. Write a program to find whether a character is consonant or vowel using switch statement. b. Write a program to print the sum of numbers from 1 to 10 using for loop.	Algorithm, Flowchart, C compiler.	Writing program skills with conditional & looping statement.
6	a. Write a program to create an integer array of size 5, read values from input device and print the values of the array. b. Write a Program to Search an element in array.	Algorithm, Flowchart, C compiler.	Writing program skills with array creation and operations on it.
7	a. Write a program to calculate factorial of a number using recursion. b. Write a program to add, subtract, multiply and divide two integers using user-defined type function with return type. c. Write a program to swap two integers using call by value and call by reference methods of passing arguments to a function.	Algorithm, Flowchart, C compiler.	Writing program skills with function declaration and definition.

8	a. Write a C program to create, declare and initialize structure. b. Write a program to declare, initialize an UNION.	Algorithm, Flowchart, C compiler.	Writing program skills with structure and union.
9	a. Write a program to find biggest among three numbers using pointer. b. Write a program to swap value of two variables using pointer. c. Write a program to swap to array using pointers.	Algorithm, Flowchart, C compiler.	Writing program skills with pointers.
10	a. Write a program to create a file called 'record' and store information about a person, in-terms of his name, age, and salary. b. Write a program to illustrate how a file stored on the disk is read.	Algorithm, Flowchart, C compiler.	Writing program skills with file handling.

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, Pentice Hall Software Series, 2005.
2. Herbert Schildt, "C: The Complete Reference", 4th edition, Tata McGraw Hill, 2000.
3. Nanjesh Bennur, Dr. C. K. Subbaraya, "Programming in C", 2nd Edition, Excellent Publishing House, 2015.

REFERENCE BOOK:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

- *Web:* https://www.tutorialspoint.com/cprogramming/index.htm
- *Journal:* "The C programming language and a C compiler", by IBM;
  link: https://ieeexplore.ieee.org/document/5387762
- Journal: "Research and Development of C Language Programming Experiment Assistant Management Platform Based on Hybrid Architecture", by Elsevier;
  link: https://www.sciencedirect.com/science/article/pii/S1877705811020534

SWAYAM/NPTEL/MOOCs:

- SWAYAM/NPTEL: "Introduction to Programming in C";
  link: https://onlinecourses.nptel.ac.in/noc19_cs42/preview
  link: https://nptel.ac.in/courses/106/104/106104128/
- MOOC: "Introductory C Programming"
  link: https://www.coursera.org/specializations/c-programming

Course Title	Course based project on Sensors and Actuators for Robotics				Course Type		HC	
Course Code	B21EO0305	Credits	1		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**1**	**2**	**2**	**-**	**28**	**50 %**	**50 %**

Course Based Project/Project Based Learning has been considered a good approach in improving education in Engineering, because, this approach facilitates learning difficult subjects, encourages active learning, and allows developing both the Engineering skills and transversal skills by using a 'learning environment that simulates a real professional challenge'.

COURSE OBJECTIVES:

The objectives of this course are:

1. Integrate knowledge and skills learnt from theory concepts to build projects
2. Design solution to Engineering/real time problems

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Build hardware to solve real time /Engineering problems	1,2,3,4,5,9, 10,11,12	1,2,3
CO2	Apply appropriate technique to solve Engineering problems	1,2,3,4,5,9, 10,11,12	1,2,3
CO3	Present the innovative ideas in building the projects	1,2,3,4,5,9, 10,11,12	1,2,3
CO4	Develop an individual as responsible team member	1,2,3,4,5,9, 10,11,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

Ref: RU/BoS/ECE/CEC/June-2022/10

CO3	√	√	√	√	√	
CO4	√	√	√	√	√	

COURSE ARTICULATION MATRIX

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

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

Guidelines to carry out project

1. The project is carried out by team of two or three students (student team).
2. Each Student team is guided and monitored by Faculty, the Course coordinator for Linear Integrated Circuits will be the Coordinator for Course based Project(CBP) Course.
3. The problem is the trigger of the learning process. The CBP approach is based on open problems, which are defined by faculty in context of Industry needs and current situation. The problems are assigned randomly to student teams.
4. The activities for each week will be assigned.
5. The Hands-On activities, along with short lectures, are included to facilitate learning key concepts, present the main aspects of the theory, and improve the background theory of students.
6. In the laboratory training, students carry out practices according to the project stages.

Assessment and Evaluation:

1. The Internal assessment is made on written reports, oral presentation and demonstration of project results with developed model in phase wise by Faculty in charge.
2. The external evaluation is made on written reports, oral presentation and demonstration of project results with developed model at the end of the semester by Examiner.

Course Title	Environmental Science				Course Type		FC	
Course Code	B21AS0303	Credits	2		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	0	0				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practical	-	-	-				
	-	-	-	-				
	Total	**2**	**0**	**0**	**28**	**-**	**50 %**	**50 %**

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand, analyze and execute favorable environmental conditions and the role of individual, government and NGO in environmental protection	6,7,8,9	1
CO2	List the causes, effects & remedial measures and find ways to overcome them by suggesting the pollution-controlled products.	6,7,8,9	1
CO3	Classify different wastes, sources of waste and their effect on population	6,7,8,9	1
CO4	Demonstrate various water conservation methods and suggest appropriate technique for conservation of water	6,7,8,9	1

CO5	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.	6,7,8,9	1
C06	Critically analyze the ecological imbalances and provide recommendations to protect the environment.	6,7,8,9	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents

UNIT – 1

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

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

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

UNIT – 2

Environmental pollution, degradation & Waste management:

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

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

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

Self study: Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes, Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.

UNIT – 3

Energy & Natural resources:

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

Natural resources:

Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance.
Mineral resources - Types of minerals, Methods of mining & impacts of mining activities.
Forest wealth - Importance, Deforestation-Causes, effects and controlling measures

Self study: Hydrology & modern methods adopted for mining activities, Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster.

UNIT – 4

Ecology, ecosystem & field work:

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

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

Field work:

Visit to waste water treatment and biogas plant at REVA university campus, and/or
Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

Self study: Need for balanced ecosystem and restoration of degraded ecosystems.

REFERENCE BOOK:

1.R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies",
Wiley India Private Ltd., New Delhi, Co-authored & Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.

2. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.

3. Benny Joseph, "Environmental Studies", Tata McGraw – Hill Publishing
Company Limited, New Delhi, 2nd Edition, 2008.

4. Dr.S.M.Prakash, "Environmental Studies", Elite Publishers, Mangalore, 2nd Edition, 2009.

5. Rajagopalan R, "Environmental Studies – from Crisis to cure", Oxford University Press, New Delhi, 3rd Edition, 2016.

6. Anil Kumar Dey and Arnab Kumar Dey, "Environmental Studies", New age international private limited publishers, New Delhi, 2nd Edition, 2007.

7. Michael Allaby, "Basics of environmental Science", Routledge-Tayler & Francis
e-library, New York, 2nd Edition, 2002.

8. Dr.Y.K Singh, "Environmental Science", New age international private limited publishers, New Delhi, 1st Edition, 2006

Course Title	Management Science				Course Type		FC	
Course Code	B21MG0301	Credits	2		Class		III Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practical	-	-	-				
	-	-	-	-				
	Total	**2**	**2**	**2**	**28**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Plan organizational structure for a given context in the organization	9,10,11	1
CO2	Carry out production operations through Work-study.	9,10,11	1
CO3	Apply various principles in quality control.	9,10,11	1
CO4	Understand the market, customers and competition to fix better price for the given product appropriately.	9,10,11	1
CO5	Plan and control the HR function better.	9,10,11	1
C06	Evolve a strategy for a business or service organization.	9,10,11	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

Ref: RU/BoS/ECE/CEC/June-2022/10

CO2	√	√	√	√		
CO3	√	√	√	√		
CO4	√	√	√	√		
CO5	√	√	√	√		
CO6	√	√	√	√		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
Introduction to Management and Organization: Concepts of Management and organization- nature, importance and Functions of Management. Systems Approach to Management - Taylor's Scientific Management Theory- Taylor's Principles of Management, Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory - Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management. Designing Organizational Structures: Basic concepts related to Organization Depart mentation and Decentralization.
UNIT – 2
Operations and Marketing Management: Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study –Basic procedure involved in Method Study and Work Measurement - Business Process Reengineering(BPR) Statistical Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis. Purchase Procedure, Stores Management and Store Records - JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix. And Marketing Strategies based on Product Life Cycle. Channels of distribution.
UNIT – 3
Human Resources Management (HRM): Concepts of HRM. HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR.. Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development. Placement, Wage and Salary Administration, Promotion. Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating -Capability Maturity Model (CMM) Levels - Performance Management System.

UNIT - 4

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

TEXT BOOKS:

REFERENCE BOOK:

I. Kotler Philip and Keller Kevin Lane, Marketing Management, Pearson, New York, 15th Edition, 2012.

2. Koontz and Weihrich: Essentials of management, McGraw Hill, New Delhi, 11th Edition, 2012.

3. Thomas N. Duening and John M. Ivancevich, Management - Principles and Guidelines, Dreamtech Press; 1st Edition, 2012.

4. Samuel C. Certo, Modern Management, Prentice Hall, New York, 9th Edition, 2012.

5. Schermerhorn, Capling, Poole and Wiesner, Management, Wiley, New York, 6th Edition, 2012.

6. John A. Parnell, Strategic Management – Theory and Practice, Cengage Publications, 2018.

7. Lawrence R Jauch, R. Gupta and William F. Glucek: Business Policy and Strategic Management Science, McGraw Hill, New York, 5th Edition, 2012.

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡಿಗರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಪರಿವಿಡಿ

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

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

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡೇತರರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಭಾಷಾ ಕೌಶಲ್ಯಗಳು

ಘಟಕ – 1

1. ಆಲಿಸುವುದು

- ಆಲಿಸುವ ಕೌಶಲ್ಯ
- ಆಲಿಸುವಿಕೆಯಲ್ಲಿನ ದೋಷಗಳು
- ಉತ್ತಮ ಆಲಿಸುವಿಕೆ

ಘಟಕ – 2

2. ಮಾತನಾಡುವುದು

- ಸಂಭಾಷಣೆ
- ವ್ಯವಹಾರಿಕ ಸಂಭಾಷಣೆ
- ದೋಷಗಳು ಮತ್ತು ಪರಿಹಾರಗಳು

ಘಟಕ – 3

3. ಓದುವುದು

- ಓದು ಕಲಿಸುವಾಗ ಗಮನಿಸಬೇಕಾದ ಅಂಶಗಳು
- ಧ್ವನ್ಯಾಂಗಗಳ ಪರಿಚಯ
- ಓದಿನ ವಿಧಗಳು

ಘಟಕ – 4

4. ಬರೆಯುವುದು

- ವರ್ಣಮಾಲೆಯ ಸ್ವರೂಪ
- ಕಾಗುಣಿತ ಸ್ವರೂಪ
- ಕನ್ನಡ ಸಂಖ್ಯೆಗಳು

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

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

Detailed Syllabus
Semester IV

Course Title	Probability and Random Process				Course Type		HC	
Course Code	B21AS0402	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practical	-	-	-	Theory	Practical	IA	SEE
	Total	**3**	**3**	**3**	**42**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

The course presents the fundamentals of probability theory and random processes needed by students in communications, signal processing, computer science and other disciplines. Topics include: axiomatic probability theory; discrete and continuous random variables; functions of random variables; generating functions; random processes; ; Markov chains; random walks, Brownian motion, diffusion and Ito processes.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Familiarize with basic concepts of statistics.
2. Understand the concept of random variable and probability distributions.
3. understand joint probability distribution and Markov Chain
4. Learn about sampling and Testing of hypothesis for small and large sample.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions.	1,2,3,4	1,2,3
CO2	Calculate probabilities and derive the marginal distributions of bivariate random variables.	1,2,3,4	1,2,3
CO3	Solve Binomial, Poisson's, Exponential and Normal distributions problems	1,2,3,4	1,2,3
CO4	Calculate probabilities of absorption and expected hitting times for discrete time Markov chains with absorbing states.	1,2,3,4	1,2,3

CO5	Translate real-world problems into probability mode	1,2,3,4	1,2,3
CO6	Apply Sampling distribution to solve Engineering problems	1,2,3,4	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1
Statistics: Mean, Mode, Median and standard deviation. Correlation, Coefficient of correlation and lines of regression. Rank correlation, Moments, skewness, kurtosis. Curve fitting by the method of least squares- Fitting curves of the form, $y = ax + b$, $y = ab^x, y = ae^{bx}, y = ax^2 + bx + c$.

UNIT - 2
Probability and Statistics: Random variables (discrete and continuous), Probability density function, probability distribution – Binomial, Poisson's, Exponential and Normal distributions and problems. [with proof for mean & SD for all distributions], probable error. Normal approximation to binomial distribution.
UNIT - 3
Joint Probability distribution and Markov chain: **Joint Probability distribution**: -Concept of joint probability, joint distributions –(both discrete and continuous random variables), independent random variables, problems on expectation and variance. **Markov chain:** Probability vectors, stochastic matrices, Fixed points, Regular stochastic matrices, Markhov chains, Higher transition probabilities. Stationary distribution of regular Markhov chains and absorbing states.
UNIT - 4
Sampling distribution: Sampling, Sampling distributions, standard error, Testing of hypothesis, Type I and Type II errors. Level of significance. Confidence limits of means, One tailed and two-tailed tests. Fitting Theoretical distribution to sample frequency distributions. Student's t-distribution, Chi-square distributions and F-distributions.

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. 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.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1.https://www.hindawi.com/journals/jps/
2.https://www.math.utah.edu/~davar/ps-pdf-files/ProbStatRanking.pdf
3.http://www.utstat.toronto.edu/mikevans/jeffrosenthal/book.pdf
4.https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring-2014/readings/MIT18_05S14_Reading7a.pdf
5.https://arxiv.org/ftp/arxiv/papers/1302/1302.6802.pdf

SWAYAM/NPTEL/MOOCs:

1. https://www.youtube.com/watch?v=COI0BUmNHT8&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE
2.https://www.youtube.com/watch?v=mrCrjeqJv6U&list=PLbMVogVj5nJQWowhOG0-K-yI-bwRRmm3C
3.https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PLbMVogVj5nJQrzbAweTVvnH6-vG5A4aN5
4.https://www.youtube.com/watch?v=r1sLCDA-kNY&list=PL46B9EA2CFEB51241
5.https://www.youtube.com/watch?v=_FTYrQtrDps&list=PLbMVogVj5nJQqGHrpAloTec_lOKsG-foc

Course Title	Robot Kinematics and Dynamics				Course Type		HC	
Course Code	B21EO0401	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50 %**

COURSE OVERVIEW:

Robot arm kinematics deals with the analytical study of the geometry of motion of a robot arm with respect to a fixed reference coordinate system without regard to the forces/moments that cause the motion. Thus, kinematics deals with the analytical description of the spatial displacement of the robot as a function of time, in particular the relations between the joint-variable space and the position and orientation of the end-effector of a robot arm. Robot arm dynamics, on the other hand, deals with the mathematical formulations of the equations of robot arm motion. The dynamic equations of motion of a manipulator are a set of mathematical equations describing the dynamic behavior of the manipulator. Such equations of motion are useful for computer simulation of the robot arm motion, the design of suitable control equations for a robot arm, and the evaluation of the kinematic design and structure of a robot arm.

COURSE OBJECTIVES:

The objectives of this course are to: to Impart knowledge on

1. Types of Frames and coordinates.
2. Utilizing the knowledge of forward and inverse kinematics to design robot manipulator
3. Learn different dynamics models.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain description, operators, frames and homogenous coordinates associated with robot design.	1,2,3	1,2
CO2	Describe basics of forward kinematics and DH criteria along with algorithm.	1,2,3	1,2
CO3	Apply the knowledge of forward kinematic to determine join and link parameters different axis robots	1,2,3	1,2
CO4	Describe basic of inverse kinematics and tool configurations.	1,2,3	1,2
CO5	Apply the knowledge of inverse kinematic to design four axis SCARA, five and six axis articulated robot	1,2,3	1,2

CO6	Apply the knowledge of Lagrange-Eular Dynamic model to different axis robots.	1,2,3	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1 **Introduction:** Dot and cross products, descriptions: Position, orientation and frames, Mapping: changing descriptions from frame to frame, Operators: Translation, rotation and homogenous coordinates with numerical. Joint variables and end position of end effector. Euler angles- Roll, pitch and yaw angles.
UNIT – 2 **Direct Kinematics** Link coordinates, DH representation and algorithm, Arm equation, Direct kinematic analysis for four axis SCARA and five, six axis Articulated robot.
UNIT – 3 **Inverse Kinematics: Inverse** Kinematic problem, General properties of solution, tool configuration, Inverse kinematics of four axis SCARA robot and five , six axis articulated robot

UNIT - 4

Manipulator Dynamics: Lagrange's equation, kinetic and potential Energy, generalized force, Lagrange-Eular dynamic model, Dynamic model of a one axis robot (inverted pendulum), dynamic model of a two-axis planner articulated robot, Numericals.

TEXT BOOKS:

1. Robert J. Schilling, "Fundamentals of Robotics, Analysis & control", Prentice Hall India Learning Private Limited , 2017
2. John P. Craig, "Introduction to Robotics mechanics and control", Prentice Hall /Pearson Education International, 4th edition, 2018.

REFERENCE BOOKS

1. Fu, Gonzalez, and Lee, "ROBOTICS: Control, Sensing, Vision, and Intelligence",Tata McGraw Hill, 2017.
2. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", Phi Learning., 2009
3. Janaki Raman .P.A, "Robotics and Image Processing An Introduction", Tata McGraw Hill Publishing company Ltd., 1995
4. Tsuneo Yohikwa, "Foundations of Robotics Analysis and Control", MIT Press., 2003.
5. Saeed B Niku, "Introduction to Robotics Analysis, Control, Applications", 3rd Edition, Wiley, 2020.

<table>
<tr><td>Course Title</td><td colspan="4">Microcontrollers for Robotics</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B21EO0402</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

This course introduces 8051 microcontrollers to provide basic understanding of architecture, instruction set, assembly level programming, interfacing to various sensors, relays, motors, actuators through various types of serial and parallel communication. Timers and interrupt functions are illustrated through the selection and control activities using suitable programming platforms such as Assemblers, C compilers, Kiel, etc. This fundamental knowledge on microcontrollers lead to explore large number of controller families like Raspberry Pi, ATMEGA, TI and PIC that are used in industrial and automation applications.

COURSE OBJECTIVES:

Course objectives are:

1. To explain the architecture of Microcontroller 8051.
2. To introduce Microcontroller 8051 Architecture and insight into instruction set of microcontrollers 8051.
3. To introduce assembly and C programming for 8051.
4. To provide insight into timer, serial communication, and interrupts modules of 8051.
5. To interface a microcontroller with peripheral devices.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the Architecture of 8051 microcontroller.	1,2,3	1,2,3
CO2	Develop 8051 Assembly level programs using 8051 instructions set	1,2,3	1,2,3
C03	Explain the Interrupt structure	1,2,3	1,2,3
CO4	Calculate Program Execution Time and Write 8051 Assembly & C language program to generate waveforms using 8051 timers	1,2,3	1,2,3
CO5	Demonstrate 8051 Assembly & C language program to send & receive serial data using 8051 using serial port	1,2,3	1,2,3
CO6	Build application by interfacing DAC, DC Motor, Stepper Motor to 8051 and IR sensor, Buzzer, LCD to Raspberry Pi	1,2,3	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

Ref: RU/BoS/ECE/CEC/June-2022/10

CO3	3	2	2									3	1	2
CO4	3	2	2									3	1	2
CO5	3	2	3									3	1	2
CO6	3	2	3									3	1	2

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1 **8051 Architecture, Addressing Modes** Introduction to Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von Neumann CPU architecture. The 8051 Architecture, Memory organization, Addressing Modes, Data transfer Instructions, Stack.
UNIT – 2 **Instruction Set, Interrupts** Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instruction. Assembler Directives. Software delay calculations. Basics of interrupts, 8051 interrupt structure. Supporting example programs in Assembly language
UNIT – 3 **Introduction to Timers/counters and Serial Communication.** Introduction to Timers and Counters, Timer delay calculations, square & rectangular wave generation. Serial Communication: Data communication, connections to RS-232, UART, Serial data transfer and reception. Supporting example programs in Assembly and C language
UNIT - 4 **Interfacing and Applications** Interfacing DAC, Stepper motor, DC motor to 8051. Introduction to **raspberry pi** & python programming. Interfacing IR sensor, buzzer, and LCD to raspberry pi

TEXTBOOKS:

1. Kenneth J. Ayala, "The 8051-microcontroller architecture, programming and applications" Thomson publication, 3rd edition, 2007
2. 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.
3. Jermy Blum "Exploring Arduino: Tools and Techniques for Engineering" Wizardry 1st Edition, Kindle Edition

REFERENCE BOOKS

1. V. Udayashankar and Malikarjunswamy, "The 8051 Microcontroller", TMH,2009
2. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005.

Course Title	Signal Conditioning and Data Acquisition Systems				Course Type		HC Integrated	
Course Code	B21EO0403	Credits	4		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**4**	**5**	**5**	**42**	**28**	**50%**	**50 %**

COURSE OVERVIEW:

This course provides basic understanding of data acquisition and data acquisition systems. This course tries to bring out the basic principles of signal conditioning, processing and acquisition, sensors, actuators and design of data acquisition hardware. The signal acquisition and conditioning has been done using LabVIEW software.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To introduce the need of data acquisition and requirement.
2. To study the sensors, signal conditioning, and data acquisition hardware.
3. To introduce the procedure of testing of sensors, signal conditioning and data acquisition hardware.
4. To study the software solution for data acquisition.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Identifying and defining requirements and specifying signal and data acquisition tasks.	1,2,3	1,2,3
CO2	Selecting appropriate sensors, signal conditioning, and data acquisition hardware.	1,2,3,4,5,9	1,2,3
CO3	Design an amplifier using an Op-Amp for the given configurations.	1,2,3,4,5,9	1,2,3
CO4	Apply signal conditioning concepts to the acquired sensor inputs.	1,2,3,4,5,9	1,2,3
CO5	Convert signals from analog to digital and vice versa as per the requirements	1,2,3,4,5,9	1,2,3
CO6	Developing a software solution to implement specified data acquisition tasks.	1,2,3,4,5,9	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1 **Introduction** Introduction to Signals, Classification of signals and representations, data acquisition, Classification of data acquisition, Sensors, Transducers, Sample and Hold circuits, Interference, Grounding and Shielding.
UNIT – 2 **Operational Amplifiers** Operational Amplifiers, Characteristics of Op-Amp, Differential amplifier, Inverting & Non –inverting amplifier, Integrator and Differentiator, Comparators, Instrumentation Amplifier, and Interfacing of IA with sensors and transducer, Basic Bridge amplifier and its use with strain gauge and temperature sensors, Numerical examples
UNIT – 3 **Signal Conditioning** Signal conditioners, Types of signal conditioning, Filters in instrumentation circuits, Low pass, High pass, Bandpass and Band Elimination Filters, Attenuation circuits, Isolation, Linearization and Circuit protection. 555 Timer, Monostable and Astable multivibrators, Voltage regulator.

UNIT - 4

Data Converters and Acquisition systems

Data Converters: DAC, Types of DACs, ADC types, accuracy and resolution, noise histograms, current loop 4-20ma circuit.

Graphical Interface (GUI) Software for DAS: Introduction to LabVIEW, Data types, Concepts of Loops, Graphs and Charts, subVIs and File I/O in LabVIEW.

Practice Session

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skills and Ability
1	Study the characteristics of negative feedback amplifiers and design of Instrumentation amplifier.	Measuring instruments	Design and circuit debugging.
2	Design and testing of second order butter-worth low pass filter and high pass filters.	Measuring instruments	Design and circuit debugging.
3	Design and testing of second order band pass filter	Measuring instruments	Design and circuit debugging.
4	Designing and testing of integrator and differentiator circuit.	Measuring instruments	Design and circuit debugging.
5	Designing and testing of a voltage regulator circuit using op-Amp	Measuring instruments	Design and circuit debugging.
6	Designing and testing of Astable multi-vibrator circuit using IC 555 for given frequency and duty cycle	Measuring instruments	Design and circuit debugging.
7	Introduction to LabVIEW.	LabVIEW	Develop innovative mind set
8	Data Acquisition using File I/O in LabVIEW.	LabVIEW	Develop innovative mind set
9	Acquisition of Temperature using Temperature sensor in LabVIEW.	LabVIEW	Develop innovative mind set
10	Design of Water Level System in LabVIEW.	LabVIEW	Develop innovative mind set

Text Books:

1. Coughlin, R.F., **Operational Amplifiers and Linear Integrated Circuits**, Pearson Education (2006).
2. Kalsi, H.S., **Electronic Instrumentation**, Tata McGraw Hill (2002).
3. Gayakwad, R.A., **Op-Amp and Linear Integrated Circuits**, Pearson Education (2002).
4. Mathivanan, N., **Microprocessor PC Hardware and Interfacing**, Prentice Hall of India Private Limited (2007).
5. Sanjay Gupta and Joseph John, **Virtual Instrumentation using LABVIEW,** McGraw Hill Education, 2017.

Reference Books:

1. Ananad, M.M.S., **Electronic Instruments and Instrumentation Technology**, Prentice Hall of India Private Limited (2004).
2. Murthy, D.V.S., **Transducers and Instrumentation**, Prentice Hall of India Private Limited (2006).

Course Title	Process Control Automation				Course Type		HC	
Course Code	B21EO0404	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	**42**	**-**	**50%**	**50 %**

COURSE OVERVIEW:

A process automation or automation system (PAS) automatically controls a process such as chemical, oil refineries, paper and pulp factories. The PAS often uses a network to interconnect sensors, controllers, operator terminals and actuators. A PAS is often based on open standards in contrast to a DCS (distributed control system), which is traditionally proprietary. However, in recent times the PAS is considered to be more associated with SCADA systems. Process automation involves using sensors, actuators, computer technology and software engineering to help power plants and factories in industries as diverse as paper, mining and cement operate more efficiently and safely.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Explore the concept of automation in uplifting of Industries.
2. Imparting the importance of PLC, SCADA and robots in automation.
3. Introduce different industrial automation techniques.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the sensors and actuators for industrial automation and control system.	1,2,3	1,2,3
CO2	Use Internet of Things for industrial automation	1,2,3,4	1,2,3
CO3	Explain architecture of industrial automation system.	1,2,3,4	1,2,3
CO4	Use programmable logic controllers for industrial automation.	1,2,3,4	1,2,3
CO5	Draw block diagram of supervisory control and data acquisition (SCADA).	1,2,3,4	1,2,3
CO6	Identification of suitable computer control system for various applications.	1,2,3,4	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

CO3	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		
CO6	✓	✓	✓	✓		

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1
Introduction and Automation Components: **Introduction:** Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus. **Automation Components:** Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.
UNIT – 2
Computer Aided Measurement and Control Systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software and Computer based data acquisition system, Internet of things (IoT) for plant automation.
UNIT – 3
Programmable Logic Controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT - 4

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.
Industrial Control system: Process industries and discrete manufacturing industries, computer process control.

TEXT BOOKS:

1. M. P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson education. Third Edition, 2008
2. Vajpayee, "Principles of CIM", PHI.

REFERENCE BOOKS

1. Amber G.H & P. S. Amber, "Anatomy of Automation", Prentice Hall.
2. Viswanandham, "Performance Modeling of Automated Manufacturing Systems", PHI.
3. Krishna Kant, "Computer Based Industrial Control", EEE-PHI
4. S.K. Singh, "Industrial Instrumentation and Control", The McGraw Hill Companies
5. C.D. Johnson, "Process Control Instrumentation Technology", PHI

Course Title	**Microcontrollers for Robotics Lab**				**Course Type**		**HC**	
Course Code	**B21EO0405**	**Credits**	**1**		**Class**		**IV Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	**CIE**	**SEE**
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50 %**

COURSE OVERVIEW:

The Microcontroller Laboratory helps the students to understand the basic operation of Microcontrollers along with fundamental programming skills in assembly language and Embedded C programming. This Laboratory creates the foundation for designing, analyzing and implementing engineering and programming problems related to embedded systems and robotics.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Introduce the simulation of assembly language programs and embedded c programs
2. To provide practical experience with microcontroller systems.
3. Introduce IO interfacing and programming of 8051 Microcontroller and raspberry board.
4. Demonstrate the controlling of sensors and actuators of robots through microcontroller programming

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Write the 8051 assembly language programs to perform arithmetic, logical, Timer/Counter and many other operations.	1,2,3,5	1,2,3
CO2	Compile and execute the 8051 assembly language programs using suitable IDE(Kiel)	1,2,3,5	1,2,3
CO3	Perform IO interfacing to 8051MC/raspberry pi board for the given application and program them accordingly	1,2,3,5	1,2,3
CO4	Write the programs in embedded C/python, convert to hex file and download it to 8051 microcontroller/Raspberry PI.	1,2,3,5	1,2,3
CO5	Conduct the experiment for the given design parameters individually (and in team) within the stipulated time.	9	-
CO6	Analyze the results, take the measurements and document the results in the form of report.	10	-

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

CO6										3			-	-	-

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

Course Contents:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
-	Introduction to 8051 Microcontroller & Keil tools	Kiel software	Assembly language programming
1	Write an ALP to transfer block of data from internal to external memory and vice versa	Kiel software	Assembly language programming
2	Write an ALP to perform a. Addition of two 32-bit numbers b. Subtraction of two 32-bit numbers c. Multiplication of 16-bit & 8-bit number d. Division of two 8-bit number e. BCD addition of 16-bit number using DAA	Kiel software	Assembly language programming
3	Write an APL to perform all logical operations (ANL, ORL, XRL, CPL, RL, RRL, RRC, RLC, SWAP) for 8-bit numbers	Kiel software	Assembly language programming
4	Write an ALP to find the largest element from an array stored in external memory.	Kiel software	Assembly language programming
5	Write an ALP to arrange array of numbers stored in internal memory in ascending order.	Kiel software	Assembly language programming
6	Generate a rectangular wave of 40% duty cycle on pin 1.0 of 1KHz using timer delay (Polling Technique)	Kiel software	Assembly language programming
7	Transfer any string through serial port at a baud rate of 9600 using polling technique	Kiel software	Assembly language programming
8	Interface DAC to 8051 to generate square, rectangular, triangular and sine waveform. (Using software delay)	Kiel software and DAC kit, 8051 trainer kit	C Language
9	Interface stepper motor to 8051 and write a program to control the speed and direction of rotation.	Kiel software, stepper motor, 8051 trainer kit	C Language

10	Interface stepper motor to 8051 and write a program to control the speed and direction of rotation.	Kiel software, 8051 trainer kit, DC motor and drivers	C Language
11	Interface IR sensor and Buzzer to raspberry pi, write a python program for obstacle detection.	raspberry pi board	Python programming
12	Interface LCD to raspberry pi, write a python program to display a any string	raspberry pi board	Python programming

TEXTBOOKS:

1. Kenneth J. Ayala, "The 8051-microcontroller architecture, programming and applications" Thomson publication, 3rd edition, 2007
2. 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.
3. Jermy Blum "Exploring Arduino: Tools and Techniques for Engineering" Wizardry 1st Edition, Kindle Edition

REFERENCE BOOKS

1. V. Udayashankar and Malikarjunswamy, "The 8051 Microcontroller", TMH,2009
2. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005.

<table>
<tr><td>Course Title</td><td colspan="4">Process Control Automation Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B21EO0406</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

This course provides various types of PLC along with interfacing modules to demonstrate the detailed applications of PLC and SCADA. A Programmable Logic Controller is a device that was invented to replace the necessary sequential relay circuits for machine control. The PLC works by looking at its inputs and depending upon their state, turning on/off its outputs.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Give Exposure to the technology of Programmable Logic Controllers (PLC) and understanding the importance of automation in industries
2. Imparts skill and knowledge on Industrial automation and process control
3. Familiarize the students about hardware and software modules of PLC Automation

4. To provide practical experience on automation products like PLC, HMI and SCADA to control and monitor the plant and machine

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Write PLC programs for the given automation problem and simulate using suitable IDE (Delta-isp).	1,2,3,5	1,2,3
CO2	Use the PLC, timer, and counter instructions to safely control simple systems	1,2,3,5	1,2,3
CO3	Describe the PLC system hardware and components and operate them by making proper circuit connections.	1,2,3,5	1,2,3
CO4	Perform process automation by writing ladder diagrams for lift control/batch process control/speed control and many other problems.	1,2,3,5	1,2,3
CO5	Conduct the experiment for the given design parameters individually (and in team) within the stipulated time.	9	-
CO6	Analyze the results, take the measurements and document the results in the form of report	10	-

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

CO5									3				-	-	-
CO6										3			-	-	-

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

Course Contents:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	PLC Basic examples: Ladder diagram simulations	Deltaisp software	Writing Ladder diagram
2	Working model for water level control for PLC Training application	Working model and PLC	Writing Ladder diagram
3	Working model for lift control with stepper motor (G+2 floor)	Working model of lift control & PLC	Writing Ladder diagram
4	Working model for batch process reactor for PLC Training application	Working model for batch process and PLC	Writing Ladder diagram
5	Working model for speed control of A C servo motor	Working model of speed control and PLC	Writing Ladder diagram
6	Working model for DOL Starter and star delta simulation module for PLC training application	Working model of DOL starter and star delta and PLC	Writing Ladder diagram
7	Working model for Traffic light control SAP MODULE IN PLC Training application	Working model for Traffic light control and PLC	Writing Ladder diagram
8	Working model for Timing simulation module for PLC Training application	Working model for Timing simulation and PLC	Writing Ladder diagram

TEXT BOOKS:

1. M. P. Groover, "Automation, Production Systems and Computer Integrated manufacturing", Pearson education. Third Edition, 2008

2. Vajpayee, "Principles of CIM", PHI.

Course Title	**Course Based Project on Microcontrollers for Robotics**				**Course Type**		**HC**	
Course Code	**B21EO0407**	**Credits**	**1**		**Class**		**IV Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Tutorial	-	-	-				
	Practice	1	2	2				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**1**	**2**	**2**	**-**	**28**	**50 %**	**50 %**

Course Based Project/Project Based Learning has been considered a good approach in improving education in Engineering, because this approach facilitates learning difficult subjects, encourages active learning, and allows developing both the Engineering skills and transversal skills by using a 'learning environment that simulates a real professional challenge'.

COURSE OBJECTIVES:

The objectives of this course are:

1. Integrate knowledge and skills learnt from theory concepts to build projects
2. Design solution to Engineering/real time problems

COURSE OUTCOMES(COs)

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

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Build hardware to solve real time /Engineering problems using microcontrollers	1,2,3,4,5,9, 10,11,12	1,2,3
CO2	Apply appropriate technique to solve microcontroller-based engineering problems	1,2,3,4,5,9, 10,11,12	1,2,3
CO3	Present the innovative ideas in building microcontroller-based projects	1,2,3,4,5,9, 10,11,12	1,2,3
CO4	Develop an individual as responsible team member	1,2,3,4,5,9, 10,11,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

Ref: RU/BoS/ECE/CEC/June-2022/10

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

COURSE ARTICULATION MATRIX

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

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

Execution:

1. The project is carried out by team of two or three students (student team).

2. Each Student team is guided and monitored by Faculty, the Course coordinator for Microcontrollers and Applications will be the Coordinator for Course based Project (CBP) Course.

3. The problem is the trigger of the learning process. The CBP approach is based on open problems, which are defined by faculty in context of Industry needs and current situation. The problems are assigned randomly to student teams.

4. The activities for each week will be assigned.

5. The Hands-On activities, along with short lectures, are included to facilitate learning key concepts, present the main aspects of the theory, and improve the background theory of students.

6. In the laboratory training, students carry out practices according to the project stages.

Assessment and Evaluation:

1. The Internal assessment is made on written reports, oral presentation and demonstration of project results with developed model in phase wise by Faculty in charge.

2. The external evaluation is made on written reports, oral presentation and demonstration of project results with developed model at the end of the semester by Examiner.

Course Title	Communication Skills				Course Type		FC	
Course Code	B21AH0301	Credits	2		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	IA	SEE
	Total	**2**	**2**	**2**	**28**		**50 %**	**50 %**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies (Speaking Skills).	10,12	1
CO2	Build inferences from the text	10,12	1
CO3	Make use of accurate writing skills using different components of academic writing.	10,12	1
CO4	Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas	10,12	1

CO5	Respond effectively to cultural communication differences.	10,12	1
CO6	Communicate ethically.	10,12	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
Functional English: Grammar: Prepositions; Modal Auxiliaries, Reading Comprehension, Active and passive voice, Giving Instructions.

UNIT – 2
Interpersonal Skills: Grammar: Tenses; Wh-questions, Compound words; Phrasal verbs, Recommendations
UNIT - 3
Multitasking Skills Grammar: Conditional Sentences, Homonyms; homophones, Subject-verb agreement.
UNIT – 4
Communication Skills Grammar: Direct and indirect speech, Interpreting visual materials (line graphs, pie charts etc.), Single word substitutes.

TEXT BOOKS:

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

REFERENCE BOOK:

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, 20ll.
4. Sen et al. Communication and Language Skills. Cambridge University Press, 20l5.

Course Title	**Indian Constitution and Professional Ethics**				**Course Type**		**FC**	
Course Code	**B21LS0301**	**Credits**	**2**		**Class**		**IV Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**2**	**2**	**2**	**28**	**-**	**50 %**	**50 %**

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution.	8,9,12	1
CO2	Demonstrate the practicality of Constitution perspective and make them face the world as a bonafide citizen.	8,9,12	1
CO3	Analyze human rights at different levels	8,9,12	1
CO4	Apply ethics in society	8,9,12	1
CO5	Discuss the ethical issues related to engineering	8,9,12	1
CO6	Realize the responsibilities and rights in the society.	8,9,12	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

Ref: RU/BoS/ECE/CEC/June-2022/10

THEORY:

Contents
UNIT1: Indian constitution Salient 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.
UNIT2: Human Rights: Nature and Scope of human rights, Universal protection of human rights (UDHR), Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups (children, women & old-age). Human values: Truth, Honesty, Loyalty, Love, Peace with examples, Difference between ethics, beliefs and morals.
UNIT3: Engineering Ethics Senses of Engineering Ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories
UNIT4: Global Issues Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors Moral Leadership, Code of Conduct, Corporate Social Responsibility.

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.
3. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw Hill, New Delhi,2003.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOK:

1. Meron Theodor, "Human Rights and International Law Legal Policy Issues", Vol. 1 and 2, Oxford University, Press, New Delhi, 2000.
2. M V Pylee, "An Introduction to Constitution of India", S Chand & Company, 5th Edition
3. Durga Das Basu, "Introduction to constitution of India", LexisNexis, 23rd Edition.
4. Edmund G Seebauer and Robert L Barry, —Fundamentals of Ethics for Scientists and Engineers, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, —Business Ethics: Decision Making for Personal Integrity and Social Responsibility Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, Value Education ', Vethathiri publications, Erode, 2011.

Course Title	Universal Human Values				Course Type		MC	
Course Code	B21AHM401	Credits	0		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	1	1				
	Tutorial	-	-	-				
	Practice	-	-	-	Theory	Practical	IA	SEE
	-	-	1	1				
	Total	**0**	**1**	**1**	**13**	**-**	**50 %**	**50 %**

COURSE OBJECTIVES:

The objectives of this course are:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession	6,9,10	1
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc	6,9,10	1
CO3	Understand the role of a human being in ensuring harmony in society and nature.	6,9,10	1
CO4	Demonstrate the role of human being in the abetment of pollution	6,9,10	1
CO5	Describe appropriate technologies for the safety and security of the society as responsible human being	6,9,10	1
CO6	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.	6,9,10	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1 Happiness and Prosperity
A look at basic Human Aspirations. Right understanding, Relationship, basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly, Method to fulfil human aspirations: understanding and living in harmony at various levels, Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seeker and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

UNIT - 2 Understanding values in human-human relationship

meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

UNIT – 3 Understanding the harmony in the Nature

Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT – 4 Natural acceptance of human values

Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

TEXT BOOKS:

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

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

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

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

REFERENCE BOOK:

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

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

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

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

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Ref: RU/BoS/ECE/CEC/June-2022/10

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