REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

HANDBOOK

B. Tech. in Electronics and Communication Engineering

2022-26

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Rukmini Educational
Charitable Trust

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Chancellor's Message

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

- Nelson Mandela.

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

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

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

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

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

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. 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!

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.

RUKMINI EDUCATIONAL CHARITABLE TRUST

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

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

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 13,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

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

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

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

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

them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

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

The B. Tech in Electronics and Communication Engineering is designed keeping in view the current situation and possible future developments, both at national and international levels. This course is designed to give greater emphasis on core Electronics and Communication Engineering with a flexibility to explore any one of the four areas like circuits and devices, signal processing, communication engineering and programming where in an ample number of courses that provide knowledge in these specialized areas. This facilitates the students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts and support to explore the areas of their interest.

In recent past, Electronics and Communication Engineering is emerged as bridging course that connects the technologies from core Electrical Engineering and Semiconductor Physics to the modern technologies such as VLSI Circuits, seamless high bandwidth communication, advanced signal processing, and finally, merging all the hardware devices of these technologies with IT. The structure of the course has undergone a face-lift with the introduction of subjects from computer science and engineering and thereby provides the flexibility for students choose for IT sectors apart from core Electronics and Communication Engineering. Thus, students in Electronics and Communication Engineering have the flexibility to broaden their horizons in software related industries. The advantage for Electronics and Communication Engineering students is that they are required in both hardware development sectors as well as software development sectors that broadens the area from core electrical engineering to multidisciplinary areas such as robotics, mechatronics, aviation, medical electronics, space exploration, etc.

The program is thus designed to expose students to various subjects having applications in VLSI design, smart system design, wired and wireless communication technologies, information processing, security systems, control engineering, power electronics, cloud based applications, information technology and electronics related industries through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students. Electronics and Communication Engineering provides the students to choose their career in any one of the following areas.

1. *Analog and Radio Frequency Electronic Circuits:* Without these, there would be no cell phones, no Wifi, not even television.
2. *Communication and Signal/ Image Processing:* It is concerned with the transmission, storage, and analysis of information signals. While traditionally electronics engineers worked on communicating and analyzing speech, audio, image, and video signals, nowadays they work on a much wider variety of problems, such as recovering and analyzing physiological and genomic signals, ecological and environmental signals, consumer preference data, financial time series, and many others. These technologies make it possible for computers to analyze data from magneto-resonance imaging and other medical imaging devices to not only display

images but identify diseases. Computer vision experts teach computers how to recognize faces, while image processing people can de-blur images, extract features, and even make art.

3. *Computer and Digital Systems:* Our society is advancing faster technologically than ever before with the help of computers. These digital systems are everywhere, from your dishwasher and wristwatch to the Mars rovers, and everything in between.
4. *Networking:* The Internet is having a profound impact on society, bringing people across the world together to work collaboratively from different countries. It also spreads and promotes democracy.
5. *Control Systems, Robotics, and Intelligent Transportation:* Automation to reduce human toil in the workplace; enhance safety in manufacturing systems, automobiles (via anti-skid braking systems or self-driving vehicles), and aircraft (e.g., via auto-pilots); biomedical applications including automatic drug delivery (e.g., insulin control for diabetics), controlled prostheses, and robotic surgery; pollution reduction in automobiles and aircraft.
6. *Electromagnetics and Microwaves:* Communication via radiowaves is essential for mobile devices, radios, and the internet. Radio- and microwaves can also be used for sensing, for example in air traffic control radar. The ability of microwaves to see through clouds and rain also makes them very useful for measuring Earth's climate and the influence of global change.
7. *Fibre Optics:* Using light to solve engineering problems runs the gamut from fiber optics to lasers for eye surgery. A thorough understanding of the interaction of light with matter even helps animators creativity. Optics are widely applicable in many fields, including all types of engineering, as well as medicine, architecture (lighting), entertainment, and many others.

The benefits of choosing Electronics and Communication Engineering are as follows.

- Ample opportunities exist in the field of embedded systems, signal processing, and communication enginnering 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 signal processing and communication.
- 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.

Program Educational Objectives (PEOs)

After few years of graduation, the graduates of B. Tech. (Electronics and Communication Engineering) 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 Electronics and Communication 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. (Electronics and Communication Engineering) program will be able to:

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

Programme Specific Outcomes (PSOs)

On successful completion of the program, the graduates of B. Tech. (Electronics and Communication Engineering) program will be able to:

- **PSO-1:** Isolate and solve complex problems in the domains of Electronics and Communication Engineering using latest hardware and software tools and technologies, along with analytical and managerial skills to arrive at cost effective and optimum solutions either independently or as a team.
- **PSO-2:** Implant the capacity to apply the concepts of electronics, communications, signal processing, VLSI, embedded systems, etc. in the design, development and implementation of application oriented engineering systems.
- **PSO-3:** Design, Model, Analyze and Build Electronics and Communication Systems to solve real life and industry problems**.**

REVA UNIVERSITY
Bengaluru, India

ACADEMIC REGULATIONS

B. Tech., (4 years) Degree Programs
(Applicable for the programs offered from 2022-23 Batch)

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

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – B. Tech., Degree Program 2022-23 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 2022-23 under respective schools.

SL No.	Name of the School	Name of the Program
1	School of Civil Engineering	B Tech in Civil Engineering
2	School of Computing and Information Technology	B Tech Computer Science and Engineering (AI and ML)
		B Tech Computer Science and Information Technology
		B Tech in Information Science and Engineering
		B Tech in Computer Science and Systems Engineering
3	School of Computer Science and Engineering	B Tech in Computer Science and Engineering
		B Tech in Artificial Intelligence and Data Science
		B Tech in Computer Science and Engineering (IoT,and Cybersecurity including Block chain Technology)
4	School of Electrical and Electronics Engineering	B Tech in Electrical and Electronics Engineering
5	School of Electronics and Communication Engineering	B Tech in Electronics and Communication Engineer
		B Tech in Electronics and Computer Engineering
		B Tech in Robotics and Automation
6	School of Mechanical Engineering	B Tech in Mechanical Engineering
		B Tech in Mechatronics Engineering

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 and project, listed under a program;
Example: "Fluid Mechanics" in B. Tech Civil Engineering program, "Engineering Thermodynamics" in B. Tech., Mechanical program are examples of courses to be studied under respective programs.
Every course offered will have three components associated with the teaching-learning process of the course, namely: L, T and P, 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 such as laboratory experiments, field studies, case studies, project based learning or course end projects and self-study courses that equip students to acquire the required skill component.

4.2 Classification of Courses
Courses offered are classified as: Core Courses, Foundation course, Open Elective Courses, Project work/Dissertation, Skill development courses, etc.

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 / analyzing /exploring a real life situation / difficult problems to

solve a multivariable or complex engineering problems. The project will be conducted in two phases, phase-I, consists of literature survey, problem identification, formulation and methodology. In Phase-II , student should complete the project work by designing or creating an innovative process or development of product as an outcome. A project work is carried out as minor project in 3rd year and major project in 4th year with appropriate credits allocated.

4.2.8 Skill Development Course: It is a practice based course introduced in first year, second year and third year that lead to a certificate, diploma and advanced diploma, respectively.

4.3 "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)	3 Years (6 Semesters)	A. Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and 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

Sl. No.	Program	Duration	Eligibility
			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. F. Passed D.Voc. Stream in the same or allied sector. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)
3	Bachelor of Technology (B Tech)		Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester in the concerned branch of study, provided he/she fulfils the University requirements.

5.2 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 = 14 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 Courses of Study:

Different **Courses 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. Skill Development Course (SDC)

g. Mandatory Non Credit Course (MC)

h. Project Work / Dissertation: A project work is carried out as minor project in 3rd year and major project in 4th year with appropriate credits allocated. These are defined under Section 4.2.7 of this regulation.

8. Credits and Credit Distribution

8.1 A candidate has to earn 166 credits for successful completion of B Tech degree with the distribution of credits for different courses with the credit distribution given in the scheme of study.

8.2 The concerned BOS based on the credits distribution 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) Skill Development Course (SDC).**

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, as per AICTE, the credit distribution for various category of courses given below.

S. No.	Course Category	Abbreviation (AICTE)	Abbreviation (REVA)	Suggested breakup of credits (AICTE)	Credit breakup (REVA)
1	Humanities and Social Sciences including Management courses (HSMC)	HSMC	FC	12	9
2	Basic Science Courses	BSC	FC	25	20
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	ESC	FC	24	29
4	Professional core courses	PCC	HC	48	58
5	Professional Elective courses relevant to chosen specialization/branch	PEC	SC	18	15
6	Open subjects – Electives from other technical and /or emerging subjects	OE	OE	18	12
7	Project work, seminar and internship in industry or elsewhere	PROJ	HC	15	19
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	MC	MC	-	-
9	Skill Development Courses (SDC)	-	SDC		06
TOTAL CREDITS				**160**	**168**

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.A candidate can enrol for a maximum of 26 credits and a minimum of 16 credits per Semester. However, he / she may not successfully earn a maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by a candidate.

8.5 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 168 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.

8.6 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 166 credits for the B Tech Degree program**.**

8.6.1 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 166 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. Continuous Internal Assessment (CIA); 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 CIA shall comprise of:

Internal Assessment Test	40 marks
Assignments / Seminars / Model Making / Integrated Lab / Project Based Learning / Quizzes, etc.	10 maarks

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

- 1st test is conducted for 20 marks during **8th week** of the Semester;
- 2nd test is conducted for 20 marks during **15th 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 50% of the total syllabus**;
- Question paper of the **2nd test should be based on remaining 50 % of the total syllabus**;
- An assignment must be designed to cover the entire syllabus

9.6 There shall be two Assignment / Project Based Learning / Field Visit / Quiz test carrying 10 marks covering the entire syllabus.

9.7 SEE for 50 marks practical exam shall be held in the 16th and 17th week of the semester.

9.8 SEE for 50 marks theory exam shall be held in the 18th 19th and 20th week of the semester and it should cover entire syllabus.

9.9 Internal test paper is set for a maximum of 40 marks to be answered in 1.5 hours duration (for 1 credit course, exam is conducted for 25 marks with a duration of 1 hour). A test paper can have 5 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 4 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.

9.10 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 (internal BoE members) to bring the quality and uniformity in the question paper.

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

9.12 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. 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.

9.13 Internal assessment marks must be decided well before the commencement of SEE.

9.14 SEE theory question 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 to 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 (question papers have to be set to test the course outcomes).

9.15 There shall be minimum 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 question paper sets shall be scrutinized by the Board of Examiners (BoE). It shall be responsibility of the BOE 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 examiners for each paper. However, there shall be moderation by one of the senior examiners, either internal or external.

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:

a. 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.

b. 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

c. 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 (for theory courses having Credits >=2).

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	When	Syllabus Covered	Max Marks	Scaled down to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	40	20	9th week
2	Test -2	During 15th Week	Remaining 50%	40	20	16th Week
3	Assignment / Quiz - 1	Every week till Test-1	First 50%	10	05	9th Week

4	Assignment / Quiz - 2	Every week during Test-1 and Test-2	Remaining 50%	10	05	16th Week
5	SEE	18th to 20th Week	100%	100	50	20th Week

9.27 Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below (for theory courses having Credit 1).

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 8th week	First 50%	25	12.5	8th week
2	Test -2	During 15th Week	Remaining 50%	25	12.5	15th Week
5	SEE	18th to 20th Week	100%	50	25	20th Week

10 Assessment of Students Performance in Practical Courses

Lab courses are of two types: integrated labs and separate labs.

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 Assessment of lab courses

10.1.1 Assessment of Separate lab course

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 internal lab test to be conducted after completion of all the experiments before last working day of the semester	20 marks
	Total	**50 marks**

10.1.2 Assessment of integrated lab course

The 10 marks meant for Internal Assessment (IA) of the performance in carrying out Integrated lab course shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	05 marks
ii	Maintenance of lab records and performance of internal lab test to be conducted after completion of all the experiments before last working day of the semester	05 marks

	Total	**10 marks**

10.2 The 50 marks meant for Semester End Examination (SEE) in case of separate lab course shall be allocated as under:

i	Conduction of practical (experiment)	30 marks
ii	Write up about the experiment/tabulation/results/inference	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

Note: No Separate SEE for integrated lab course

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

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

For >= 2 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 credit courses

i	IA (Performance of internal test to be conducted after completion of entire syllabus)	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	25 marks
	Total	**50 marks**

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

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

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

12. 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. Evaluation of **Skill Development Courses:** The concerned BoS shall recommend to conduct test/demo/viva-

voce/MCQ to test the student knowledge.

14. 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 30% (15 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 (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	21	6.83	21 x 6.83 = 143.43
2	23	7.29	23 x 7.29 = 167.67
3	22	8.11	22 x 8.11 = 178.42
4	24	7.40	24 x 7.40 = 177.6
5	22	8.29	22 x 8.29 = 182.38
6	24	8.58	24 x 8.58 = 205.92
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**168**		**1348.56**

Thus,

$$\boldsymbol{CGPA} = \frac{\mathbf{21\times6.83+23\times7.29+22\times8.11+24\times7.40+22\times8.29+24\times8.58+22\times9.12+10\times9.25}}{\mathbf{166}} = \frac{\mathbf{1346.58}}{\mathbf{168}} = 8.02$$

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 8.02 x 10=80.2

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

Classification of Results

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

CGPA	Grade (Numerical Index)	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.

14.2 Attendance Requirement

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

14.2.2. 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.

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

17. Provision for Appeal

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

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 30% (15 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 courses worth of 12 credits or less 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 12 credits 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 12 credits 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 12 credits from semester 1 to 6 together shall move to the 7th semester of the succeeding year.

21. Re-evaluation of Answer Scripts and Announcement of Re-evaluation Results

After declaration of the results of programs within next 10 days, if any candidate wishes to apply for Photocopy/Revaluation (only theory courses), s/he shall apply to the Controller of Examinations, by paying the prescribed fees notified by the University from time to time. The photocopies of the said answer books shall be made available within next TEN working days after the last date prescribed for receipt of the application at the Office of the Controller of Examinations. Photocopies will not be issued for practical/drawing/audit courses.

22. Results of Re-Evaluation will be announced within TWENTY working days (except for third evaluation).

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

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

I Semester

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC	Credit Pattern				Contact Hours / Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22AS0101	Calculus and Differential Equations	FC	3	0	0	3	3	50	50	100	BSC
2	B22AS0104	Engineering Chemistry	FC	3	0	0	3	3	50	50	100	BSC
3	B22AH0103	Communication Skills	FC	0	0	1	1	2	25	25	50	HSMC
4	B22CI0104	Programming with C	HC	3	0	0	3	3	50	50	100	ESC
5	B22ME0103	Elements of Mechanical Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22EN0101	IoT and Applications	HC	1	0	1	2	3	50	50	100	ESC
7	B22ME0102	Design Thinking	HC	1	0	1	2	3	50	50	100	ESC
8	B22AS0105	Engineering Chemistry Lab	FC	0	0	1	1	2	25	25	50	BSC
9	B22CI0108	Programming with C Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22ME0104	Engineering Workshop	HC	0	0	1	1	2	25	25	50	ESC
TOTAL				**14**	**0**	**6**	**20**	**26**	**400**	**400**	**800**	
TOTAL SEMESTER CREDITS				**20**								
TOTAL CUMULATIVE CREDITS				**20**								
TOTAL CONTACT HOURS				**26**								
TOTAL MARKS				**800**								

II Semester

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22AS0201	Integral Transforms	FC	3	0	0	3	3	50	50	100	BSC
2	B22AS0202	Engineering Physics	FC	3	0	0	3	3	50	50	100	BSC
3	B22EN0102	Introduction to Accounting	FC	1	0	0	1	1	25	25	50	HSMC
4	B22CS0104	Introduction to Data Science	HC	2	0	0	2	2	50	50	100	ESC
5	B22EE0101	Basics of Electrical and Electronics Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22ED0101	Elements of Civil Engineering and Engineering Mechanics	HC	3	0	0	3	3	50	50	100	ESC
7	B22ME0101	Computer Aided Engineering Drawing	HC	2	0	1	3	4	50	50	100	ESC
8	B22AS0207	Engineering Physics Lab	HC	0	0	1	1	2	25	25	50	BSC
9	B22CS0108	Data Science Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22EE0102	Basics of Electrical and Electronics Lab	HC	0	0	1	1	2	25	25	50	ESC
11	B22EN0201	Skill Development Course-1	SDC	0	0	2	2	4	50	50	100	SDC
12	B22ME0105	Tree Plantation in Tropical Region: Benefits and Strategic Planning	FC	1	0	0	1	1	25	25	50	HSMC
TOTAL				**18**	**0**	**6**	**24**	**30**	**475**	**475**	**950**	
TOTAL SEMESTER CREDITS				**24**								
TOTAL CUMULATIVE CREDITS				**44**								
TOTAL CONTACT HOURS				**30**								
TOTAL MARKS				**950**								

III Semester

Sl. No	Course Code	Title of the Course	HC/FC/ SC/OE/ MC	Credit Pattern & Credit Value				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total		CIE Marks	SEE Marks	Total Marks	
1	B22AS0305	Linear Algebra and Partial Differential Equations	FC	3	0	0	3	3	50	50	100	BSC
2	B22EN0301	Analog Electronics	HC	3	0	0	3	3	50	50	100	PCC
3	B22EN0302	Digital Electronics	HC	3	0	0	3	3	50	50	100	PCC
4	B22EN0303	Network Analysis and Synthesis	HC	3	0	0	3	3	50	50	100	PCC
5	B22EN0304	Python programming and Applications	HC	3	0	1	4	5	50	50	100	ESC
6	B22EN0305	Analog Electronics lab	HC	0	0	1	1	2	25	25	50	PCC
7	B22EN0306	Digital Electronics lab	HC	0	0	1	1	2	25	25	50	PCC
8	B22EN0307	Course Based Project on Analog and Digital Electronics	HC	0	0	1	1	2	25	25	50	PCC
9	B22EE0310	Universal Human Values	FC	2	0	0	2	2	50	50	100	HSMC
10	B22EN0308	Technical Documentation	FC	1	0	0	1	1	25	25	50	HSMC
11	B22MEM301	Indian Constitution	MC	2	0	0	0	2	25	25	50	HSMC
12	B22EN0309	Skill Development -2	SDC	0	0	2	2	4	50	50	100	SDC
		TOTAL		**20**	**0**	**6**	**24**	**32**	**475**	**475**	**950**	
				TOTAL SEMESTER CREDITS				**24**				
				TOTAL CUMULATIVE CREDITS				**68**				
				TOTAL CONTACT HOURS				**32**				
				TOTAL MARKS				**950**				

IV Semester

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE/MC	Credit Pattern & Credit Value				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total		CIE Marks	SEE Marks	Total Marks	
1	B22AS0402	Probability and Random Process	FC	3	0	0	3	3	50	50	100	BSC
2	B22EN0401	Linear Integrated Circuits	HC	3	0	0	3	3	50	50	100	PCC
3	B22EN0402	Analog Communication	HC	3	0	0	3	3	50	50	100	PCC
4	B22EN0403	Electromagnetics and Transmission lines	HC	2	1	0	3	4	50	50	100	PCC
5	B22EN0404	Signals and Systems	HC	3	0	1	4	5	50	50	100	PCC
6	B22ENS4XX	Professional Elective-1	SC	3	0	0	3	3	50	50	100	PEC
7	B22EN0405	Linear Integrated Circuits Lab	HC	0	0	1	1	2	25	25	50	PCC
8	B22EN0406	Analog Communication Lab	HC	0	0	1	1	2	25	25	50	PCC
9	B22EN0407	Course Based project on Linear Integrated Circuits	HC	0	0	1	1	2	25	25	50	PROJ
10	B22CS0301	Professional Ethics	FC	2	0	0	2	2	50	50	100	HSMC
11	B22CI0309	Entrepreneurship	FC	1	0	0	1	1	25	25	50	HSMC
12	B22AS0403	Environmental Science	MC	2	0	0	0	2	25	25	50	HSMC
		TOTAL		**22**	**1**	**4**	**25**	**32**	**475**	**475**	**950**	
				TOTAL SEMESTER CREDITS				**25**				
				TOTAL CUMULATIVE CREDITS				**93**				
				TOTAL CONTACT HOURS				**32**				
				TOTAL MARKS				**950**				

Professional Elective -1: Industrial Electronics, Machine Learning, Computer Organization and Architecture, Electronic Instrumentation

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC	Credit Pattern & Credit Value				Contact Hours / Week	Examination			Course category (As per AICTE)
				L	T	P	Total		CIE Marks	SEE Marks	Total Marks	
1	B22EN0501	Digital Signal Processing	HC	3	0	0	3	3	50	50	100	PCC
2	B22EN0502	Microcontroller and ARM Processor Applications	HC	3	0	0	3	3	50	50	100	PCC
3	B22EN0503	Digital System Design Using Verilog	HC	1	1	0	2	3	50	50	100	PCC
4	B22ENS5XX	Professional Elective-2	SC	3	0	0	3	3	50	50	100	PEC
5	B22ENS5XX	Professional Elective-3	SC	3	0	0	3	3	50	50	100	PEC
6	B22XXO5XX	Open Elective-1	OE	3	0	0	3	3	50	50	100	OE
7	B22EN0504	Digital Signal Processing Lab	FC	0	0	1	1	2	25	25	50	PCC
8	B22EN0505	Digital System Design Using Verilog Lab	HC	0	0	1	1	2	25	25	50	PCC
9	B22EN0506	Microcontroller and ARM processor Applications lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EN0507	Course Based Project on Microcontroller and ARM Processor Applications	HC	0	0	1	1	2	25	25	50	PROJ
11	B22EN0508	Skill Development Course-3	SDC	0	0	2	2	4	50	50	100	SDC
12	B22EN0509	Research Based Project	HC	0	0	1	1	2	25	25	50	PROJ
			TOTAL	**16**	**1**	**7**	**24**	**32**	475	475	950	
TOTAL SEMESTER CREDITS				**24**								
TOTAL CUMULATIVE CREDITS				**117**								
TOTAL CONTACT HOURS				**32**								
TOTAL MARKS				**950**								

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC	Credit Pattern & Credit Value				Contact Hours / Week	Examination			Course category (As per AICTE)
				L	T	P	Total		CIE Marks	SEE Marks	Total Marks	
1	B22EN0601	Microwave and Antennas	HC	3	0	0	3	3	50	50	100	PCC
2	B22EN0602	Digital Communication	HC	3	0	0	3	3	50	50	100	PCC
3	B22EN0603	CMOS VLSI Circuits	HC	3	0	0	3	3	50	50	100	PCC
4	B22EN0604	Control Engineering	HC	3	0	1	4	5	50	50	100	PCC
5	B22ENS6XX	Professional Elective-4	SC	3	0	0	3	3	50	50	100	PEC
6	B22XXO6XX	Open Elective-2 (Multidisplinary)	OE	3	0	0	3	3	50	50	100	OE
7	B22EN0605	Microwave and Antennas lab	HC	0	0	1	1	2	25	25	50	PCC
8	B22EN0606	Digital Communication lab	HC	0	0	1	1	2	25	25	50	PCC
9	B22EN0607	CMOS VLSI Circuits lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EN0608	Mini Project	HC	0	0	2	2	4	50	50	100	PROJ
11	B24ED0501	Indian Knowledge System	MC	2	0	0	0	2	25	25	50	HSMC
	TOTAL			**20**	**0**	**6**	**24**	**32**	450	450	900	-
TOTAL SEMESTER CREDITS				**24**								
TOTAL CUMULATIVE CREDITS				**141**								
TOTAL CONTACT HOURS				**32**								
TOTAL MARKS				**900**								

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC	Credit Pattern & Credit Value				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total		CIE Marks	SEE Marks	Total Marks	
1	B22XXO7XX	Open Elective-3	OE	3	0	0	3	3	50	50	100	OE
2	B22XXO7XX	Open Elective -4(MOOC)	OE	3	0	0	3	3	50	50	100	OE
3	B22EN0703	Computer Networks	HC	3	0	1	4	5	50	50	100	PCC
4	B22ENS7XX	Professional Elective-5	SC	3	0	0	3	3	50	50	100	PEC
5	B22EN0702	Major Project Phase – 1	HC	0	0	2	2	4	50	50	100	PROJ
6	B22EN0704	Skill Development Course(MOOC)/Internship	SDC	0	0	2	2	4	50	50	100	SDC
		TOTAL		**12**	**0**	**5**	**17**	**22**	**300**	**300**	**600**	
TOTAL SEMESTER CREDITS				**17**								
TOTAL CUMULATIVE CREDITS				**158**								
TOTAL CONTACT HOURS				**22**								
TOTAL MARKS				**600**								

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC	Credit Pattern & Credit Value				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total		CIE Marks	SEE Marks	Total Marks	
1	B22EN0801	Major Project Phase – 2	HC	0	0	10	10	20	50	50	100	PROJ
		TOTAL		**0**	**0**	**10**	**10**	**20**	50	50	100	
TOTAL SEMESTER CREDITS				**10**								
TOTAL CUMULATIVE CREDITS				**168**								
TOTAL CONTACT HOURS				**20**								
TOTAL MARKS				**100**								

	PROFESSIONAL ELECTIVES							
PE	**Course Code**	**Course Name**	**Course Code**	**Course Name**	**Course Code**	**Course Name**	**Course Code**	**Course Code**
PE-1 / 4TH SEM	B22ENS411	Industrial Electronics	B22ENS412	Machine Learning	B22ENS413	Computer Organization and Architecture	B22ENS414	Electronic Instrumentation
PE-2 / 5TH SEM	B22ENS521	Automotive Embedded System	B22ENS522	Information Theory and Coding	B22ENS523	Theory of Algorithms		
PE-3 / 5TH SEM	B22ENS531	Semiconductor Fabrication Technology	B22ENS532	Photonics and Optical Networks	B22ENS533	Object-Oriented Programming in C++ with Data Structures		
PE-4/ 6TH SEM	B22ENS641	VLSI design and verification	B22ENS642	Cryptography and Network Security	B22ENS643	Data Base Management Systems		
PE-5 / 7TH SEM	B22ENS751	Real Time Operating Systems	B22ENS752	Wireless and Multimedia Communication	B22ENS753	AI and Applications		

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE to Other Departments							
5TH SEM /OE1		6TH SEM /OE2		7TH SEM /OE3		7TH SEM /OE4	
Course code	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**
B22ECO501	Consumer Electronics	B22ECO601	Basics of Communication Systems	B22ECO701	Automotive Electronics	B22ECOM1	MOOC course
B22ECO502	Embedded Systems	B22ECO602	Sensors and Instrumentation	B22ECO702	Robotic Systems	B22ECOM1	MOOC Course
				B22ECO703	Healthcare Electronics		

First year
(2022-26 Batch)

Detailed Syllabus
Semester-1

Course Title	Calculus and Differential Equations				Course Type		HC	
Course Code	B22AS0101	Credits	3		Class		I Semester	
	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**	**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, 2,4	1
CO2	Use Partial differentiation to solve problems in Electronics Engineering.	1, 2,4	1
CO3	Calculate rate of change of multivariate functions using partial differential equations and solve problems related to composite functions and Jacobian.	1, 2,4	1
CO4	Apply multiple integrals to determine area, volume, etc.	1, 2,4	1
CO5	Apply the linear differential equations in modeling.	1, 2,4	1
CO6	Apply analytical techniques to compute solutions and solve differential equations	1, 2,4	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO5			✔			
CO6			✔			

COURSE ARTICULATION MATRIX

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

3. https://www.ajol.info/index.php/jorind/cart/view/50976/39662
4. 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/

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Chemistry</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22AS0104</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>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>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Engineering chemistry covers very relevant topics compatible with ECE 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;

1. It provide 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	Understand the phenomenon of light and matter interaction to study the materials	1**,2,3**	1
CO2	Demonstrate the electrochemical processes & illustrate the method of preparation of solar grade silicon.	1**,2,3,7**	1
CO3	Select different materials in controlling the corrosion & fabrication of printed circuit boards (PCB).	1**,2,3,7**	1
CO4	Illustrate the properties of polymers, nano materials, composite materials and their applications in various fields.	1**,2,3**	1
CO5	Know the doping in photovoltaic devices & applications of Jablonski energy diagram.	1**,2,3,6**	1
CO6	Use of promising materials for electrochemical energy storage and engineering, and environmental remedies.	1**,2,3,7**	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**	**1**										**1**		
CO2	**2**	**1**	**1**				1						**1**		
CO3	**1**	**2**	**1**				1						**1**		
CO4	**3**	**2**	**1**										**1**		
CO5	2	2	1			1							**1**		
CO6	3	2	1				1						**1**		

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

COURSE CONTENT

THEORY

Contents
UNIT - 1 **Light and Matter Interaction** Electro-magnetic spectrum-Applications in Engineering, Interaction of EM radiation with matter, work function of matter, Electrons in matter. Bonding theories: MOT, Band structure of matters HOMO-LUMO. Photochemical and thermal reactions: Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram – 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-MnO_2) 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 and antireflective coating. Production of single crystal semiconductor by Crystal pulling technique (Czochralski technique), difference between single and polycrystalline materials, zone refining process of Si.
UNIT - 3 **Concepts of Corrosion** Thermodynamics and Kinetics of electrochemical corrosion – Theory for corrosion, galvanic series, thermodynamics aspects of corrosion reactions, Nernst equation, dry and wet corrosion and the cell formation, potential- pH diagram (Fe and Al), kinetics of corrosion reactions, Butler-Volmer equation, polarization, passivity, immunity. Types of corrosion – Galvanic corrosion, pitting, crevice corrosion, and intergranular corrosion. Corrosion measurements – Weight loss method, by tafel extrapolation plots. Corrosion control – Cathodic protection (Sacrificial anode and impressed current methods), Anodic protection. Protective coatings – Metal coatings (hot dip: tinning and galvanizing), spray techniques, role of inhibitors
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. Jain and Jain, "Engineering Chemistry", Dhanapat Rai Publications, 16th Edition, 2015.
2. SS Dara and SS Umare," Engineering Chemistry,"S. Chand Publications, 17th Edition, 2014.
3. R.V. Gadag & Nithyananda Shetty, "Engineering chemistry", Ik International Publishing house, 3rd Edition, 2014.

Reference Books:

1. Fontana. M.G., "Corrosion Engineering", Tata McGraw Hill, 3rd Edition, 2005.
2. Charles P. Poole Jr and Frank J. Owens," Introduction to Nanotechnology", Wiley-Interscience, 1st edition, 2003.
3. V.R. Gowrikar, N.N. Vishwanathan and J. Sreedhar," Polymer chemistry", NEW AGE International Pvt Ltd, 2021.

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/

Course Title	Communication Skills				Course Type		FC	
Course Code	B22AH0103	Credits	1		Class		I Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	0	0	0				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**28**	**0**	**50%**	**50%**

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

COURSE OBJECTIVE (S):

The Course objectives are to

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

COURSE OUTCOMES: (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate speaking ability with clarity, confidence, and comprehension an communicate with one or many listeners using appropriate communicativ strategies (Speaking Skills).	10	
CO2	Develop the ability to write cohesively, coherently, and flawlessly avoidin grammatical errors, using a wide vocabulary range, organizing their ideas logically o a topic (Writing skills).	10	
CO3	Make use of reading different genres of texts by adopting various reading strategie (Reading Skills).	10	
CO4	Take part in interviews confidently and develop accurate writing skills.	10	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
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					
CO2										3					
CO3										3					
CO4										3					

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

COURSE CONTENT

THEORY

Contents
UNIT – 1
Functional English: Language as a Tool of Communication, - Effective Communication-Modes of Communication- Email communication - Giving Instructions.
UNIT – 2
Interpersonal Skills: Traits of good Listener types of Listening-- Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends/relatives, - Process descriptions (general/specific).
UNIT - 3
Multitasking Skills: Types of Speaking- Paralinguistic Features-Types of paragraphs (cause and effect / compare and contrast / narrative / analytical); Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions, PPT).
UNIT – 4
Persuasive Skills: Reading and Interpretation- SQ3R- Making inference from the reading passage; predicting the content of a reading passage, - Different types of Essay Writing, applying for a job; Writing a cover letter with résumé / CV.

Text Books:

1. Thorpe, Edgar and Showick Thorpe" Objective English". Pearson Education, 2013.
2. Dixson, Robert J. "Everyday Dialogues in English". Prentice Hall India Pvt Ltd., 1988.
3. Turton, Nigel D. "ABC of Common Errors" Mac Millan Publishers, 1995.
4. Ashraf Rizvi, "Effective Technical Communication" McGraw-Hill Education (India) Pvt. LTD., New Delhi, 2018.

Reference Books:

1. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Blackswan, 2013.
2. 2.Raman, Meenakshi and Sangeeta Sharma. Technical Communication. Oxford University Press, 2015.
3. 3.Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.

Course Title	Programming with C				Course Type		HC	
Course Code	B22CI0104	Credits	3		Class		I Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	-	-	-				
	Total	3	3	3	42	-	**50%**	**50%**

COURSE OVERVIEW:

Algorithms and flowcharts are the fundamental tools for problem solving which can be used by the computers. The computer programs can be developed using algorithms and flowcharts to provide solutions to problems. C Language is a general-purpose, structured and procedure oriented programming language. It is one of the most popular computer languages today because of its

structure and higher-level abstraction C. This course introduces algorithms, flowcharts and various C Programming language constructs for the development of real world applications.

COURSE OBJECTIVE (S):

The objectives of this course are to

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

COURSE OUTCOMES (COs)

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

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

BLOOM'S LEVEL OF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

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

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

COURSE CONTENT

THEORY

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNINGEXERCISES

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

<table>
<tr><td>Course Title</td><td colspan="3">Elements of Mechanical Engineering</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22ME0103</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5"></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>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

Elements of Mechanical Engineering is a basic course of Mechanical Engineering discipline. It focuses on overall view of mechanical engineering area's like thermal, design and manufacturing streams. The course is designed to understand basic concept like formation of steam and compute the steam properties like specific volume, enthalpy, and internal energy using steam tables. The students are introduced to internal combustion engines, turbines (water, steam and gas) and refrigeration-air conditioning system. The students will be imparted to calculate BP, IP, mechanical efficiency of IC engines. The students are exposed to the machine elements like springs, belt drives and gear drives. Acquainted with different machine tools like lathe, drilling machines and CNC machines. The students will be exposed to joining processes like Soldering, Brazing and Welding and various power transmission systems. Students are introduced to the engineering materials and modern manufacturing Technology like 3D printing technology.

COURSE OBJECTIVES

The objectives of this course are to

1. Develop the basic knowledge on heat & work, steam formation, working principle of boilers, turbines, IC engines and refrigeration - air conditioning systems.
2. Incorporate the concept of different types of machine elements like springs, belt drives & chain drives.
3. Give exposure in the field of engineering materials and manufacturing processes.
4. Incorporate the concepts of modern manufacturing processes like CNC, 3D printing technology and its applications
5. Acquire a basic understanding role of Mechanical Engineering in the industry and society.

COURSE OUTCOMES (COs)

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

CO	Course Outcomes	POs	PSOs
CO1	Evaluate the properties of steam and performance parameters of IC engines.	1, 2	1,2
CO2	Describe the working principle of boilers, turbines, refrigeration and air conditioning systems	1	1
CO3	Classify the engineering materials and discuss the concept of casting, CNC machine, laser engraving and 3D printing technology.	1	1
CO4	Compare the different kinds of machine tools and select the suitable machine tool for processing the materials and different metal joining process for the different applications	1,2	1,2
CO5	Discuss the application of machine elements and Calculate the speed ratio of belt drives and Gear Drives.	1,2	1,2

CO6	Describe the need of mechatronics approach in industry and application of robots.	1	1

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

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

COURSE CONTENT

THEORY

Contents
UNIT-1
Introduction to Energy Systems: Concept of heat and work, Steam formation, Types of steam, Steam properties, numerical on steam properties, Introduction to boilers, working of Babcock and Wilcox boiler.
UNIT-2
Prime Movers: Types and working principle of turbines, IC Engines, numerical on IC engines. **Introduction to Refrigeration and Air Conditioning:** Working principle of refrigeration system, working of domestic refrigerator and window air conditioner
UNIT-3
Materials and Manufacturing Processes: Introduction to engineering materials and classifications, casting, Machine Tools- lathe & drilling machine, metal joining process-welding, brazing and soldering, modern manufacturing technology-CNC machines, laser engraving and 3D printing.
UNIT-4
Machine Elements: Types and applications of springs, belt drives, gear drives and chain drives, numerical on belt drives and gear trains. **Introduction to Mechatronics and Robotics:** Need of Mechatronics in industries, measurement system, open and closed loop control system, Robot anatomy, applications of Robotics.

TEXT BOOKS

1. K R Gopala Krishna, Sudheer Gopala Krishna and S C Sharma, “Elements of Mechanical Engineering”, Subhash Publishers, 13th Edition, 2015.

2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, 2000.

REFERENCE BOOKS

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

2. William Bolton, “Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering”, Pearson, 2015.

3. K. K. Appukuttan, “Introduction to Mechatronics”, Oxford University Press, 2007.

JOURNALS/MAGAZINES

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

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering

2. https://www.my-mooc.com/en/categorie/mechanical-engineering

3. https://nptel.ac.in/cours

Course Title	IoT and Applications				Course Type		HC Integrated	
Course Code	B22EN0101	Credits	2		Class		I Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-				
	Practical	1	2	2	Theory	Practical	CIE	SEE
	Total	**2**	**3**	**3**	**14**	**28**	**50%**	**50%**

COURSE OVERVIEW:

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

COURSE 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 component of IoT architecture	1,2,3,4,5	1,2
CO2	Interpret various Applications of IoT	1,2,3,4,5	1,2
CO3	Identify IoT development boards, sensors & actuator	1,2,3,4,5	1,2
CO4	Identify communication technologies, protocols, and cloud services	1,2,3,4,5,9,10	1,2
CO5	Demonstrate the interfacing of sensors & actuators to IoT board	1,2,3,4,5,9,10	1,2
CO6	Develop simple IoT projects and modules	1,2,3,4,5,9,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

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

COURSE ARTICULATION MATRIX

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

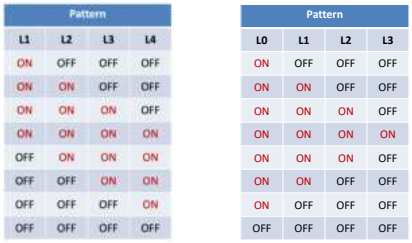
Note: 1-Low, 2-Medium, 3-High

Course Content Theory:

Contents
UNIT – 1 **IoT Basics** Previous technologies before IoT, Introduction to IoT, How IoT works, Components of IoT Infrastructure, Basic elements of general IoT Architecture, Characteristics of IoT, benefits and challenges of IoT, Applications of IoT.
UNIT – 2 **IoT Enabling Technologies** IoT Development Boards: Arduino, Add-on ESP module, Node MCU, Raspberry Pi; Sensors and Actuators: Temperature Sensor, PIR Sensor, Ultrasonic senor; Communication Technologies: Bluetooth, ZigBee, LoRa, WiFi, Cellular; Protocols: HTTP, MQTT, CoAP; IoT Cloud Platforms: Arduino Cloud, Thing Speak, Blink Cloud

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
	Introduction to Arduino Board & getting stared with Arduino IDE software	Hardware & software	Identifications of various parts of Arduino Board &
1	Write a program to blink an LED a) Infinite number of times with ON & OFF duration of 1 sec b) infinite number of times with ON time duration 2 sec and OFF time duration 0.5 sec c) Only 3 times with ON and OFF duration 2 sec	Arduino UNO, Arduino IDE, LED's	Arduino coding

2	Write a program to blink 4 LED in the given pattern  Pattern L1 L2 L3 L4 ON OFF OFF OFF ON ON OFF OFF ON ON ON OFF ON ON ON ON OFF ON ON ON OFF OFF ON ON OFF OFF OFF ON OFF OFF OFF OFF Pattern L0 L1 L2 L3 ON OFF OFF OFF ON ON OFF OFF ON ON ON OFF ON ON ON ON ON ON ON OFF ON ON OFF OFF ON OFF OFF OFF OFF OFF OFF OFF	Arduino UNO, Arduino IDE, LED's	Arduino coding, Looping structure
3	Write a program to blink an LED with different times and duration using the concept of user defined function	Arduino UNO, Arduino IDE, LED's	Arduino coding, user define function
4	Write a program to interface motion sensor and display its status using g LED. If motion is detected it turn on LED otherwise keeps the turn off the LED.	Arduino UNO, Arduino IDE, LED, PIR sensor	Interface PIR sensor
5	a) Write a program to increase and decrease the brightness of LED. b) Write a program to control the brightness of LED using Potentiometer	Arduino UNO, Arduino IDE, LED, Potentiometer	
6	a) Write a program to interface LDR to Arduino board and display the voltage across LDR on serial monitor b) Write a program to control the brightness of LED based on the intensity of light on LDR	Arduino UNO, Arduino IDE, LED, LDR	Interface LDR sensor
7	a) Write a program to interface temperature sensor and display the values on the serial monitor b) Write a program display range of temperature on LCD	Arduino UNO, Arduino IDE, LCD, Temperature sensor	Interface Temperature sensor
8	Write a program to interface ultrasonic sensor and display the distance from an object.	Arduino UNO, Arduino IDE, Ultrasonic sensor	Interface Ultrasonic sensor
	Challenging Experiments		
9	a) Introduction to ESP module & programming using Arduino IDE software b) Write a program to demonstrates how to use Wifi module ESP8266-01 to blink LED (with simple LED)	ESP8266 Arduino Uno, LED, Arduino IDE	Interface of LED to ESP Module, Program ESP using Arduino IDE
10	Write a program to demonstrate how ESP8266 can be used as an HTTP client and HTTP server to control and monitor the status of an LED	ESP8266, Arduino Uno, LED, Arduino IDE	Understand about Client Server Model
11	Write a program demonstrate how ESP8266 can be used as HTTP Webserver and get commands from the client (mobile/Laptop) directly.	ESP8266, Arduino Uno, LED, Arduino IDE	Understand about Client Server model, Create Webserver
12	Write a program to demonstrate how to implement Publisher/Subscriber method (MQTT) to control and monitor the ESP8266 GPIO2 LED	ESP8266, Arduino Uno, LED, Arduino IDE	Understand about Publisher/Subscriber Model
13	Write a program to demonstrate how ESP8266 can be used to log sensor data into thinkspeak cloud.	ESP8266, Arduino Uno, LED, Arduino IDE, ThingSpeak Cloud Service	Connect to cloud and storing data.
Part-B (Case Study/ Projects - Sample Topics)			

1. **IoT based Automated Table Lamp**
2. **IoT based Light Dimmer and Speed Controller**
3. **IoT based Energy Monitor and Over Current Cut-off**
4. **IoT based Smart Home Controller Using Blynk**
5. **IoT based Motion Detector Using Cayenne**
6. **IoT based Air Pollution Meter**
7. **IoT based Smart Camera**
8. **IoT based Pet Feeder**
9. **IoT based Electronic Door Opener**
10. **IoT based Underground Cable Fault Detector**
11. **IoT based Air & Sound Pollution Monitoring System**
12. **IoT based Weather Reporting System**
13. **IoT based Toll Booth Manager System**
14. **IoT based Heart Attack Detection & Heart Rate Monitor**
15. **IoT based Person/Wheelchair Fall Detection**
16. **IoT based Water Quality Monitoring System**
17. **IoT based Patient Health Monitoring**
18. **IoT based Garbage Monitoring System**
19. **IoT based Liquid Level Monitoring System**
20. **IoT based Biometric Attendance System**
21. **IoT based Irrigation Monitoring & Controller System**
22. **IoT based Gas Pipe Leakage Detector**
23. **IoT based Alcohol & Health Monitoring System**
24. **IoT based Streetlight Controller System**
25. **IoT based Traffic Signal Monitoring & Controller System**
26. **IoT based Fire Department Alerting System**
27. **IoT based Antenna Positioning System**
28. **IoT based Garbage Monitoring with Weight Sensing**
29. **IoT based Colour Based Product Sorting Machine**
30. **IoT based Smart Mirror with News & Temperature**
31. **IoT based Car Parking System**
32. **IoT based Automatic Vehicle Accident Detection and Rescue System**

TEXTBOOKS:

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

Course Title	**Design Thinking**				**Course Type**		**HC Integrated**	
Course Code	**B22ME0102**	**Credits**	**2**		**Class**		**I Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-				
	Practical	1	2	2	Theory	Practical	CIE	SEE
	Total	**2**	**3**	**3**	**14**	**28**	**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

The objectives of this course are to:

1.Impart knowledge on design thinking process for understanding designs.
2. Provide design skills to analyze design thinking issues and apply the tools and techniques of design.
3. 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, 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.	1,8,9,10,12	1,2

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

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

COURSE CONTENT

THEORY

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

Tutorials:

Sl. No	Name of the Topic	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

Sl. No	Name of the Topic	Tools and Techniques	Expected Skill /Ability
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 and Paul Harris, "Basics Design-Design Thinking", AVA Publishers, 2010

2. Kathryn McElroy, "Prototyping for Designers: Developing the best Digital and Physical Products", O'Reilly, 2017.

REFERENCE BOOKS

1. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking – New Product Essentials from PDMA", Wiley, 2015.

2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", John Wiley & Sons, 2012.

JOURNALS/MAGAZINES/ADDITIONAL SOURCES

1. Leonard, D., and Rayport, J. F. 1997. Spark Innovation through Empathic Design. In Harvard Business Review, November-December 1997, 102-113.

2. https://www.ideo.com

3. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

4. https://www.ibm.com/design/thinking/page/toolkit

5.https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we

6. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking

7. https://youtu.be/M66ZU2PCIcM

8. https://thisisdesignthinking.net/2017/07/innogy_energy_ecarsharing/

SWAYAM/NPTEL/MOOCs:

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

2. https://nptel.ac.in/courses/11010612

Course Title	**Engineering Chemistry Lab**				**Course Type**		**HC**	
Course Code	B22AS0105	**Credits**	**1**		**Class**		**I Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practice	CIE	SEE
	Practice	1	2	2				

	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OVERVIEW:

Engineering chemistry LAB covers very relevant experiment which is related to the topics compatible with ECE students and make them aware of importance of various aspects of basic science in engineering. The practice gives insights on areas of light and matter interaction, optical properties of materials, clean energy, electrical conduction in solutions, 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 importance of science which very essential for research in engineering stream.

COURSE OBJECTIVE (S):

Engineering chemistry lab covers the very basic knowledge and experimental required for engineering students to understand its importance of Science in technology.

1. It provide the basic knowledge and experimental skill 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. Electrochemical methods will be used to fabricate materials as thin films and various sensing techniques for lab analysis
4. Preparation of semiconducting and conducting materials, polymers and understand their Commercial significance.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	Pos	PSOs
CO1	Estimate the amount of metal ions present by interaction of light source.	1,2,3,9,10	1
CO2	Demonstrate the electrolytic process in electrochemical cell for the purpose of energy storage and energy conversion devices.	1,2,3,9,10	1
CO3	Describe the corrosion phenomenon and list out various precautions to be taken in the selection of materials in controlling corrosion.	1,2,3,9,10	1
CO4	Preparation of commercially important polymers, Nano materials, composite materials and their applications	1,2,3,9,10	1
CO5	Analyse various water quality parameters in daily life suitable for portability.	1,2,3,8	1
CO6	Preparation of thin film and bulk solid state conductors and semiconductors relevant to device applications	1,2,3,9,10	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	2	1						3	3			1		
CO2	2	1	2						3	3			1		
CO3	1	2	1						3	3			1		
CO4	2	2	3						3	3			1		
CO5	2	2	2					3	3	3			1		
CO6	1	2	1						3	3			1		

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

Practice

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Verification of Beer-Lambert's Law by detection of Copper by spectroscopy.	Calorimeter, Visible spectroscopy, cuvettes	Understand the theory of interaction of light with matter and the electronic transitions in material .Experimentally verify the Beer Lambert law and quantify the amount of substance
2	Estimation of Iron by Potentiometric sensor.	Potentiometer, electrodes, reference electrodes	Understand the theory of potential changes and measure and interpret the potential changes associated with change in chemical composition. This is relevant in electrochemical energy storage and conversion devices like batteries, capacitors, fuel cells
3	Estimation of concentration of acid mixture by Conductometric sensor.	Conductometer, conducting electrolytes	Understand the theory, circuit connection and perform the experiment, Interpret the ionic conductivity in the solution
4	Determination of pH/pKa of solutions using glass membrane electrode sensor.	pH meter, glass electrodes, pH sensing electrochemical cell setup	Understand the electrochemical theory, perform the experiment to sense and evaluate the pH of the give solution. Interpret the importance of pH in engineering materials and their application
5	Faraday's law verification by using Electrodeposition of Cu/Ni/Zn on stainless steel.	DC power supply units, Electrochemical cells, different coating substrate	Understand the theory of soft electrochemical deposition of thin films and perform the experiment on deposition different conductive substrates
6	Determination of percentage of iron in corrosion products.	Ostwald Viscometer	Understand the theory of viscosity and perform the experiment to estimate viscosity of different fluids.
7	Estimation of percentage of Copper in brass alloy by iodometric method	Cu-Zn containing alloy, Iodometric technique	Understand the theory and perform the experiment, collect the data and interpret amount of copper present in the given engineering material
8	Evaluation of Dissolved Oxygen by Winkler's method and hence assessment of quality of water.	Indicators, Industrial and domestic effluents	Understand the theory of Winkler's method and the iodometric estimation.

9	Estimation Of Total Hardness Of Water By Complexometric Method Using EDTA	Hard water, Complexing agents	Understand the theory and perform the experiment to understand and interpret water quality. Devise the easy method for removing the hardness causing agent through complexometry
10	Preparation of semiconducting nanomaterials and characterization.	UV-Vis Spectrophotometer	Understand the theory and perform the experiment to estimate the alkalinity of the industry feed water. Understand the need neutral water, adverse effects of alkaline water
11	Determination of band gap of bulk and Semiconducting materials by UV-Visible spectroscopy.	UV-Visible Spectrophotometer	A better understanding the optical band gap of the materials. Able to perform experiment with UV-Vis spectrophotometer and interpret the spectra and relate with the electronic band structure
12	Synthesis of Conducting Polyaniline from aniline by Chemical method.	Simple oxidation method.	A better understanding of conducting polymers and their relevant applications in devices
13	Preparation of Conducting polyaniline thin film by electro polymerization.	C power supply units, electrochemical reduction techniques, different conducting substrate	To demonstrate the soft and simple electrochemical method for preparation of thin conductive films on desired substrates
14	Preparation of Dye – sensitized solar cell.	FTO, Dyes, Electrolytes, I-V measurement unit, Solar simulation setup	To demonstrate the fabrication of lab scale DSSC and understand the function of photoelectrochemical cell

PART_B: Projects

No	**Title of the Experiment**	**Tools and Technics**	**Expected Skill/Ability**
1	Investigation of ionically conducting media	Conductometer, different ionic conductance media	To demonstrate the effect of ionic conductance and understand the importance in electrochemical energy devices
2	pH and Potentiometric sensor	pH meter, Potentiometer	To demonstrate the effect of pH on engineering materials and the potential changes with change in chemical composition
3	Assembly of energy storage devices	Batteries, DC power supply units	To assemble and perform cell voltage and discharge experiments

Text Books

1. V R Gowariker, N V Viswanathan, Jayadev Sreedhar," Polymer Science", Wiley eastern ltd, 4th Edition, 2021.
2. Sudha Rani, S.K. Bashin, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company; 3rd edition, 2012.

Reference Books:

1. J. Mendham, Vogel's "Quantitative Chemical Analysis", 6th Edition, 2009.

Course Title	**Programming with C Lab**				**Course Type**	**HC**
Course Code	B22CI0108	**Credits**	1		**Class**	**I Semester**
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage
	Lecture	-	-	-		

	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	1	2	2	-	28	**50%**	**50%**

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

Explain algorithms, flowcharts and different programming constructs of C to be used for Development of applications.

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

COURSE OUTCOMES (COs)

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

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

BLOOM'S LEVELOF THE COURSE OUTCOMES

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

CO4						✓
CO5		✓	✓			
CO6						✓

COURSE ARTICULATIONMATRIX

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

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

PRACTICE:

PART A:			
No	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill /Ability**
1	Consider Loan applications in a bank consisting of various customer details such as Name, Organization, salary and loan amount applied. Segregate the loan applications based on income (low: <=5 lpa, medium: >5lpa <10lpa and high:>10lpa)	Condition checking	Apply if-else and switch
	Two files DATA1 and DATA2 contain sorted lists of integers. Write a C program to merge the contents of two files into a third file DATA i.e., the contents of the first file followed by those of the second are placed in the third file. Display the contents of DATA.	Files operations	Apply File concepts
2	Statistical measures are used for data analysis and interpretation. Develop program to determine the mean and stand deviation of data stored in an array.	Statistical Computing	Use Array and loops
	Consider the details of Airline passengers such as Name, PAN-No., Mobile-no, Email-id, Source, Destination, Seat-No and Air-Fare. Develop a program to read the details of airline passengers, store them in the structure "Airline" and List details of all the passengers who travelled From "Bengaluru to London".	Search technique	Apply Structures
3	Assume that Mr. Peterson shopped N items at Big Market and his Cart comprises of name of the item, cost of the item per UNIT and quantity. Read the details of shopping and store them in the structure "Shop". Compute the total amount spent on shopping at Big Market and also find out the item with minimum and maximum cost.	Statistical measure	Apply Structure and if then else
	b. Write a C program to define a structure named Student with name and DOB, where DOB in turn is a structure with day, month and year. Read the details of student and store them in	Nested Structures	Apply Nested Structures

	the structure "Student". Display name and date of birth of students using the concept of nested structures.		
4	Consider a set of N students with SRN, name, and marks scored in 8 subjects. Read the details of students and store them in the structure "Student_Marks". Compute total marks and average marks of each student and display them with suitable headings.	Average computation and visualization	Apply Structure, Array and Loops
	b. Create the structure "Book" with book_id, title, author_name and price. Write a C program to pass a structure as a function argument and print the book details.	Functions	Passing structures to function
5	Assume that Ms. Jassica shopped N items at Amazon and the Cart comprises of name of the item, cost of the item per UNIT and quantity. Arrange the items in the increasing order of cost of the item per UNIT.	Sorting	Apply sorting the contents of structure.
	Write a C program to compute the monthly pay of "N" employees using each employee's name, Basic_Pay, DA and HRA. The DA and HRA are 80% and 30% of the Basic_Pay respectively. Gross-salary is computed by adding DA and HRA to Basic_Pay. Store all the details in an array of structures and print the name and gross salary of each employee.	Reading and storing data	Use structures for reading and storing data
6	a. Consider the details of "N" Faculty members consisting of Name, EMP-ID,name of the school, address and salary. Create a file to store the above details. Retrieve the contents of the file to perform following operations: (i) Display the details of the faculty based on salary range entered. (ii) Display the details of the faculty based on the EMP-ID entered.	File operations	Create file, store data and display details.
	b. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if else and switch case.	String operations	Apply string functions
PART B:			
	Project 1: Address Contact List with the following modules: User Add User(Name, Address, Primary contact number, secondary contact number, E-mail ID) Delete User Search for User Edit Find and replace the user name Edit the contact (Phone Number) details. Edit the Address of the user Report List of users based on the starting letter of their names. List of users based on first 2 digits of their mobile number. List of users based on the domain name of their E-mail ID.		
1	Develop a program in C to create the structure "Contact" with the fields, user_name, address, mobile, phone1 and email_id. Read the data into the structure "Contact" and store them in the file "Contact.txt".	Structures and Files	Develop the program using Structures and Files
2	Develop a program in C to open contact list from the file "Contact.txt" in read mode and delete contact details of the person based on name of the person by searching his/her details. Display the updated list.	String, File and Linear Search	Develop the program using String and File
3	Develop a program in C to input the string,"Str1"(which can be either a mobile no. or name of the user) and search for it in the file , "Contact.txt" and display the details if it is found else display an error.	String, File and Linear Search	Develop the program using String and File

4	Develop a program in C to input the name of the user into the string, "Str1" , search for it in the file "Contact.txt" and replace the content of "Str1" with the new data if found.	String, File and Linear Search	Develop the program using String, File and apply linear search
5	Develop a program in C to input the phone number of user into the string, "Str1", search for it in the file "Contact.txt" and edit it with new data if found and save the same.	String, File and Linear Search	Develop the program using String, File and apply linear search
6	Develop a program in C to input the address of the user and search for the same in the file, "Contact.txt" and edit the address with new address and save the same.	String, File and Linear Search	Develop the program using String, File and apply linear search
7	Develop a program in C to input a letter into "Letter", compare it with the details stored in "Contact.txt" and then display the list of the users whose name begin with "Letter ".	File operations	Develop the program using file
8	Develop a program in C to input first two digits of a mobile number into "Mobile", search for the same in "Contact.txt" and display the details of all the users whose mobile number begin with "Mobile".	File operations	Develop the program using file
9	Develop a program in C to input a domain name of email-id and search for the same in the file, "contact.txt" and list the details of the users whose email-id matches with the given domain name.	File operations	Develop the program using file

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Course Title	**Engineering Workshop**				Course Type		HC	
Course Code	B22ME0104	Credits	1		Class		I Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of classes per Semester		Assessment in weightage	
	Lecture	-	-	-				
	tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	**1**	**2**	**2**				
	Total	1	2	2	0	28	50 %	50 %

COURSE OVERVIEW

Workshop practice provides the basic working knowledge of the production and properties of different materials used in the industry. It also explains the use of different tools, equipment's, machinery and techniques of manufacturing, which ultimately facilitate shaping of these materials into various usable forms. Also to provide the basic knowledge on working and function of two wheeler and four wheeler vehicle engine and power transmission system.

COURSE OBJECTIVES

1. To make student familiar with automobile engine terminology and to have visualization of shape, size and working of engine parts.
2. To introduce the use of tools and instrument and their selection for carrying out the fitting, sheet metal work and welding work.
2. To introduce the processes used of convert of raw material in to product.

COURSE OUTCOMES (COs)

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

CO	Course Outcomes	POs	PSOs
CO1	Visualise the parts of two wheeler engine and analyse the sequence of parts connected and their functional relationship.	1, 2, 9	1
CO2	Identify and explain the function of the major components of engine and power transmission system of Toyota Innova and Toyota Fortuner cars	1,2,9	1,2
CO3	Prepare the fitting model as per the given engineering drawing by using appropriate fitting tools.	1, 2, 9	1
CO4	Develop the simple sheet metal models as per drawing specification using sheet metal tools.	1,2,3,9	1,2
CO5	Demonstrate the working and application of laser engraving, 3D printing and welding processes.	1, 9	1,2
CO6	Draw the layout of workshop and prepare a technical document about the process to be followed in engineering workshop.	1,10	1

COURSE ARTICULATIONMATRIX

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

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

Part-A

1. Dismantling and assembly of 2-wheeler (2–stroke) engine Parts.
2. Identification of parts of an engine of Toyota Innova and Toyota Fortuner
3. Calculation of speed ratio of belt, chain and gear drives.
4. Study of power train of bicycle, 2-wheeler and 4-wheeler.
5. Demonstration of laser engraving process and 3D printing process.

Part-B

1. Study of fitting tools and preparation of fitting models.
2. Study of sheet metal tools and development of pen stand and funnel
3. Hands on training on welding.
4. Study of power tools.

TEXT BOOKS

1. K.R. Gopalkrishna, “Elements of Mechanical Engineering”, Subhash Publishers, 12th Edition, 2012.
2. SKH Chowdhary, AKH Chowdhary and Nirjhar Roy, “The Elements of Workshop Technology - Vol I & II”, Media Promotors and publisher, 11th Edition, 2001.

REFERENCE BOOKS

1. David A. Crolla, “Automotive Engineering-Powertrain, Chassis System and Vehicle Body”, Butterworth-Heinemann is an imprint of Elsevier, 1st Edition, 2009.
2. R.S.Parmar, “Welding Processes and Technology”, Khanna Publishers, New Delhi, 2003.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. https://www.shutterstock.com/search/disassembled-bike-engine
3. https://pdfcoffee.com/ex5-assembly-and-disassembly-of-ic-engine-parts-pdf-free.html

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/cours

Detailed Syllabus
Semester-2

Title	Integral Transforms				Course Type		HC	
Course Code	B22AS0201	Credits	3		Class		II semester	
	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**	**0**	**50%**	**50%**

COURSE OVERVIEW:

This course is an essential one for electrical and electronics engineering students. This course covers the concept ofLaplace 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 Fouriertransforms in signal processing, communications, circuit design.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the Laplace transformation from the time domain to the frequency domain, which transforms differential equations into algebraic equations and convolution into multiplication	1, 2,4	1
CO2	Evaluate - transforms of periodic, discontinuous and discrete functions, Fourier series of various type of functions.	1, 2,4	1
CO3	Apply the Fourier transform to boundary value problems	1, 2,4	1
CO4	Analyze the spectral characteristics of signals using Fourier analysis.	1, 2,4	1
CO5	Apply Z-transform to solve problems in the areas like signal processing, control engineering etc.	1, 2,4	1
CO6	Apply - transform techniques to solve Differential equations and difference equations.	1, 2,4	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		
CO2	3	3		1									1		
CO3	3	3		1									1		
CO4	3	3		1									1		
CO5	3	3		1									1		
CO6	3	3		1									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/

Course Title	Engineering Physics				Course Type		HC	
Course Code	B22AS0202	Credits	3		Class		II semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	-	-	-				
	Total	**3**	**3**	**3**	**42**	**28**	**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, different kind of dielectric materials and polarization.	1,2	1,2,3
C04	Understand the light matter interaction, carriers generation and recombination, nano-materials and their interesting properties.	1,2	1,2,3
C05	Explain the light matter interaction, carriers generation and recombination in materials.	1,2	1,2,3
C06	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 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	1
CO2	3	3	2	2									2	2	1
CO3	3	2											1	1	1
C04	3	2											1	1	1
C05	3	2											2	1	1
C06	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 and failures, Expression for electrical conductivity, Thermal conductivity, expression - Wiedemann-Franz law, Quantum free electron theory-Success, 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 Publications 2017

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

Course Title	**Introduction to Accounting**				**Course Type**		**FC**	
Course Code	B22EN0102	**Credits**	**1**		**Class**		**II semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	-	-	-				
	Total	**1**	**1**	**1**	**14**	**-**	**50%**	**50%**

COURSE OVERVIEW

The course introduces the basic framework of accounting to all students to understand accounting concepts and constraints, and help them in preparation of financial records, statements and analysis of the major financial statements.

COURSE OBJECTIVES:

This course enables graduating students to

1. Educate students about the accounting principles and practices.
2. Orient about accounting recording and identification of income, expenses, Assets and Liabilities.
3. Get detailed knowledge of the practice of accounting in different forms of business
4. Gain the ability of using accounting information as a tool in applying solutions for managerial problems, evaluating the financial performance, and interpreting the financial structure.
5. Make students to Apply quantitative skills to analyse and solve business problems and to take advantage of business opportunities.

COURSEOUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Acquire conceptual knowledge of basics of accounting and Identify events that need to be recorded in the accounting records	1,2,4,11	1
CO2	Identify and analyse the reasons for the difference between cash book and pass book balances	1,2,4,11	1
CO3	Equip with the knowledge of accounting process and preparation of final accounts	1,2,4,11	1
C04	Develop the ability to use accounting information to solve a variety of business problems	1,2,4,11	1
C05	Describe, explain, and integrate fundamental concepts underlying accounting and finance management	1,2,4,11	1
C06	Explain the need for the bank reconciliation statement and cash balance.	1,2,4,11	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	✓	✓	✓			
CO2	✓	✓	✓			
CO3	✓	✓	✓			
C04	✓	✓	✓			
C05	✓	✓	✓			
C06	✓	✓	✓			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY

Contents
UNIT – 1 **INTRODUCTION TO ACCOUNTING & ACCOUNTING PROCESS** Introduction – Meaning and Definition-Objectives of Accounting – Functions of Accounting – Users of Accounting information- Limitations of Accounting – Accounting Principles –Accounting Concepts and Conventions. Meaning – Process of Accounting – Kinds of Accounts – Rules – Transaction Analysis – Journal – Ledger – Balancing of Accounts – Trail Balance Problems, Accounting Concepts: Entity, Money Measurement, Going Concern, Accounting Period, Cost Concept, Dual Aspect, Accounting Mechanism – Single Entry and Double Entry. (Only Theory)
UNIT – 2 **RECORDING OF BUSINESS TRANSACTIONS** - Voucher and Transactions: Origin of Transactions – Source documents and Vouchers, Preparation of vouchers; Accounting equation approach – Meaning and Analysis of transactions using accounting equation; Rules of debit and credit- Capital & Revenue Transactions. The Accounting Process Recording of Transactions: Books of original entry – Journal (Simple problems), types of subsidiary books (i) Cash book – Simple, Cashbook with bank column and Petty cashbook, (ii) Purchases book, Sales book, Purchases returns book, Sale returns book; Ledger: Meaning, Utility, Format; Posting from journal and subsidiary books; Trial Balance- P& L Account and Balance sheet -Bank Reconciliation Statement: Meaning, Need and Preparation, Correct cash balance. (Simple problems)

Reference Books:

1. Tulsian, P.C. "Financial Accounting", 20th Edition, Pearson Education, 2016
2. S.N. Maheshwari, and. S. K. Maheshwari. "Financial Accounting". 5th Edition, Vikas Publishing House, New Delhi, 2012.
3. Dr. Jawaharlal, " Accounting theory and practices", 4th Edition, HPH, 2022.
4. Bhushan Kumar Goyal and HN Tiwari," Financial Accounting", International Book House, 2021

Course Title	**Introduction to Data Science**				**Course Type**		**HC**	
Course Code	**B22CS0104**	**Credits**	**2**		**Class**		**II Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Total	**2**	**2**	**2**	**28**	**-**	**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, 8,12	1,2,3
CO2	Apply the SQL commands in developing the real-world applications.	1 to 5,9,12	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 12	1, 2, 3
CO4	Create the real-world AI based solutions using different machine learning algorithms	1 to 6, 8 to 12	1, 2, 3
CO5	Illustrate modeling Error in Linear Regression	1 to 6, 8 to 12	1, 2, 3
CO6	Demonstrate applications of Data Science	1 to 6, 8 to 12	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY

Contents
UNIT – 1
Introduction to Microsoft Excel:
History and importance of Microsoft Excel, Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Sorting, Filtering, Grouping, Ungrouping and Subtotal. 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: Basics of Structured Query Language, creation, insertion, updation, 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.
Application of Data Science
Data science life cycle, Applications of data science with demonstration of experiments by using Microsoft Excel.

TEXT BOOKS:

1. 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	**Basic Electrical and Electronics Engineering**				**Course Type**		**HC**	
Course Code	**B22EE0101**	**Credits**	**3**		**Class**		**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
	Practice	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW

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

COURSE OBJECTIVES

The objectives of this course are to:

1) Explain and to make the students familiar about the basics of Electrical Circuits.
2) Illustrate the basics of magnetic circuits and construction, working principle of DC machines, Transformers.
3) Illustrate the characteristics of Diodes and their applications.
4) Discuss the characteristics and applications of BJT's.
5) To familiarize the students about Number systems.
6) To validate the logical expressions using Boolean algebra.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Summarize the basics of electrical engineering terminology and the usage.	1-2	1
CO-2	Apply KCL and KVL to Solve Electrical Circuits		
CO-3	Demonstrate the working principle of DC Machines and Transformers and provide applications of DC Machines, Transformers.	1-2,4	1
CO-4	Analyze the characteristics of PN junction diode, Zener diode and their application	1-2,4	1
CO-5	Analyze the working principle and characteristics in three configurations of BJT	1-2	1

CO-6	Apply the concept of Number system and Arithmetic operations in digital system	1-2	1

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1											1		
CO-2	3	3		2									1		
CO-3	3	2		2									1		
CO-4	3	3											1		
CO-5	3	2											3		
CO-6	3	2	3										3		

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
Introduction to Electrical Engineering: Basics of DC Circuits: Ohms law, Kirchhoff's Current Law, Kirchhoff's Voltage law, Numerical examples as applicable. Basics of AC Circuits: Sinusoidal voltage and currents, Magnitude and phase, polar and rectangular representation, RL, RC and RLC series and parallel circuits, power factor, phasor diagrams, three phase AC –types of three phase connection (star and delta), Comparison between single phase and three phase AC, Numerical examples as applicable.
UNIT – 2
Magnetic Circuits and Electrical Machines: Magnetic Circuits: Definition of magnetic circuit and basic analogy between electric and magnetic circuits, Faradays laws, permittivity, permeability, EMF, MMF equations, Reluctance. Electrical machines: DC Generator, DC Motors, Transformers - Principle of operation, Construction and EMF equations, types and applications. Induction motor: Concept of RMF, Working principle, types and applications Numerical examples as applicable
Unit-3
Semiconductor Diodes and Transistors: Semiconductor Diodes :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. Transistors: Bipolar junction Transistors BJT configuration: BJT Operation, Common Base, Common Emitter and Common Collector, Characteristics, Numerical examples as applicable.
Unit-4
Digital Electronics and Number System: 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.

TEXT BOOKS

1. Nagrath I.J. and D. P. Kothari, "Basic Electrical and Electronics Engineering", Second Edition Tata McGraw Hill, 2020.
2. Hayt and Kimberly, "Engineering Circuit Analysis", 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., "Basic Electrical Engineering", Second Edition, Tata McGraw Hill, 2019.
4. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
5. D.P. Kothari, I. J. Nagrath, "Basic Electronics", Second Edition, McGraw Hill Education (India) Private Limited, 2017.

REFERENCE BOOKS

1. Hughes, "Electrical Technology", International Students 9th Edition, Pearson, 2005.
2. Robert L. Boylestad and Louis Nashelsky, "Introduction to Electricity, Electronics and Electromagnetics"

Prentice Hall, 5th edition, 2001

SWAYAM/NPTEL/MOOCS
1. https://nptel.ac.in/courses/108108076
2. **https://nptel.ac.in/courses/108101091**
3. **https://www.udemy.com/course/basic-electrical-engineering-part-1**

Course Title	**Elements of Civil Engineering and Engineering Mechanics**				**Course Type**		**HC**	
Course Code	**B22ED0101**	**Credits**	**3**		**Class**		**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
	Practice	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces the students to basic concepts of Engineering Mechanics, which are essential for all Engineers. The course familiarizes students shall be learning about mechanical interaction between bodies. That is, we will learn how different bodies apply forces on one another and how they then balance to keep each other in equilibrium, and forces and types of forces, centroid and moment of inertia Students will learn about basic concept of forces, force systems, beams, trusses, properties of geometric shapes.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Understand a broad concept of Engineering Mechanics.
2. Enable students to apply fundamentals and basic concepts of rigid body mechanics to solve problems of bodies in rest.
3. Enable the students to apply conditions of static equilibrium to analyze physical system of coplanar forces.
4. Analyze the civil engineering structures namely determinate beams and trusses.
5. Provide an overview of centroid and moment of inertia of plane area
6. Understand the concept of dynamics and fluid mechanics in civil engineering.

COURSE OUTCOMES (COs)

After completion of this course, the students will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand basics of mechanics related to Particle, Continuum and Rigid body; Forces, Couple & moment of couple.	1,2	2
CO2	Compute the resultant of system of forces in plane and space acting on bodies.	1,2,5	2
CO3	Analyze civil engineering structures using static equilibrium conditions.	1,2,3,4,5	2
CO4	Compute the reactions developed at the supports of beams and member forces of trusses.	1,2,3,4,5	2
CO5	Determine the centroid and moment of inertia of different geometrical shapes.	1,2,3,4,5	2
CO6	Solve the engineering problems using dynamic equilibrium condition.	1,2,3,4,5	2

BLOOM'S LEVEL OF THE COURSE OUTCOME

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

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

COURSE ARTICULATION MATRIX

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

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

Contents

Unit-1

Introduction to Civil Engineering: Scope of Civil Engineering. Effect of the infrastructural facilities on socio-economic development of a country.

Introduction to Engineering Mechanics: Basic idealizations; Force and its characteristics, Force System and its classification, Principle of superposition of forces, Principle of transmissibility of forces, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system (theory only). Analysis of Force Systems: Resolution of forces, Composition of forces - Definition of Resultant, Composition of coplanar -concurrent force system, Parallelogram Law of forces.

Unit-2

Analysis of Force system: Composition of coplanar - non- concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar concurrent and non-concurrent force systems.

Equilibrium of Coplanar Forces: Definition of static equilibrium, Conditions of static equilibrium for different coplanar force systems, Concept of Free Body Diagram and Lami's theorem with problems.

Unit-3

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

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

Unit-4

Analysis of structures: Types of beams, loads, support and problems on beams. Plane trusses: Method of joints with numerical.

Introduction to Dynamics : Introduction to Kinematics and Kinetics, Rectilinear motion: uniform motion, uniformly accelerated motion, motion under gravity, Concept of Dynamic Equilibrium with problems.

Introduction to Fluid Mechanics:

Introduction, method of describing fluid motion, definitions of types of fluid flow, stream line, path line and stream tube.

Text Books:

1. T R Jagadeesh, “Elements of Civil Engineering”, Sapna book house
2. BK Kolhapure, “Elements of Civil Engineering”, Eastern Book Promoters
3. M.N. Shesha Prakash and Ganesh.B. Mogaveer, “Elements of Civil Engineering and Engineering Mechanics”, PHI Learning, 3rd Revised edition.

4. Engineering Mechanics by RS Khurmi, S Chand and Company.
5. Fluid Mechanics by P.N. Modi and R.K. Bansal.

Reference Books:

1. A. Nelson, "Engineering Mechanics-Statics and Dynamics", Tata Mc-Graw Hill Education Private Ltd, New Delhi, 2009
2. S. S. Bhavikatti, "Elements of Civil Engineering", New Age International Publisher, New Delhi, 3rd edition 2009.
3. Hydraulics and Fluid Mechanics Including Hydraulics Machines by Dr. P.N. MODI & S.M. SETH (Author), Standard Book House Since 1960.

Course Title	**Computer Aided Engineering Drawing**				**Course Type**		**HC**	
Course Code	**B22ME0101**	**Credits**	**3**		**Class**		**II Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	3	4	4	28	28	50 %	50 %

COURSE OVERVIEW

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

COURSE OBJECTIVES

The objectives of this course are to

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

COURSE OUTCOMES (COs)

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

CO	Course Outcomes	POs	PSOs
CO1	Draw orthographic projection of point, line manually and also by using CAD software.	1,2,5,10	1
CO2	Draw orthographic projection of plane surfaces manually and also by using CAD software.	1,2,5, 10	1
CO3	Draw orthographic projection of simple solids manually and also by using CAD software.	1,2,5, 10	1
CO4	Draw sectional views of prisms, pyramids, cone and cylinder manually and also by using CAD software.	1,2,5, 10	1
CO5	Draw the development of lateral surfaces of the solids manually and also by	1,2, 3,5,10	1

CO	Course Outcomes	POs	PSOs
	using CAD software.		
CO6	Create isometric view of the solids manually and also by using CAD software.	1,2,3,5,10	1

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

Contents
Unit-1
Introduction – Geometrical constructions, engineering drawing standards, Introduction to CAD Software. Points, Line and Plane Surface: 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
Solids: 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 Lateral Surfaces of Solids: Parallel line method for prisms and cylinders, Radial line method for pyramids and cones
Unit-4
Isometric Projections: 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	Analysing 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	analysing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analysing and software skill
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	Interpretation and software skill

Sl. No	Practice	Tools and Techniques	Expected Skill /Ability
9	Draw the projection of section of solids in simple position	Solid Edge Software	Analysing 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	Analysing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analysing and software skill

TEXT BOOKS

1. K S Narayanswamy and Mahesh L, "Engineering Drawing", WILEY Publishers, 1st Edition, 2017.
2. K. R. Gopalakrishna and Dr. M S Reddy, "Engineering Graphics-1", Subhas Publications, 2015.
3. Bhatt N.D., Panchal V.M and Ingle P.R, "Engineering Drawing", Charotar Publishing House Pvt. Ltd, 53rd Edition, 2019.

REFERENCE BOOKS

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

SWAYAM/NPTEL/MOOCS

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

Course Title	**Engineering Physics lab**				**Course Type**		**HC**	
Course Code	**B22AS0207**	**Credits**	**1**		**Class**		**II Semester**	
	LTP	Credits	Contact Hours	Workload	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	1	2	2				
	Total	**1**	**2**	**2**	**0**	**28**	**50%**	**50%**

COURSEDESCRIPTION:

Engineering Physics Lab (EPL) is a preparatory course for the B.Tech. Students to give hands on exposure to electronic components, circuits, measurement techniques, graphs plotting and calculations. This lab course correlates theory and experiment to apply scientific techniques to practical problems. The course orients the students to analyze and understand the experimental data.

COURSE OBJECTIVE(S):

The Course Objectives are to

1. Explain the fundamental physics concepts of various electrical and optical components (Resistors, Capacitors, Inductors, Semiconductors, Diodes, LASER, LCR, OFC).
2. Explain the working mechanism of the above components when embedded in circuits.
3. Demonstrate the different applications of electrical and optical components in real world applications.
4. Discuss and design the functionality of these components for real world applications.

COURSEOUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the physics concepts in understanding the new circuits for real-world applications.	1, 2, 6,8,10	1,2,3

CO2	Apply the physics knowledge in developing the real-world applications based on the various combinations of electrical and optical components.	1,2, 3,6,9,10	2, 3
CO3	Build the solutions for real world problems, perform analysis, interpretation and reporting of data using graphs and tables.	1,2,3,4,9,10	1, 2, 3
CO4	Design the different circuits for day-to-day usage applications for sensors and other applications.	1,2,3,4,9,10	1, 2, 3
CO5	Illustrate modeling indifferent circuits through software.	1,2,5,10	1, 2, 3
CO6	Demonstrate the different circuits to predict the different outcome.	1,2,3,9,10	1,2, 3

BLOOM'SLEVELOFTHECOURSEOUTCOMES

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

COURSE ARTICULATIONMATRIX

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

Practice:

No	**Title of the Experiment**	**Tools and Technics**	**Expected Skill/Ability**
1	Determination of Planck's constant using light emitting diode (LED).	LED's of different colors, circuit board and wires	Understand the theory, circuit and perform the experiment, collect the data and interpret the results.
2	Determination of energy gap of a given semiconductor.	Semiconductor, hot water, circuit board and wires.	Understand the theory, circuit connection and perform the experiment, collect the data and interpret the results to estimate the bandgap

3	Study of Photo Diode characteristics.	Photo diode, light source, circuit board and wires	Understand the theory, circuit connection and perform the experiment, collect the data and interpret the results to know the photo response of a diode.
4	Study of variation of Resistivity in intrinsic semi-conductor crystal	Semiconductor, hot water, thermometer	Understand the theory, circuit connection and perform the experiment, collect the data and interpret the results to know the temperature dependent response of a semiconductor.
5	Inductor-capacitor-resistance (LCR) Series & Parallel circuits	Inductor, capacitor and resistance connected circuit board, variable function generator, wires	Understand the theory, circuit connection and perform the experiment, collect the data and interpret the results to know the variation of AC resistance of LCR series and parallel connection.
6	Determination of numerical aperture (N.A.) of given optical fiber	Optical fiber cable, light source, graduated circular stand	Understand the theory, connection and perform the experiment, collect the data and interpret the results to know the numerical aperture of a given cable.
7	Diffraction haloes using light amplification by stimulated emission of radiation (LASER)	LASER light source, lycopodium particle dispersed glass slide, screen	Understand the theory and perform the experiment, collect the data and interpret the results to estimate the particle size.
8	Dielectric constant by charging and discharging of a capacitor	Capacitor, resistance, voltmeter, timer connected circuit board	Understand the theory, circuit connection and perform the experiment, collect the data and interpret the results to estimate the dielectric constant of a given material.
9	Determination of wavelength of a LASER by diffraction	LASER light source, grating, screen	Understand the theory and perform the experiment, collect the data and interpret the results to estimate the wavelength of a given light source.
10	Attenuationand propagation characteristics of optical fiber cable (OFC)	Optical fiber cable, light source, intensity measuring unit.	Understand the theory and perform the experiment, collect the data and interpret the results to know the intensity of a reduced light.
11	Simulation of rectifier diode/Zener diode characteristics using TINA(in the computer) or Every circuit (in mobile)	Computer, TINA tool.	A better understanding of the working of the diode by forcing different voltages through the tool and seeing the characteristic curves on the monitor.
12	Simulation of LCR series and parallel circuits using TINA(in computer) or Every circuit (in mobile)	Computer, TINA tool.	A better understanding of the working of the LCR circuits by replacing different L, C & R values.

PART_B:Projects

No	Title oftheExperiment	Tools and Technics	Expected Skill/Ability
1	To design light sensor	Light, photodiode, ammeter, and wires	To demonstrate the performance of light sensor and its various parameters.
2	Temperature sensor	Thermometer, semiconductor, ammeter/voltmeter and wires	To demonstrate the performance of temperature sensor and its various parameters.

Text Books

1. M.N. Avadhanulu and P.G. Kshirsagar, “A Text book of Engineering Physics”, S. Chand & Company Ltd, New Delhi, 10th revised Ed
2. Gaur and Gupta, “Engineering Physics”, Dhanpat Rai Publications 2017

REFERENCE BOOKS:

1. Arthur Beiser, “Concepts of Modern Physics”, Tata McGraw Hill Edu Pvt Ltd- New Delhi, 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

Course Title	Data Science Lab				Course Type		HC	
Course Code	B22CS0108	Credits	1		Class		II Semester	
	LTP	Credits	Contact Hours	Workload	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	1	2	2				
	Total	**1**	**2**	**2**	**0**	**28**	**50**	**50**

COURSE DESCRIPTION:

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: ML algorithms, SQL and demonstration of experiments by using MS-Excel and MySQL.

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the concepts of Microsoft Excel in developing the real-world applications.	1, 2, 4,10	1,2,3
CO2	Apply the SQL Queries in developing the real-world applications.	1,2, 3,9,10	2, 3
CO3	Build the solutions for real world problems, perform analysis, interpretation and reporting of data using regression algorithms.	2,3, 4, 8,9, 10	1, 2, 3
C04	Design ER diagrams for database.	2,3, 4,8, 9, 10	1, 2, 3
CO5	Illustrate modeling in Multiple Linear Regression.	1 to 5, 8 to 10	1, 2, 3
CO6	Demonstrate the Logistic Regression to predict the Data.	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			✓	✓		
C04			✓	✓	✓	✓
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
CO4	3	3	3	2	2			1	3	3			3	3	3
CO5	3	3	3	2	2			1	3	3			3	3	3
CO6	3	3	3	2	2			1	3	3			3	3	3

Practice:

No	**Title of the Experiment**	**Tools and Technics**	**Expected Skill/Ability**
1	The height (in cm) of a group of fathers and sons are given below, Findthe lines of regression and estimate the height of son when the height of father is 164 cm.	MS Excel	Create and perform operations on Excel data set by applying Linear regression

Hgt of Father	158	166	163	165	167	170	167	172	177	181
Hgt of Son	163	158	167	170	160	180	170	175	172	175

<table>
<tr>
<td>2</td>
<td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES,perform the following:
i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trend line feature.
iv) Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
v) Compute the coefficient of determination and the coefficient of correlation</td>
<td>MS Excel</td>
<td>Perform prediction and visualiza-tion 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 equation.
iii) Plot the regression line (hint: use MS Excel's Add Trend line feature).
iv) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
v) Compute the coefficient of determination and the coefficient of correlation.</td>
<td>MS Excel</td>
<td>Perform prediction and visualiza tion of data</td>
</tr>
<tr>
<td>4</td>
<td>Apply multiple linear regression to predict the stock index price which is a dependent variable of a fictitious economy based on two independent / input variables interest rate and unemployment rate.
<table>
<tr><th>Year</th><th>Month</th><th>Interest rate</th><th>Un employment rate</th><th>Stock index price</th></tr>
<tr><td>2022</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 availed of Rs.10, 00,000during 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>5.2%</td></tr>
<tr><td>3</td><td>Year of the loan</td><td>3</td></tr>
<tr><td>4</td><td>Starting payment number</td><td>1</td></tr>
<tr><td>5</td><td>Ending payment number</td><td>36</td></tr>
<tr><td>6</td><td>Total interest paid during period</td><td>?</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Create Excel data and perform EMI estimator</td>
</tr>
<tr>
<td>6</td>
<td>Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO should not be NULL.</td>
<td>SQL</td>
<td>Creating Tables</td>
</tr>
</table>

7	Create the customer database of a big Market with CUSTOMER_ ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_ CODE. Store at least twenty customer's details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.	SQL	Creating and retrieving Tables
8	Apply 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
9	Apply Multiple linear regression to predict the factory products which is A, B and C are independent variables and cost dependent variable.	MS Excel	Apply Linear regression
10	Logistic Regression-case study	MS Excel	Apply Logistic regression
11	Design the ER diagram and create schema of the REVA library Management system.	Entity Relationship	Entity Relationship
12	Design the ER diagram and create schema for Hospital Management system.	Entity Relationship	Schema design

PART_B:Projects

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Big Mart sales forecasting	MS Excel	Apply Linearregression
2	Bangalore crime analysis	MS Excel	Apply Linearregression

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

Course Title	**Basic Electrical & Electronics Lab**				**Course Type**	**HC**
Course Code	**B22EE0102**	**Credits**	**1**		**Class**	**II Semester**
	LTP	Credits	Contact	Work	Total Number of Classes Per Semester	Assessment in Weightage
	Lecture	-	-	-		

	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	1	2	2				
	Total	1	2	2	-	28	50%	50%

COURSE OVERVIEW

Basic Electrical & Electronics Engineering lab covers the concept of various types of electrical apparatus, tools and conduction of experiments to Analyze, Design of KCL & KVL, two-way switch or staircase wiring, Determination of VI characteristics Zener Diode, Silicon Diode, Half Wave rectifier using Diode, study& analyses of Lead & lag component, verification of logic gates.

COURSE OBJECTIVES

The objectives of the course are to

1. Establish a broad concept of various types of electrical apparatus, tools and instrumentation.
2. Provide hands on experience with electrical apparatus and electrical safety norms.
3. Train students to read and understand schematics so as to make electrical connection for different appliances.
4. Train students in collecting and interpreting experimental data.
5. Enhance written skills of students.

COURSE OUTCOMES (CO'S)

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

CO#	Course Outcomes	PO's	PSO's
CO-1	Use appropriate electrical tools for electrical connections and repair of electrical equipment's.	1,2,4,5,9,10	1
CO-2	Recognize various symbols in a schematic and make connection as per the schematic	1,2,9,10	1
CO-3	List out various safety procedures	4,5,9,10	1
CO-4	Make use of various measuring instruments to collect experimental data	2,4,9,10	1
CO-5	Analyse the results obtained from experiments.	2,3,9,10	1
CO-6	Demonstrate the ability to critically evaluate the performance of electrical appliances.	1,2,9,10	1

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3		3	3				3	3			1		
CO-2	3	3							3	3			1		
CO-3				3	3				3	3			1		
CO-4		3		3					3	3			1		
CO-5		3	2						3	3					
CO-6	3	2							3	3					

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

COURSE CONTENT

List Experiment

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	Study and Analysis 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	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring	Two-way switch or staircase wiring Kit	Connection, Working & application of Two-way switch
4	Study and analysis the Characteristics: light sensor and temperature sensor	Sensor kit	Characteristics of sensors
5	Study and analysis of V-I Characteristics of Zener PN Junction diodes (Both Forward and Reverse Characteristics).	VI characteristics of Zener Diode kit	VI characteristics of Zener Diode
6	Study and analysis of Transistor as switch	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
7	Design half wave, Full wave-center tap and Bridge rectifier with and without capacitive filter and measure efficiency and ripple factor.	Rectifier kit	Determine the efficiency, Voltage regulation, ripple factor of rectifiers
8	Design of Clippers and clampers with reference voltages	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.	Characteristics of BJT in Common Emitter Configuration	Input & Output Characteristics of BJT
10	Verification of basic logic gates using discrete components	Trainer kit	Universal gates will be realized using basic gates

Demo:

1. To Study the importance of Earthing during accidental shorting of line wire and the body of equipment.
2. To study the Importance and mechanism of MCB.

TEXT BOOKS

1. Nagrath I.J. and D. P. Kothari, “Basic Electrical Engineering”, Third Edition Tata McGraw Hill, 2009.
2. Hayt and Kimberly, “Engineering Circuit Analysis”, 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.

REFERENCE BOOKS

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

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/108108076
2. https://nptel.ac.in/courses/108101091
3. https://www.udemy.com/course/basic-electrical-engineering-part-1

Course Title	Tree Plantation in Tropical Region: Benefits and Strategic Planning				Course Type		FC	
Course Code		Credits	1		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	1	1	1	14	0	50%	50%

Course Description: This course introduces significance of trees that provide us with a great many ecosystem services, including air quality improvement, energy conservation, stormwater interception, and atmospheric carbon dioxide reduction. These benefits must be weighed against the costs of maintaining trees, including planting, pruning, irrigation, administration, pest control, liability, cleanup, and removal.

Students are expected to involve in planting a tree and nurturing till the completion of their degree program. Successful maintenance of tree is considered to be one of the eligibility criterions for the award of university degree.

This course is a part of "**REVA Vanamahotsava – One Student, One Tree"**

COURSE OBJECTIVE (S):

The Course objectives are to

1. Develop basic understanding of role of trees in climate change
2. Emphasize on the selection and placing a tree for maximum benefit to environment
3. Involve in planting a tree and nurture till the completion of the degree program
4. Generate experiential report on the tree plantation process involved

COURSE OUTCOMES: (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the possible key benefits of trees arresting climate change and global warming	7,9	
CO2	Develop the ability to identify the type of a tree to be planted in urban area agricultural fields and forestry areas	7,9	
	Make use of reading different literature on climate change and global warming	7,9	

CO3	by adopting various reading strategies (Reading Skills)		
CO4	Take part in planting a tree and nurturing it and Generate report on tree plantatio process involved	7,9	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
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						
CO2							3		3						
CO3							3		3						
CO4							3		3						

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

COURSE CONTENT

THEORY

Contents
Unit 1: Introduction: The tropical region, Benefits and costs of urban and community forests
Unit 2: General Guidelines for Selecting and Placing Trees Guidelines for Energy Savings, Guidelines for Reducing Carbon Dioxide, Guidelines for Reducing Stormwater Runoff, Guidelines for Improving Air Quality Benefits, Guidelines for Avoiding Conflicts with Infrastructure, Guidelines for Maximizing Long-Term Benefits, Trees for Hurricane-Prone Areas **Activity based learning** Every student has to thoroughly understand the significance of planting a tree, identify type of tree and place to be planted, plant a tree and nurture till the completion of the degree.

Text Books:

1. Kelaine E. Vargas, E. Gregory McPherson, James R. Simpson, Paula J. Peper, Shelley L. Gardner, and Qingfu Xiao, "Tropical community tree guide: Benefits, Costs and Strategic Planting", U.S. Department of Agriculture, Forest Service Pacific Southwest Research Station Albany, California, 2008

Reference Books:

1. Peter Wohlleben, The Heartbeat of Trees, Penguin Books, 2021
2. Daniel Chamovitz, "What a Plant Knows: A Field Guide to the Senses", 2020

Evaluation of this course

As per 9.27 of the **"Academic Regulations UG -Engg 2022",** following evaluation procedure is applicable to this course.

9.27 Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below (for theory courses having Credit 1).

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 8th Week	First 50%	25	12.5	8th week
2	Test -2	During 15th Week	Remaining 50%	25	12.5	15th Week
5	SEE	18th to 20th Week	100%	50	25	20th Week

Additional guidelines for conducting this course

Since this course is aimed as a special drive to restore climate change and arresting global warming, following guidelines have been framed to conduct this course as activity-based learning to build greener nation through student community. Successful implementation of this drive meets one of the very important Sustainable Development Goals (SDG's) of UN Envision 2030 on Climate Change and Global warming. This is also one of the requirements in NEP 2020 and UGC/AICTE.

1. Classes will be conducted by the nominated faculty (one hour per week) as per the syllabus.
2. Flipped classes, field experiences, group discussions and seminars can be used by the faculty so as to engage the students through student centric learning mechanisms
3. Students should be involved into understanding cause and effects of climate change, types of pollutions, and environmental hazards
4. Quizzes and debates on climate change and global warming can be arranged for each section
5. Students should plant the suitable tree and nurture
6. "Team Vanamahotsava" – A Central assistance team from REVA University will support for identifying trees, place and organizing plantation drives.
7. Regular progress review is planned to be monitored by digital system – an advanced version of current progress monitoring App.

8. School Directors are responsible to oversee all the arrangements and progress monitoring of this drive.
9. Frequent school level and university level branding shall be arranged to give awareness of this noble drive among all the stake holders such as parents, alumni, industry and academic partners, government sectors, NGO's, ministries, and the society.
10. Regular plant maintenance drive can be planned by "Team Vanamahotsava". However, planting a tree and its nurture responsibility solely rests on individual students.
11. Successful maintenance of tree is considered to be one of the eligibility criterions for the award of university degree.

Second year
(2022-26 Batch)

Detailed Syllabus
Semester-3

Course Title	Linear Algebra and Partial Differential Equations				Course Type		FC	
Course Code	B22AS0305	Credits	3		Class		III Semester	
	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 arbitrar variables. Equations solvable by direct integration , Solution of Lagrange's linear PDE. Method of variable separable-D hea equation, 1-D wave 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	Analog Electronics				Course Type		HC	
Course Code	B22EN0301	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:

Analog Electronics is an essential area of study for Electronics and Communication Engineering students, as it forms the foundation for many electronic devices and systems used in various industries such as telecommunications, automotive, consumer electronics and medical devices. Analog circuits are used in many applications such as signal processing, amplification, filter, power regulation and control systems. The topics include in this course are design and analysis of BJT and MOSFET amplifiers ,feedback amplifiers, power amplifies, differential amplifiers and operational amplifiers.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand types of BJT biasing and operation of BJT amplifiers
2. Understand types of MOSFET biasing and operation of MOSFET amplifiers
3. Learn about feedback concepts.
4. Comprehend the operation of differential and operational amplifiers

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Design and analyze the single stage BJT amplifiers	1,2,3,4,5,12	1,2,3
CO2	Compare the characteristics of CE , CB and CC amplifiers	1,2,3,4,5,12	1,2,3
CO3	Design and analyze single stage MOSFET amplifiers	1,2,3,4,5,12	1,2,3
CO4	Construct various types of feedbacks in amplifiers and analyze their characteristics.	1,2,3,4,5,12	1,2,3
CO5	List the characteristics of MOS differential pair	1,2,3,4,5,12	1,2,3
CO6	Construct and analyze the different applications of operational amplifiers	1,2,3,4,5,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1 **BJT BIASING AND SINGLE STAGE AMPLIFIERS:** Review of BJT Device Structure and Physical Operation, BJT Current Voltage characteristics, Operating point, BJT biasing and stability, Amplifier Basic Principles, Circuit Models for

Amplifiers, Frequency Response of Amplifiers, Small Signal Models for BJT, Analysis of CE, CB, CC Amplifiers.

UNIT – 2

MOSFET BIASING AND SINGLE STAGE AMPLIFIERS :MOSFET Device Structure and Physical Operation, MOSFET Current Voltage characteristics, MOSFETS Circuits at DC, MOSFET Biasing and stability, Small Signal models for MOSFET, Analysis of CG, CS,CD Amplifiers.

UNIT – 3

FEEDBACK AND POWER AMPLIFIERS:

FEEDBACK AMPLIFIERS: Feedback Concepts, Feedback Connection Types, Practical Feedback Circuits- Voltage Series Feedback and Current-Series Feedback. Related problems.

POWER AMPLIFIERS: Series-Fed Class A Amplifier, Transformer-Coupled Class A Amplifier, Class B Amplifier Circuits-Transformer-coupled Push-Pull Circuits, Complementary-symmetry Circuits, Class C and Class D amplifiers. Related Problems

UNIT – 4

DIFFERENTIAL AMPLIFIERS AND OPERATIONAL AMPLIFIERS:MOS Current Mirror, Common Mode Rejection Ratio, DC Offset, MOS Differential Amplifier Op-Amp Introduction, Ideal characteristics, Inverting Amplifier and analysis, Non-Inverting Amplifier and analysis, Summing Amplifier, Difference amplifier Buffer, Integrator, Differentiator

TEXT BOOKS:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education, 11th edition, 2015.
2. David A. Bell, "Electronic Devices & Circuits", Prentice Hall of India/Pearson Education, 4th edition, 2007.
3. David A. Bell, "Operational Amplifiers and Linear ICs", Prentice Hall of India, 2nd edition, 2006.

REFERENCE BOOKS

1. Jacob Millman & Christos. C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits ",Tata McGraw Hill, 2nd edition, 2008.
2. Floyd, "Electronic Devices", Prentice Hall of India, Pearson Education, 6th Edition, 2010. Anil Kumar Maini, Varsha Agrawal,"Electronic Devices and Circuits", John Wiley & Sons, 2009.
3. Sedra and Smith," Microelectronic Circuits", 7th edition, Oxford University Press.

<table>
<tr><td>Course Title</td><td colspan="4">Digital Electronics</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EN0302</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>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">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td></td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Digital Electronics is a very important course for Electronics Engineers as it deals with the fundamental aspects of digital circuits design. Both the Combinational and the sequential circuit realization and implementations are

studied. The course is rich in numerical examples which help students to develop good analytical and logical skills. The course also has an opportunity to expose the students to the real-world problems and hence generates interest in studying the course. This course opens with an introduction to combinational logic, logic gates, minimization techniques, arithmetic circuits. It then moves to deal with sequential circuits: flip-flops, synthesis of sequential circuits, and case studies, including counters, registers. State machines will then be introduced. Different representations of truth table, logic gate, timing diagram, switch representation, state diagram, and state equations will be discussed.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Illustrate Boolean laws and systematic techniques for minimization of expressions.
2. Demonstrate the methods for simplifying Boolean expressions.
3. Familiarize the commonly used terms like min-term, max-term, canonical expression, SOP, POS etc
4. Introduce the Basic concepts of combinational and sequential logic.
5. Present real-world examples for making the learners attuned to Logic concepts.
6. Highlight the formal procedures for the analysis and design of combinational circuits and sequential circuits.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Define a Boolean term, expression, SOP, POS, Min-term etc.	1,2,3,4,5	1,3
CO2	Construct the K-map from a Boolean expression and to find the minimal SOP/POS forms	1,2,3,4,5	1,3
CO3	Design arithmetic and combinational logic circuits using gates, encoders,	1,2,3,4,5	1,3
CO4	Design specified synchronous or asynchronous sequential logic circuits using appropriate flip flops.	1,2,3,4,5	1,3
CO5	Design sequential circuit with Moore and Mealy configurations.	1,2,3,4,5	1,3
CO6	Design the applications of Combinational & Sequential Circuits.	1,2,3,4,5	1,3

BLOOM'S LEVEL OF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

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

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

COURSE CONTENT
THEORY

CONTENTS
UNIT - 1
Boolean Algebra and Minimization Techniques of combinational Circuits: Basic Theorems and Properties of Boolean Algebra, canonical forms, , Sum of Products and Product of sums simplification, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, Incompletely specified functions (Don't care terms), Quine-McClusky techniques – 3 & 4 variables.
UNIT – 2
Design of Combinational Logic Circuits: Code Conversion, Binary adders and subtractor, Parallel adder, Carry Look Ahead adder, BCD adder. Principle of Encoder and Decoder with cascading of decoders. Principle of Multiplexers and Demultiplexers, Cascading of Multiplexers, Applications of Multiplexers and decoders, Comparators (1 and 2 bit)
UNIT - 3
Introduction to Sequential Logic: Latches, Flip-Flops-SR, D, JK & T The master-slave flip- flops: SR flip-flops, JK flip-flops, Shift Registers- SISO, SIPO, PISO, PIPO, Universal Shift Registers, Design of Counters: Asynchronous and Synchronous, Up/Down Counters, Design of a Modulo-n counter.
UNIT - 4
Sequential Circuit Design: Introduction to Mealy and Moore FSM, Synchronous sequential circuit analysis and construction of state table and diagram, State reduction techniques, Design of a Sequence Detector with overlapping, Serial Adder with Accumulator, Design of 2*2 Binary Multiplier

TEXT BOOKS:

1. Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2002.
2. Morris Mano, "Digital design‖, Prentice Hall of India" Third Edition.
3. John M Yarbrough, "Digital Logic Applications and Design" Thomson Learning,2001.

REFERENCE BOOKS:

1. Charles H Roth Jr., Larry L. Kinney "Fundamentals of Logic Design" Cengage Learning, 7th Edition.
2. Samuel C Lee, "Digital Circuits and Logic Design" PHI learning, 1st Edition, 2009

JOURNALS/MAGAZINES:

1. https://en.wikipedia.org/wiki/Digital_electronics
2. https://learnabout-electronics.org/Digital/dig10.php
3. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials
4. https://www.youtube.com/watch?v=CeD2L6KbtVM
5. https://www.youtube.com/watch?v=BqP6sVYlrr0
6. https://www.youtube.com/watch?v=ibQBb5yEDlQ

SWAYAM/NPTEL/MOOCs:

1. http://nptel.ac.in/courses/117106086/6

2. http://nptel.ac.in/courses/117105080/12
3. http://nptel.ac.in/courses/117105080/21
4. http://nptel.ac.in/courses/117106086/26

<table>
<tr><td>Course Title</td><td colspan="4">Network Analysis and Synthesis</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EN0303</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>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>0</td><td>3</td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course introduces the concepts to determine voltage, current and power in branches of any circuits excited by dc and ac voltages and current sources by simplifying techniques to solve dc circuit problems using basic circuit theorems and structured methods like node voltage and mesh current analysis. The goal also includes derivation of the transient responses of RC and RL circuits, steady state response of circuits to sinusoidal excitation in time domain, introduction to two port networks and application of Laplace transform in network theory. The course also includes the concepts of synthesizing a network from its admittance functions.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the concepts of super mesh, super node and network theorems.
2. Evaluate two port network parameters to simplify the network computations.
3. Analyze the excitation response of the electrical network and the techniques for characterizing the networks using network parameters.
4. Construct an analysis strategy to determine a particular transient response of passive electrical network.
5. Synthesize a network from its network functions.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Evaluate the branch currents and node voltages of any given electrical circuit bythe application of super-mesh, super-node and various network theorems.	1,2,3,4	1,2,3
CO2	Model a two port network in terms of Z, Y, h & T parameters.	1,2,3,4	1,2,3
CO3	Design the resonant circuits for given frequency and compute the performanceparameters	1,2,3,4	1,2,3
C04	Apply initial and final conditions to analyze transient behavior of network.	1,2,3,4	1,2,3

CO5	Apply Laplace transform technique to analyze the transient behavior of series andparallel RLC circuits.	1,2,3,4	1,2,3
CO6	Synthesize one port networks using Foster and Cauer Forms.	1,2,3,4	1,2,3

BLOOM'S LEVEL OF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

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

COURSE CONTENT
THEORY

Contents
UNIT-1
Network Analysis Techniques & Theorems: Mesh Analysis: Super-mesh, Nodal Analysis: super-node for ac and dc n/w's, Network Theorems: Superposition theorem, Thevenin's theorem (Norton's equivalent circuit from Thevenin's), Maximum power transfer theorem for ac and dc n/w's. Numerical examples on each topic.
UNIT-2
Two Port Networks: Definition of Z, Y, h & T parameters, Inter-relationships between parameters. Numerical examples. **Resonance Circuits:** R-L-C Series & R||L||C Parallel resonance (resonant frequency, cut-off frequencies, bandwidth, dynamicimpedance, quality factor-derivations included for series resonance and parallel resonance), Numericals.

UNIT-3
Transient Analysis using LT: Initial & Final conditions of network elements. Evaluation of initial and final conditions in RL, RC and RLC circuits with AC and DC excitations. Application of Laplace transform technique: Review of Laplace transformation; Laplace transform of network and time domain solution for RL, RC and RLC networks for AC and DC excitations; Transient behaviour of circuit elements under switching conditions and their representations, Numerical.
UNIT-4
Network Synthesis: Introduction, System/Transfer Functions, Driving point functions**,** Pole-zero representation of system function, Hurwitz polynomials, Positive real functions, Elementary synthesis concepts, Realization of LC, RC & RL functions: Foster I & II Forms, Cauer I & II Forms, Numericals.

TEXT BOOKS:

1. W H Hayt, J E Kemmerly, S M Durbin, "Engineering Circuit Analysis", 6th Edition, Tata McGraw-Hill Publication,2011.
2. R R Singh, "Network Analysis and Synthesis", 2nd edition, Tata McGraw-Hill Publication, 2019.
3. A Chakrabarti, "Circuit Theory (Analysis and Synthesis)", Dhanpat Rai & Co.,2013.

REFERENCE BOOKS:

1. Nahvi, Edminister, "Electric Circuits", Schaum's Outline Series, McGraw Hill, 2003.
2. J. David Irwin, R. Mark Nelms, "Basic Engineering Circuit Analysis", 8th edition, John Wiley, 2006.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://www.circuitbasics.com/circuit-analysis/
2. https://openpress.usask.ca/physics155/chapter/7-advanced-circuit-analysis-techniques/
3. https://web.stanford.edu/class/engr108/lectures/circuits.pdf

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec01.mp4
2. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec02.mp4
3. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec04.mp4
4. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec06.mp4
5. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod06lec45.mp4

SELF-LEARNINGEXERCISES:

1. Transient Analysis of RL and RC circuit with AC and DC excitations using LTSpice/TINA software tool.

<table>
<tr><td>Course Title</td><td colspan="3">Python Programming and Applications</td><td colspan="2">Course Type</td><td colspan="2">HC (Integrated)</td></tr>
<tr><td>Course Code</td><td>B22EN0304</td><td>Credits</td><td colspan="2">4</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>32</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">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>4</td><td>5</td><td>5</td><td>42</td><td>28</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

This beginner-level course introduces students to the basics of programming using the Python programming language, and covers fundamental concepts such as data types, variables, control structures, and functions. Through practical exercises, students develop their skills in problem-solving and coding, and gain familiarity with popular libraries and frameworks used in Python development. By completing this course, students should have a solid foundation in Python programming, which is essential for learning Machine Learning. This course is ideal for those with little to no programming experience, who are interested in pursuing a career in data science and machine learning.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Introduce students to the basic concepts of programming, such as data types, variables, control structures, and functions.
2. Provide hands-on coding exercises to help students develop their problem-solving and coding skills.
3. Familiarize students with the Python programming language and its syntax, data structures, and built-in functions.
4. Teach students how to write simple Python programs and scripts to solve real-world problems.
5. Cover object-oriented programming principles and techniques that are essential for building larger-scale programs.
6. Introduce students to popular Python libraries and frameworks used in data science and machine learning, such as NumPy, Pandas, and Scikit-Learn.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Use the built-in data types and operators in python programming	1,2,3,5	1,2,3
CO2	Build functions and modules using python programming language.	1,2,3,5	1,2,3
CO3	Design object oriented programs using python class and objects.	1,2,3,5	1,2,3
CO4	Demonstrate and use the concept of inheritance for code reusability.	1,2,3,5	1,2,3
CO5	Demonstrate the basics of file handling including creating, opening, reading and writing ti files.	1,2,3,5	1,2,3
CO6	Use advanced features like Numpy, Pandas, Matplotlib of python to develop ML applications.	1,2,3,5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1
Introduction to Python: Features of python programming, application of python programming, Getting started, keywords, variables and identifiers, Python Indentation, statements and comments, Data types: numbers, list, tuple, strings, set, dictionary, type conversion, python I/O, python operators, branching and looping statements.
UNIT – 2
Python functions, Class and Objects: Python functions: Syntax of functions, arguments and return values, scope and lifetime of variables, python global keyword, python modules and packages. **Classes and objects:** Introduction to object-oriented programming, class, objects, attributes and methods, creating an object in python, self-parameter, constructors in python, deleting attributes and objects.
UNIT – 3
Inheritance, Exceptions and File handling Mechanisms: Inheritance: Python inheritance syntax, Examples on single inheritance and multiple inheritance. **Exception Handling:** Exceptions, exception handling and user defined exceptions.**File Handling:** Python file operations, directories.
UNIT – 4
Data Science with Python: **Numpy:** Introduction, arrays, indexing, slicing, shaping, sort and search operations. **SciPy:** Introduction and data manipulation using SciPy. **Pandas:** Introduction, Series, DataFrames, Read CSV, Analyzing DataFrames. **Matplotlib:** Creating plots, charts and visualization.

PRACTICE SESSIONS:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill bility**
1.	**Getting started with Python**; Basic Programs to demonstrate the python syntax and indentation.	Python 3/Jupiter Notebook	Programming, Computer Knowledge
2.	**Data types:** Program to demonstrate all operations on numbers, list, tuple, dictionary, set and strings in python programming	Python 3/Jupiter Notebook	Programming, Computer Knowledge
3.	**Branching and looping statements**		
	3.a. Write a python program to find the largest of 3 numbers. (Using branching statements)	Python 3/Jupiter Notebook	Programming, Computer Knowledge
	3.b. Write a python program to get a list as input from user and find the largest element of the list	hon 3/Jupiter Notebook	gramming, Computer Knowledge

	3.c. Write a python program to sort the list in ascending order (Bubble sort algorithm)	hon 3/Jupiter Notebook	gramming, Computer Knowledge
4	**Functions:**		
	4.a. Write a python program to implement Simple Calculator by creating Functions.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
	4.b. Write a function that receives marks scored by a student in 3 subjects and calculates the average and percentage of these marks. Call this function and display the results.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
5	**Object Oriented Programming:**		
	5.a. Write a program to create a class named student with attributes Name, and SRN and member function show to display the data members of the object. Create two objects of student class, read and display the contents of objects.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
	5.b. Create a base class person with data members name, age and derived class student with data members name, age, SRN and college. Write a program to demonstrate single inheritance.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
6	**File operation:** Write a program to access (read/write) a file and display its contents.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
7.	**Exceptions:** Write a program to depict exception handling in python for ZeroDivisionError.		
8.	**Numpy:**		
	8.a. Create 1D, 2D and 3D arrays using numpy package	hon 3/Jupiter Notebook	gramming, Computer Knowledge
	8.b. Demonstrate indexing, random(), zeros(), sort(), reshape(),operations on numpy arrays.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
9.	**Pandas:**		
	9.a. Write a Python program to demonstrate pandas data structures: Series and DataFrame.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
	9.b. Write a Python program to filter and sort data in a Pandas Dataframe.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
	9.c. Write a Python program to read a CSV file using Pandas and display its contents.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
10.	**Matplotlib:**		
	10.a. Write a Python program to plot a line graph using Matplotlib.	hon 3/Jupiter Notebook	gramming, Computer Knowledge
	10.b. Write a Python program to plot a scatter plot using Matplotlib.	hon 3/Jupiter Notebook	gramming, Computer Knowledge

TEXT BOOKS:

1. Allen Downey, Think Python: How to Think like a Computer Scientist, Green Tea Press, 2nd edition, 2015.
2. Kenneth A. Lambert, Fundamentals of Python: First Programs (introduction to Programming), 2nd Edition, Cengage Learning, 2019.
3. Charles R. Severance, Python for everybody: Exploring data using python 3, 2nd Edition, Wiley India Pvt Ltd, 2020.

REFERENCE BOOKS

1. John M. Zelle, PYTHON Programming: An Introduction to Computer Science, 3rd Edition, Franklin, Beedle& Associates.
2. Michael Dawson, Python Programming for the Absolute Beginners, 4th Edition, CENAGE Learning.
   Springer, Kent D. Lee, Python Programming Fundamentals, 3rd Edition.
3. John V. Guttag, Introduction to Computation and Programming using Python, 3rd Edition, MIT Press.

Course Title	Analog Electronics Lab				Course Type		HC	
Course Code	B22EN0305	Credits	1		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practical	1	2	2				
	-	-	-	-				
	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OVERVIEW:

In analog electronics lab the students can gain hands-on experience in designing, building, and testing electronic circuits that operate using continuous signals. The design and analysis of BJT biasing amplifier, MOSFET biasing and amplifier , BJT power amplifiers . Implementation of OP-amp as inverting, Non inverting, Summer sub tractor , integrator and differentiator.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand various biasing techniques for BJT
2. Demonstrate single stage BJT amplifier.
3. Demonstrate Single stage MOSFETCS amplifier
4. Analyse BJT power amplifiers.
5. Study various applications of Op-amp.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Design and analyse BJT fixed bias and Self bias circuits	1,2,3,4,5,9, 10	1,2,3
CO2	Design and analyse Single stage BJT amplifier Emitter follower.	1,2,3,4,5,9, 10	1,2,3
CO3	Design and analyse MOSFET biasing circuits.	1,2,3,4,5,9, 10	1,2,3
CO4	Design and analyse single stage MOSFET amplifiers BJT power amplifiers.	1,2,3,4,5,9, 10	1,2,3
CO5	Construct and verify the operation of Op-amp as inverting, non-inverting , Summing and difference amplifier.	1,2,3,4,5,9, 10	1,2,3
CO6	Construct and verify the operation of op-amp as differentiator and Integrator	1,2,3,4,5,9, 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	2	3	1	1	1				2	2			2	1	3
CO2	3	2	3	1	3				2	2			2	1	3
CO3	3	2	3	1	3				2	2			2	1	3
CO4	3	2	3	1	3				2	2			2	1	3
CO5	3	2	3	1	3				2	2			2	1	3
CO6	3	2	3	1	3				2	2			2	1	3

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	ExpectedSkill /Ability
1	Design and Analysis of BJT CE Fixed, Self-Bias Circuits	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
2	Design and analysis of BJT CE amplifier	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
3	Design and analysis of BJT Emitter follower	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
4	Design and Analysis of MOSFET CS Self Bias Circuits.	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
5	Design and Frequency Analysis of MOSFET CS Amplifier	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
6	Design and analysis of Class-C tuned amplifier	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
7	Design and analysis of class B push pull power amplifier	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
8	Design and implementation of Op-amp inverting and non-inverting amplifier	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
9	Design and implementation of Op-amp Summing and Difference amplifier	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team
10	Design and implementation of Op-amp integrator and Differentiator	CRO, Function generator, power supply .Simulation tool	Design and circuit debugging. Working in a team

Extended learning: Simulate the above circuits using suitable simulation tool and analyze the performance.

TEXT BOOKS:

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, PHI/Pearson Education, 11th edition, 2015.
2. David A. Bell, “Electronic Devices & Circuits”, Prentice Hall of India/Pearson Education, 4th edition, 2007.
3. David A. Bell, “Operational Amplifiers and Linear ICs”, Prentice Hall of India, 2nd edition, 2006.

REFERENCE BOOKS

1. Jacob Millman & Christos. C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits ",Tata McGraw Hill, 2nd edition, 2008.
2. Floyd, "Electronic Devices", Prentice Hall of India, Pearson Education, 6th Edition, 2010. Anil Kumar Maini, Varsha Agrawal,"Electronic Devices and Circuits", John Wiley & Sons, 2009.

Course Title	Digital Electronics Lab				Course Type		HC	
Course Code	B22EN0306	Credits	1		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**28**	**28**	**50%**	**50 %**

COURSE OVERVIEW:

Electronics is classified based on the type of signal/information, in to Analog Electronics and Digital Electronics. Digital Electronics deals with signal/information represented using discrete values of 0's and 1's (Binary). Digital electronics are designed using logic gates/circuits and are usually represented using Boolean Equations. Digital Electronics is further classified in to Combinational Logic/Circuits and Sequential Logic/Circuits. This course develops students' ability to understand and design the basic building blocks of modern digital systems and provides them with a fundamental knowledge for complicated digital hardware design

COURSE OBJECTIVES:

The objectives of this course are:

1. Illustrate Boolean laws and systematic techniques for minimization of expressions.
2. Demonstrate the methods for simplifying Boolean expressions.
3. Familiarize the commonly used terms like min-term, max-term, canonical expression, SOP,POS etc.
4. Introduce the Basic concepts of combinational and sequential logic.
5. Present real-world examples for making the learners attuned to Logic concepts.
6. Highlight the formal procedures for the analysis and design of combinational circuits and sequential circuits.
7. Introduce the concept of memories, programmable logic devices and digital ICs.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Verify Demorgan's theorem for 2 variables	1,2,3,4,5,9, 10	1,2,3
CO2	Realize Half adder, Full adder , Half subtractor and Full subtractor using basic gates	1,2,3,4,5,9, 10	1,2,3
CO3	Realize binary to Grey conversion and Grey to binary conversion practically	1,2,3,4,5,9, 10	1,2,3
CO4	Construct and realize 4:1 MUX and DEMUX circuits	1,2,3,4,5,9, 10	1,2,3
CO5	Construct and verify the truth table of of JK master slave, T, D flip flops	1,2,3,4,5,9, 10	1,2,3
CO6	Construct and verify the truth table of counters and shift registers	1,2,3,4,5,9, 10	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

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

COURSE ARTICULATION MATRIX

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

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	To Verify (i) Demorgan'sTheorem for 2 variables. (ii) The sum-of product and product-of-sum expressions using universal gates.	IC Trainer Kit	Design and circuit debugging. Working in a team
2	Realization of (i) Half Adder & Full Adder using i) basic gates. ii) NAND gates. (ii) Half subtractor& Full subtractor using i) basic gates ii) NAND gates	IC Trainer Kit	Design and circuit debugging. Working in a team
3	Realization of 4-bitParallel Adder/Subtractor using IC 7483.	IC Trainer Kit	Design and circuit debugging. Working in a team
4	Realization of 3 bit Binary to Grey code conversion and vice versa using basic/Universal gates.	IC Trainer Kit	Design and circuit debugging. Working in a team
5	Realization of 4:1 MUX and 1:4 DEMUX using basic/universal gates	IC Trainer Kit	Design and circuit debugging. Working in a team
6	Arithmetic circuit realization (Half/Full, Adder/Subtractor) using MUX	IC Trainer Kit	Design and circuit debugging. Working in a team
7	Construction and verification of JK master slave, T, D flip flop using logic gates	IC Trainer Kit	Design and circuit debugging. Working in a team
8	Construction and realization of 3- bit ripple up/down counter using IC 7476 and other logic gates.	IC Trainer Kit	Design and circuit debugging. Working in a team
9	Design and verification of 3-bit synchronous counter using 7476 JK, T and D flip flops.	IC Trainer Kit	Design and circuit debugging. Working in a team
10	Realize the following shift registers usingIC7474/7495(i) SISO (ii) SIPO (iii)) PISO(iv))PIPO	IC Trainer Kit	Design and circuit debugging. Working in a team

TEXT BOOKS:

1. John M Yarbrough, "Digital Logic Applications and Design" Thomson Learning,2001.
2. Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2002.
3. Morris Mano, "Digital design‖, Prentice Hall of India" Third Edition.

REFERENCE BOOK:

1. Charles H Roth Jr., Larry L. Kinney "Fundamentals of Logic Design" Cengage Learning, 7th Edition.
2. Samuel C Lee, "Digital Circuits and Logic Design" PHI learning, 1st Edition, 2009

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://en.wikipedia.org/wiki/Digital_electronics
2. https://learnabout-electronics.org/Digital/dig10.php
3. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials
4. https://www.youtube.com/watch?v=CeD2L6KbtVM
5. https://www.youtube.com/watch?v=BqP6sVYlrr0
6. https://www.youtube.com/watch?v=ibQBb5yEDlQ

<table>
<tr><td colspan="2">Course Title</td><td colspan="4">Course Based Project on Analog and Digital Electronics</td><td colspan="2">Course Type</td><td colspan="2">HC(PROJ)</td></tr>
<tr><td colspan="2">Course Code</td><td>B20EN0307</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 rowspan="2">Total Number of Classes Per Semester</td><td rowspan="2"></td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>IA</td><td>SEE</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>28</td></tr>
</table>

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	√	√	√	√	√	
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	**Universal Human Values**				**Course Type**		FC	
Course Code	**B22EE0310**	**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	0				
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Practice	0	0	0				
	Total	2	2	0	28	0	50%	50%

COURSE OBJECTIVE

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the significance of value inputs in a classroom and start applyingthem in their life and profession.	6,7,8	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.	6,7,8	1
CO3	Understand the role of a human being in ensuring harmony in society and nature.	6,7,8	1
CO4	Demonstrate the role of human being in the abetment of pollution.	6,7,8	1
CO5	Describe appropriate technologies for the safety and security of the society as responsible human being.	6,7,8	1
CO6	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.	6,7,8	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

Content
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, ExcelBooks, New Delhi, 2010
4. Bertrand Russell, Human Society in Ethics & Politics, Routledge Publishers, London, 1992

REFERENCE BOOKS:

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

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

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

EVALUATION PATTERN:

· Internal Assessment-1 will be conducted as a MCQ test for 20 Marks which covers Unit-1 and Unit-2 of the syllabus. This exam will be conducted during IA-1 examinations slot and 5 marks will be assigned to the first assignment

· Internal Assessment-2 will be conducted as a MCQ test for 20 Marks which covers Unit-3 and Unit-4 of the syllabus. This exam will be conducted during IA-2 examinations slot and 5 marks will be assigned to the second assignment.

· Semester End Exam will be conducted as a MCQ exam for 50 Marks which covers unit-1, unit-2, unit-3 and unit-4. This exam will be conducted during semester end examination slot.

Course Title	**Technical Documentation**				**Course Type**	**FC**
Course Code	**B22EN0308**	**Credits**	**1**		**Class**	**III Semester**
	LTP	Credits	Contact Hours	Work Load	Total Number of	Assessment

Course Structure	Lecture	1	1	1	Classes Per Semester		Weightage	
	Tutorial	-	-	-	Theory	Practical	**CIE**	**SEE**
	Practical	-	-	-				
	Total	**1**	**1**	**1**	**14**	**-**	**50%**	**50 %**

COURSE OVERVIEW: Technical writing is all about strategically placing facts and figures in a sensible and user-understandable way. A structured approach encourages creating a better output, all the while considering available resources and objectives. This course focusses on various factors to improve the skills of Technical documentation.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Acquire language skills
2. Develop linguistic and communicative competencies
3. Study academic subjects more effectively using the theoretical and practical components of English syllabus, and hence will develop study skills and communication skills in formal and informal situations.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Produce effective engineering documents that enable readers to access relevant information.	6,8,9,10,12	**1**
CO2	Learn to avoid communication problems that distract the readers, causing confusions, distrust, or misunderstanding.	6 8,9,10,12	**1**
CO3	Practice various verbal reasoning and grammar practice.	6,8,9,10,12	**1**
CO4	Search engineering information, both in traditional ways and online.	6,8,9,10,12	1
CO5	Write research/design reports with special emphasis on content and style.	6,8,9,10,12	1
CO6	Improve the art of presentations in team	6,8,9,10,12	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						1		1	2	2		2	1		
CO2						1		1	2	2		2	1		
CO3						1		1	2	2		2	1		
CO4						1		1	2	2		2	1		
CO5						1		1	2	2		2	1		
CO6						1		1	2	2		2	1		

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1 **Information Design and Development**- Different kinds of technical documents, Information development life cycle, factors affecting information and document design, Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style.
UNIT-2 **Advanced Technical Communication :**Introduction to advanced technical communication, Usability, Managing technical communication projects, time estimation, Single sourcing, Localization, Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

TEXT BOOKS:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002. 7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213).

EVALUATION PATTERN:

Since Technical documentation is 1 credit course and asper the regulations 23-24, IA1 and IA2 will not be conducted however internal assessment marks of 25 will be awarded based on two assignments/quizzes/presentation.

- **Semester End Exam is for 25 Marks and evaluation is based on the Technical report prepared by the students and viva-voce. This exam will be conducted during semester end practical examination slot.**

Course Title	Indian Constitution				Course Type		MC	
Course Code	B22MEM301	Credits	0		Class		III/IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	0	2	2				
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Practice	0	0	0				
	Total	0	2	2	30	0	50 %	50 %

COURSE OVERVIEW

The Constitution of India lays down in defining fundamental political principles, establishes the structure, procedures, powers and duties of government institutions and sets out fundamental rights, directive principles and duties of citizen. It helps to know and understand state executive and elections system of India.

COURSE OBJECTIVES

The objectives of this course are to:

1. Know about the basic structure of Indian Constitution.
2. Know the Fundamental Rights (FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
3. Know about our Union Government, political structure & codes, procedures.
4. Know the State Executive & Elections system of India.
5. Learn the Amendments and Emergency Provisions, other important provisions given by the constitution

COURSE OUTCOMES (Cos)

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

CO	Course Outcomes	POs	PSOs
CO1	Analyse the basic structure of Indian Constitution	6,8,9, 12	
CO2	Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution	6,8,9, 12	
CO3	Know about Indian Union Government, political structure & codes, procedures.	6,8,9, 12	
CO4	Understand our State Executive & Elections system of India	6,8,9, 12	
CO5	Understand the Amendments and Emergency Provisions, other important provisions given by the constitution	6,8,9, 12	
CO6	Understand constitutional amendments till today	6,8,9, 12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

Unit – 1
Indian Constitution: Necessity of the constitution, societies before and after the constitution adoption, introduction to the Indian constitution, making of the constitution, role of the constituent assembly.
Unit – 2
Salient features of India Constitution: Preamble of Indian constitution and key concepts of the preamble, fundamental rights and its restriction and limitations in different complex situations.
Unit – 3
DPSP's and Fundamental Duties: Directive Principles of State Policy (DPSP's) and its present relevance in Indian society, fundamental duties and its scope and significance in nation, union executive: parliamentary system, union executive – president, prime minister, union cabinet.
Unit – 4
Executive and Elections system of India: Parliament - LS and RS, parliamentary committees, important parliamentary terminologies, judicial system of India, supreme court of India and other courts, judicial reviews and judicial activism, state Executive and Governer, CM, state cabinet, legislature - VS & VP, election commission, elections and electoral process, amendment to constitution, and important constitutional amendments till today, emergency provisions.

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.

REFERENCES BOOKS

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

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

EXAMINATION PATTERN:

The course is Mandatory course, As per the regulations 23-24 no IA tests or assignments for the course evaluation. Semester End Examination question paper is of MCQ pattern set for maximum marks of 50. Marks obtained is scaled down to 25.

Detailed Syllabus

Semester -4

Course Title	Probability and Random Process				Course Type		HC	
Course Code	B22AS0402	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	**Linear Integrated Circuits**				**Course Type**		**HC**	
Course Code	**B22EN0401**	**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	-	-	-	Theory	Practical	**IA**	**SEE**
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

Linear Integrated Circuits introduces the basic building blocks of Operational amplifiers, stabilization techniques, testing and feedback techniques. The Course also introduces to the design of applications related to analog computation, measurements, rectification, active filtering, timers, Data Converters. This co to analog computation, measurements, rectification, active filtering, timers, Data Converters. This course supports acquiring of knowledge in analysis and design of IC based circuits.

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the internal components and characteristics and frequency response of Operational amplifier.
2. Explain the linear, non-linear applications of Op-Amp and active filters.
3. Comprehend the applications of Op-Amp as comparators, waveform generators, VCO and PLL operation and its application
4. Discuss various applications of special function Op-Amp ICs such as 555 IC, Voltage Regulator IC
5. Understand the performance of various types of ADC and DAC using Op-Amp

COURSE OUTCOMES(COs)

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

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Summarize the internal components, characteristics and frequency response of Op-Amp	1,2,3,4,5	1,2,3
CO2	Identify the linear, non-linear applications of Op-Amp and active filters.	1,2,3,4,5	1,2,3
C03	Analyze the operational amplifier applications as Wave form generators.	1,2,3,4,5	1,2,3
CO4	Categorize Op-Amp based comparators, waveform generators, VCO and PLL operation and its application.	1,2,3,4,5	1,2,3

CO5	Design various applications of special function Op-Amp ICs such as 555 timer, Voltage Regulator IC.	1,2,3,4,5	1,2,3
CO6	List and compare the performance of various types of ADC and DAC using Op-Amp	1,2,3,4,5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents

UNIT – 1

OP-AMPS Frequency Response, Compensation and applications:

Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, Features of 741 Op-Amp, Block diagram of Op-Amp, Modes of Operation - Inverting, Non-Inverting, Circuit stability, frequency and phase response, frequency compensating methods, bandwidth, and slew rate effects,. Linear Applications: Voltage sources, current sources and current sinks, Current amplifiers, Instrumentation amplifier, precision rectifiers

UNIT – 2

Non-linear applications of OP-AMP

Clamping circuits, peak detectors, Sample and hold circuit, V-I and I-V converter, Log and Antilog amplifiers, Multiplier and Divider, Triangular/Rectangular waveform generators, waveform generator design .Crossing detectors, Inverting Schmitt trigger circuits, Active filters- first and second order low pass and high pass filters

UNIT – 3

Voltage regulators, 555 timer and PLL

Series op-amp regulator, IC voltage regulator, 723 general purpose regulators, 555 timer-basic timer circuit, 555,timer used as Astable and Monostable multivibrator, IC565 PLL - Block Schematic, Description of Individual Blocks,Applications.

UNIT – 4

DATA CONVERTERS:

Introduction, DAC and ADC Specifications. Basic DAC techniques**,** Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Different Types of ADCs - Parallel Comparator Type ADC, Single and dual slope ADC, Successive Approximation ADC,

TEXT BOOKS:

1. David A Bell, “Operational amplifiers and Linear ICs”, PHI/Pearson, 2nd edition, 2004
2. D. Roy Choudhury and Shail B Jain, “ Linear Integrated Circuits”, New Age International, 2nd edition, 2006
3. R. Gayakwad, “Op-amps and Linear Integrated Circuits” (4/e), PHID. A. Bell, Solid state Pulse Circuits (4/e), PHI, 2009

REFERENCE BOOK:

1. Thomas L. Floyd, David Buchla, “Basic Operational Amplifiers and Linear Integrated Circuits”, Prentice Hall, 1999
2. Bruce Carter,” Op Amps for Everyone”, ISBN: 978-0-12-391495-8, Fourth Edition.
3. BIS, ISO standards and Datasheet

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. IEEE transactions on Circuits and Systems
2. https://en.wikipedia.org/wiki/List_of_linear_integrated_circuits
3. http://www.fairchildsemi.com/an/AN/AN-88.pdf
4. https://www.onsemi.com/pub/Collateral/AN-118.pdf.pdf
5. https://www.onsemi.com/pub/Collateral/AN-140.pdf.pdf
6. https://web.archive.org/web/20130502174545/http://www.fairchildsemi.com/an/AN/AN-340.pdf

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/108/108108111/
2. https://www.coursera.org/lecture/electronics/2-1-introduction-to-op-amps-and-ideal-behavior-Q5Di2
3. https://www.coursera.org/lecture/electronics/2-5-active-filters-L2ASa
4. https://www.coursera.org/lecture/sensors-circuit-interface/3-basic-amplifiers-sojqu
5. https://www.coursera.org/lecture/internet-of-things-sensing-actuation/op-amps-kxEOi
6. https://static1.squarespace.com/static/60494675b50d044ae4a81842/t/604a10a95e0cc12e7de634d5/1615466669126/analog_circuit_design_coursera.pdf

<table>
<tr><td>Course Title</td><td colspan="3">Analog Communication</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EN0402</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number ofClasses Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</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 provides the basics of analog communication systems such as amplitude modulation and demodulation, DSB-SC modulation and demodulation, SSB and VSB modulation and demodulation. Later, comparison of various modulation schemes is carried out to differentiate all amplitude modulation schemes. Frequency division multiplexing and frequency translation are demonstrated with block diagram. Angle modulation and demodulation techniques are illustrated to provide a better insight of the course. Finally, the course provides introduction to noise and analyze the receiver model in presence of the noise. This fundamental knowledge on analog communication helps to explore and apply the techniques in design of various analog communication systems.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Comprehend the knowledge of various Analog modulation & demodulation schemes.
2. Understand the time domain and frequency domain description of AM, DSBSC, SSB and VSB schemes
3. Comprehend the knowledge of frequency modulation schemes
4. Introduce the fundamental concepts of noise in communication systems

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Derive the time domain representation of Amplitude modulation, DSB-SC and hence sketch the frequency spectrum of AM and DSB-SC	1,2,3,4,5,9,10	1,2,3
CO2	Analyze time domain and frequency domain problems of SSB and VSB schemes	1,2,3,4,5,9,10	1,2,3
CO3	Categorize the features and applications of all amplitude modulation Schemes.	1,2,3,4,5,9,10	1,2,3
CO4	Illustrate FM modulation and Demodulation Schemes	1,2,3,4,5,9,10	1,2,3
CO5	Relate AM , FM and PM modulation schemes	1,2,3,4,5,9,10	1,2,3
CO6	Devise the model of AM and FM receivers	1,2,3,4,5,9,10	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	3	2	1				1	1			1	2	1
CO2	3	3	3	2	1				1	1			3	2	1
CO3	3	3	3	2	1				1	1			2	3	3
CO4	3	3	3	2	1				1	1			3	2	1
CO5	3	3	3	2	1				1	1			2	3	2
CO6	3	3	3	2	1				1	1			3	3	2

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

COURSE CONTENT

Theory:

Contents
UNIT – 1
Amplitude modulation: Electromagnetic Spectrum used in communication, concept of bandwidth and power. Modulation , need for modulation, Classifications, AM, Frequency – Domain description. Generation of AMwave: square law modulator, switching modulator. Detection of AM waves: square law detector, Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, Coherent detection of DSBSC modulated waves. Costas loop. Related numerical
UNIT - 2
Single Side Band (SSB) and Vestigial Side Band (VSB) transmission: Quadrature Carrier Multiplexing, Introduction to Hilbert Transform, properties of Hilbert Transform, Pre-envelope, Complex-envelope, Single Side-Band Modulation, Frequency-Domain and Time-Domain Description of SSB, Phase Discrimination Method for Generating an SSB Modulated Wave. Demodulation of SSB Waves, VSB: Frequency Domain Description, Generation and Coherent detection of VSB, Applications of SSB VSB modulation in television. Comparison of Amplitude Modulation Techniques. Frequency Division Multiplexing, Frequency Translation. Related numerical
UNIT - 3
Angle Modulation and Pulse Analog Modulation: Basic Definitions, FM, PM, Narrow Band FM, Wide Band FM(with Bessel function), Transmission Bandwidth of FM Waves, Generation of FM Waves: Indirect FM And Direct FM. Demodulation of FM Wave- Balanced Frequency discriminator, Phase Locked Loop. Pulse modulation schemes – PAM, PPM and PWM
Unit-4
Introduction to Noise and Noise in Continuous Wave Modulation Systems: Introduction, Noise and its types :Shot Noise, Thermal Noise, White Noise, Noise Equivalent BW, Narrow Bandwidth,Noise Figure, Equivalent Noise Temperature, Cascade Connection of Two-Port Networks, Receiver Model, Noise in AM Receivers,Noise In DSB-SC Receivers, Pre-Emphasis and De-Emphasis in FM. Related numerical

TEXT BOOKS:

1. Simon Haykins, “An Introduction to Analog and Digital Communication”, John Wiley, 3rd Edition 2003.
2. Simon Haykins, “Communication Systems”, John Willey 4th Edition, 2001.

REFERENCE BOOK:

1. B. P. Lathi, “Modern digital and analog Communication systems”, Oxford University press, 3rd Edition, 2005.
2. Kennedy, Davis,” Electronic Communication Systems “, Tata Mcgraw-Hill, 4th Edition, 1999.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

https://ieeexplore.ieee.org/document/1456366
https://ieeexplore.ieee.org/abstract/document/1054507
https://onlinelibrary.wiley.com/toc/10991131a/4/1
https://www.youtube.com/watch?v=00ZbuhPruJw
https://www.youtube.com/watch?v=beFoCZ7oMyY
https://www.youtube.com/watch?v=A6BRXPqxya0

SWAYAM/NPTEL/MOOCs:

https://www.coursera.org/lecture/satellite-communications/from-analog-to-digital-AUNu1 https://www.classcentral.com/course/swayam-analog-communication-13893 https://onlinecourses.nptel.ac.in/noc20_ee69/preview

Course Title	Electromagnetics and Transmission lines				Course Type		HC	
Course Code	B22EN0403	Credits	3		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	1	2	2				
	Practice	0	0	0	Theory+ Tutorial	Practical	IA	SEE
	Total	**3**	**5**	**4**	**28+28**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The course covers the basic principles of electromagnetics: The experimental laws, electrostatics, magnetic fields of steady currents, potential, Laplace's and Poisson's law, Maxwell's equations, propagation and radiation of electromagnetic waves. The course mainly deals with understanding the properties of electric and magnetic fields which helps to understand the Maxwell's equations which are governing communication in any media. The course also gives an insight to generation of electromagnetic waves and to understand their behavior in different media. Fundamentals of Transmission line ,properties, performance parameters and applications.

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the implementation of Maxwell's equation for electrostatic fields
2. Elaborate the concept of electromagnetic waves and their practical applications through different media.
3. Study the propagation, reflection, and transmission of plane waves in bounded unbounded media.
4. Comprehend the properties of Transmission lines

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Establish the relation between E and V in Electrostatic field	1,2,3,4	1,2,3
CO2	Solve the problems on ampere circuit law applicable to Magnetic field	1,2,3,4	1,2,3
CO3	Represent Maxwell's equations in integral and differential for	1,2,3,4	1,2,3
CO4	Analyze Electromagnetic Wave equation in different media	1,2,3,4	1,2,3
CO5	Draw the Electrical equivalent of Transmission line	1,2,3,4	1,2,3
CO6	Compare the characteristics of transmission line for various load conditions	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	3	3	3									3	2	1
CO2	3	3	3	3									3	2	1
CO3	3	3	3	3									3	2	1
CO4	3	3	3	3									3	2	1
CO5	3	3	3	3									3	2	1
CO6	3	3	3	3									3	2	1

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1
Electrostatics: Basics of coordinate system, Coulomb's Law, Electric Field Intensity - Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Divergence theorem, Maxwell's Equations for Electrostatic Fields, Continuity Equation, Poisson's and Laplace's Equations Electrostatic energy ,capacitance, Illustrative Problems.
UNIT - 2
Magneto statics: Biot - Savart's Law , Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, , Inductance and Magnetic Energy, Illustrative Problem. **Maxwell's Equations (Time Varying Fields):** Faraday's Law and Transformer EMF, Displacement Current Density, Maxwell's Equations in differential and integral Forms, Conditions at a Boundary Surface: Dielectric - Dielectric, Illustrative Problems.
UNIT - 3
EM Wave Characteristics - I: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves - Definition, Relation Between E & H, Wave Propagation in Lossless and Conducting Media, Wave Propagation in Good Conductors, Illustrative Problems.Power of EM wave, Poynting's vector, Poynting's theorem, EM wave at boundary between two different media: Reflection of plane wave at normal incidence. Illustrative problems.
UNIT - 4
Transmission Lines : Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless transmission line, Distortion - Condition for Distortion less and Minimum Attenuation, Illustrative Problems.SC and OC Lines, Input Impedance Relations, Reflection Coefficient, VSWR impedance matching- Single Stub Matching, Illustrative Problems.

Extended learning: Apply MATLAB to solve and understand problems in Electro static and Magnetic fields.

TEXT BOOKS:

1. Matthew N. O. Sadiku, "Elements of Electromagnetics" 4th., Oxford niv.Press
2. William H. Hay Jr. and John A. Buck, "Engineering Electromagnetics" 7thEd., 2006, TMH.
3. John D. Ryder," Networks, Lines and Fields" 2nd Ed., 1999, PHI.

REFERENCE BOOK:

1. - E.C. Jordan and K. G. Balmain, "Electromagnetic Waves and Radiating Systems" 2nd Ed., 2000, PHI.

2. Nathan Ida, “Engineering Electromagnetics” 2ndEd., 2005, Springer (India) Pvt. Ltd., New Delhi.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://aemjournal.org/index.php/AEM/scope
2. https://www.tandfonline.com/toc/uemg20/current
3. IEEE Transactions on electromagnetic Compatibility
4. Progress in electromagnetic research

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/117/103/117103065/
3. https://www.classcentral.com/course/swayam-introduction-to-electromagnetic-theory-14146
4. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/

Course Title	Signals and Systems				**Course Type**		HC Integrated	
Course Code	B22EN0404	**Credits**	4		**Class**		IV	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	4	5	5	42	28	**50%**	**50%**

COURSE OVERVIEW:

The course covers the fundamentals of signal and system analysis tackling both continuous-time (CT) and discrete-time (DT) systems. The course provides the necessary background needed for understanding analog and digital signal processing, automatic control, analog and digital communications, and probability and random processes. The course focuses on the study of linear time-invariant (LTI) systems and their analysis in the time domain or in the frequency domain. Fourier analysis in the course includes Fourier series for periodic continuous-time signals, the continuous-time Fourier transform (CTFT) and the discrete-time Fourier transform (DTFT). In addition the course includes a chapter on Z transform.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Provide insight into fundamentals of Continuous and Discrete-time signals and systems, their properties and representations.
2. Introduce time domain representation of Linear Time invariant Systems such as convolution Sum, Convolution Integral.
3. Provide understanding of signal representation in Fourier domain such as Fourier Series, Fourier transform, discrete time Fourier transform.
4. Provide insights into applications of Fourier transform and brief understanding of signal representation in Z-domain.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the operations on Signals and summarize the properties of Systems.	1,2,3,4,5,9	2

CO2	Apply Convolution operation on an LTI System to calculate the output.	1,2,3,4,5,9	2
CO3	Represent the continuous and Discrete time periodic signals in frequency domain.	1,2,3,4,5,9	2
CO4	Represent the continuous and Discrete time Aperiodic signals in frequency domain.	1,2,3,4,5,9	2
CO5	Analyse the stability of Discrete time system by applying Z-transform.	1,2,3,4,5,9	2
CO6	Represent the discrete time system in Z-domain and determine the behaviour of Causal LTI system using properties of Z-Transform.	1,2,3,4,5,9	2

BLOOM'S LEVEL OF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

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

COURSE CONTENT

THEORY

Contents
UNIT-1
Introduction to Signals and Systems Definitions of signals and systems, Elementary signals, Classification of signals, properties of signals, Basic operations on signals, Classification of systems, Properties of systems, Sampling theorem .
UNIT-2
Analysis of Linear Time Invariant Systems and Fourier Series Time domain representation of LTI systems, Impulse response representation, Types of Convolution: Convolution Sum and Integral, Correlation and types of correlation , Laplace transform and Inverse Laplace transform, applications to solve differential equations ,Fourier Representation of Periodic Signals: CTFS and DTFS of basic signals.

UNIT-3
Fourier Transforms and its applications FT representation of CT signals – Definition of FT, FT of standard CT signals, Properties and their significance, Inverse FT.FT representation of DT signals-Definition of DTFT, DTFT of standard DT signals, Properties and their significance, Inverse DTFT. Frequency Domain Sampling for DFT
UNIT-4
Z-Transforms and its applications Z -Transforms: Definition, Properties of Z transform, ROC, Inverse Z – transforms, transform analysis of LTI Systems. Z-Transforms and its application to solve difference equations.

PRACTICE SESSION:

Sl No	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Waveform generation	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
2	Perform Operations on Dependent Variable of a Signal.	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
3	Perform Operations on Independent Variable of a Signal.	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
4	To Calculate Signal Power and Signal Energy	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
5	Linear Convolution	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
6	Circular Convolution	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
7	Auto correlation	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
8	Cross Correlation	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
7	Solve Any Given Difference Equation of An LTI System Without Initial Conditions.	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
8	Solve Any Given Difference Equation of An LTI System with Initial Conditions.	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
9	Fourier synthesis of waveforms	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification
10	Applications of Sampling Theorem.	Simulation of Mathematical model in Octave or MATLAB scripting	Program synthesis, Debugging, Simulation and Verification

TEXT BOOKS:

1. Simon Haykin, "Signals and Systems**",** John Wiley, India Pvt Ltd, Second Edition, 2018.
2. S Palani, "Signals and Systems", Springer International Publishing AG, Second Edition, 2021.
3. I J Nagrath, "Signals and Systems", Tata McGraw Hill, 3rd edition, 2010.
4.

REFERENCE BOOKS:

1. Michael Roberts, “Fundamentals of signals and systems”, TATA McGraw Hill, Second Edition ,2010
2. Allan V. Oppenheim, S. Wilsky and S. H. Nawab, “Signals and Systems”, Pearson Education, Second Edition, 2019.
3. Benoit Boulet, “Fundamentals of Signals and Systems”, Da Vinci Engineering Press, 2nd edition, 2006.
4.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/abstract/document/9244176
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
3. https://www.khanacademy.org/science/electrical-engineering/ee-signals
4. http://bonnie.ece.gatech.edu/book/TUTORIAL/tutorial.html
5. https://stanford.edu/~boyd/ee102
6. https://www.springer.com/journal/34
7. https://www.inderscience.com/jhome.php?jcode=ijsise
8. https://ieeexplore.ieee.org/document/1143815
9. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=79
10. https://www.ieee.org/membership-catalog/productdetail/showProductDetailPage.html?product=PER310-PRT

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/104/108104100/
2. https://nptel.ac.in/courses/117/101/117101055/
3. https://nptel.ac.in/courses/108/106/108106163/
4. https://www.coursera.org/courses?query=signals%20and%20systems
5. https://nptel.ac.in/courses/117/104/117104074/
6.

Professional Elective-1

<table>
<tr><td>Course Title</td><td colspan="4">INDUSTRIAL ELECTRONICS</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22ENS411</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td></td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>-</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 the basic concepts of power semiconductor devices for controlling and converting electrical power. Principles of converter circuit analysis are introduced and design of power circuits including inverters, rectifiers.

COURSE OBJECTIVES:

The Course Objectives are:

1. Understand the operation of various Power S.C devices for industrial applications.
2. Familiarize the operation of controlled rectifiers with and without resistive load.
3. Make students to learn the single phase invertors, choppers and step-up choppers.
4. Understand the different sensors operation. And uses in automated manufacturing applications.
5. Familiarize with the operation and principles of the regulated power supply.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain and differentiate the operation of various Power S.C devices for industrial applications	1,2,3,4,6	1,2,3
CO2	Explain and analyze the operation of controlled rectifiers with and without resistive load.	1,2,3,4,6	1,2,3
CO3	Explain and analyze the single phase invertors, choppers and step-up choppers	1,2,3,4,6	1,2,3
CO4	Classify different sensors used in automated manufacturing applications and explain their operation.	1,2,3,4,6	1,2,3
CO5	Discuss the operation and principles of the regulated power supply.	1,2,3,4,6	1,2,3

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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

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

COURSE CONTENT

THEORY

Contents
Unit 1
Power S.C devices --Power electronics: Power electronics devices. Controlled rectifiers: Controlled rectifiers: SCR Half wave rectifier circuit, working with wave forms, mathematical analysis for resistive load - SCR Full wave rectifier circuit, working with wave forms, mathematical analysis for resistive load.
Unit 2
Inverters: single phase inverters, Choppers: principle of chopper operation, control strategies, step-up choppers

Unit 3
Sensors : sensors/Transducers, Principles ,classification of sensors, Parameters, Characteristics, Smart sensors, Primary sensors, Excitation, Amplification, Filters, Converters, Information coding/Processing, Data Communication, Standards for Smart Sensor Interface , The Automation.
Unit 4
Power Supplies: Block diagram of regulated power supply – A simple regulated transistorized power supply (circuit and working) – Principle and working of switch mode power supply (SMPS).

TEXT BOOKS:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Third Edition, 2004
2. P.S.Bimbra, "Power Electronics: devices, circuits, and applications", Mohammed Rashid
   D Patranabis, "Sensors and Transducers": 2nd edition.

REFERENCE BOOKS:

1. G.K. Mithal, "Industrial Electronics", Khanna Publishers.

Course Title	**Machine Learning**				**Course Type**			
Course Code:	B22ENS412	**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	0	0	0				
	Practice	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50 %**

COURSE OVERVIEW:

This course introduces the basics of machine learning, including the types of problems it can solve, the different types of data and features, and the role of machine learning in data science. Supervised Learning Algorithms will cover the most popular algorithms including linear regression, logistic regression, decision trees, and random forests. Unsupervised Learning will cover techniques, including clustering and dimensionality reduction etc. Introduction to Statistical Learning Theory will cover the fundamental concepts of bias-variance tradeoff, overfitting and regularization, and cross-validation. Semi-Supervised Learning and Reinforcement Learning will cover how the techniques can be used to learn from partially labeled data and make decisions in an uncertain environment. By the end of the course, student will have a solid foundation in machine learning and be able to apply these techniques to a wide range of problems.

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the basics of machine learning, including its applications, types of problems it can solve, and the role of machine learning in data science.
2. Apply supervised learning algorithms, including linear regression, logistic regression, decision trees, and random forests, to solve real-world problems and evaluate their performance.
3. Apply unsupervised learning techniques, including clustering and dimensionality reduction, to explore data and identify patterns and relationships.

4. Understand the fundamental concepts of statistical learning theory, including bias-variance tradeoff, overfitting and regularization, and cross-validation, and apply these concepts to improve the performance of machine learning algorithms.
5. Understand the mathematical foundations of semi-supervised learning techniques and how to learn from partially labeled data.
6. Apply reinforcement learning concepts, including agents, environments, and rewards, to teach machines how to make decisions based on feedback from their environment.
7. Understand the mathematical foundations of deep learning techniques, including artificial neural networks, convolutional neural networks, and recurrent neural networks, and how they work.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the key concepts and techniques used in machine learning, including supervised and unsupervised learning, statistical learning theory, semi-supervised learning, and reinforcement learning.	1,2,3,4,6	2
CO2	Implement supervised learning algorithms, such as linear regression, logistic regression, decision trees, and random forests, to solve real-world problems and evaluate their performance.	1,2,3,4,6	2
CO3	Implement unsupervised learning techniques, such as clustering and dimensionality reduction, to explore data and identify patterns and relationships.	1,2,3,4,6	2
CO4	Understand the concepts of statistical learning theory, including bias-variance tradeoff, overfitting and regularization, and cross-validation, and use these concepts to improve the performance of machine learning algorithms.	1,2,3,4,6	2
CO5	Use semi-supervised learning techniques to learn from partially labeled data and make decisions in an uncertain environment.	1,2,3,4,6	2
CO6	Apply reinforcement learning concepts, including agents, environments, and rewards, to teach machines how to make decisions based on feedback from their environment.	1,2,3,4,6	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

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

CO6	**3**	**2**	**3**	**3**		**3**								**3**	

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
Introduction to Machine Learning What is Machine Learning ?, Machine Learning versus Traditional Programming, The Seven Steps of Machine Learning, Applications of Machine Learning, Types of Machine Learning, Advantages and Disadvantages of Machine Learning. **Supervised Learning Algorithms** Introducing Supervised Learning Types of Supervised Learning, Regression, Naïve Bayes classifier algorithm, Decision Tree, K-Nearest Neighbors (K-NN) algorithm, Logistic Regression, Support Vector Machine (SVM) Algorithm, Random Forest Algorithm.
UNIT – 2
Unsupervised Learning Working of unsupervised learning, Need for using unsupervised learning, Algorithms. Clustering, K-means Clustering. Hierarchical clustering, Association rule learning, Probabilistic clustering, Gaussian Distribution, Gaussian Mixture Models (GMMs)
UNIT - 3
Introduction to Statistical Learning Theory Estimation of unknown function f Prediction, Feature selection, Model selection, Model evaluation, Classification metrics. Regression metrics, Clustering metrics, Statistical learning algorithms, Supervised learning, Regression, Classification, Unsupervised learning,
UNIT – 4
Semi-Supervised Learning, Reinforcement Learning Markov Decision Process (MDP), Bellman Equations, Monte Carlo Methods, Policy iteration and value iteration, Q-Learning, State-Action-Reward-State-Action (SARSA), Model-based Reinforcement Learning

TEXT BOOKS:

1. Dr Ruchi Doshi , Dr. Kamlesh Lakhwani, Ritesh Kumar Jain, Kamal Kant Hiran, "Machine Learning: Master Supervised and Unsupervised Learning Algorithms with Real Examples", BPB Publications, First Edition 2022.

REFERENCE BOOKS:

1. Tom Mitchell: Introduction to Machine Learning , McGraw Hill 2013
2. Ethem Alpaydin-Introduction to Machine Learning-The MIT Press (2014)

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_cs18/course
2. https://drive.google.com/file/d/1EIkf3njWc6p_HOax7WHiAg_XXvAK6F_C/view

Course Title	**Computer Organization and Architecture**				**Course Type**		**SC**	
Course Code	B22ENS413	**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	0	0	0				
	Practice	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Computer organization and architecture explore the fundamental concepts of computer operation, organization, and architecture. It gives an outline of computer software and hardware, and how the basic functional components are linked to create a comprehensive computer system. The course covers the basics of data transfer, I/O synchronization, interrupts, and Direct Memory Access techniques. Additionally, it includes the standards and bus protocols such as PCI, SCSI, and USB. This course will help the students to have a better idea about the data types, memory system and architecture inside the computer

COURSE OBJECTIVES:

The objectives of this course are to:

1. Describe the architecture and functionality of the fundamental components of a computer.
2. Understand the machine level programming concepts
3. Define the input and output characteristics and its organization.
4. Outline the concepts of memory, their types and uses.
5. Demonstrate the arithmetic and logical operations and their associated circuits.
6. State the fundamental concepts of data transfer

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the architecture and functionality of the fundamental components of a computer.	1,2,3	1,2,3
CO2	Apply the machine level programming concepts	1,2,3	1,2
CO3	Illustrate the input and output characteristics and its organization.	1,2,3	1,2,3
CO4	Review the concepts of memory, their types and uses.	1,2,3	1,2
CO5	Compute the arithmetic and logical operations using their associated circuits.	1,2,3	1,2
CO6	Examine the fundamental concepts of data transfer	1,2,3	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

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

Course Contents

Contents
UNIT - 1
Basic Structure of Computers: Computer types, Functional units, Basic operational concepts, Bus structures, Performance-processor clock, Basic performance equation, clock rate, performance measurement. Machine Instructions and Programs: Memory location and Addresses, Memory Operations, Instructions and instruction sequencing, Addressing modes, Assembly language, Stack and Queues, Subroutines.
UNIT - 2
Input/ Output Organization: Accessing I/O Devices; Interrupts; enabling and disabling interrupts, Handling multiple devices, Device requests, Exceptions, Direct Memory Access, Buses-Synchronous Bus, Asynchronous Bus, Interface Circuits-Parallel Port, Serial Port, Standard I/O interfaces.
UNIT – 3
The Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cache Memories, Virtual Memories, Address Translation, Associative Mapped TLB, Secondary Storage-Magnetic Hard Disks.
UNIT – 4
Arithmetic and Basic Processing Unit: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers. Fundamental Concepts, Register transfers, Performing an Arithmetic or Logic Operation, Fetching a word from memory, Storing a word in memory.

TEXT BOOKS:

1. Carl Hamacher, Z Varnesic and S Zaky, “Computer Organization”, Fifth Edition, McGraw Hill 2002.
2. Computer Architecture: A Quantitative Approach (5th edition) by J.L. Hennessy and D.A. Patterson (Morgan Kauffmann Publishers)

REFERENCE BOOK:

1. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.
2. William Stallings: Computer Organization & Architecture, 7th Edition, PHI, 2006.
3. Vincent P. Heuring& Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education,2004.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. IEEE Computer Architecture Letters: A peer-reviewed journal that focuses on computer architecture and organization.
2. ACM Transactions on Computer Systems (TOCS): A journal that covers a wide range of topics related to computer systems, including computer organization.
3. IEEE Transactions on Computers: This journal publishes research articles on computer architecture and organization, among other computer-related topics.
4. Communications of the ACM (CACM): A renowned magazine that covers various aspects of computing, including computer organization.
5. Memory Organization and Assembly Language Programming - ScienceDirect
6. Interrupt Handling - an overview | ScienceDirect Topics

SWAYAM/NPTEL/MOOCs:

Computer architecture and organization - Course (nptel.ac.in)
https://youtu.be/e9w_XERZ2UM https://youtu.be/3ye2OXj32DM https://youtu.be/8s4b8mYCMAE
https://youtu.be/HWwNTWY1rxo https://youtu.be/G0rbpTX_ytE https://youtu.be/3RfqkVyvnnc

Course Title	**Electronic Instrumentation**				**Course Type**		SC	
Course Code	B22ENS414	**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:

This course provides basic understanding of measurement and instruments, which further leads to design different circuits. Electronic instrumentation deals with the principles and operations of measuring instruments used in the design and configuration of automated systems. This course also deals with analog and digital instruments, oscilloscopes as well as virtual instrumentation. This course tries to bring out the basic principles of measurements, analog instruments, digital instruments, CROs, different display devices and recording instruments.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Impart with the knowledge of generalized measurement systems.
2. Learn the characteristics of various types of measurement systems and errors in measuring instruments.
3. Analyze the circuits for the measurement of Resistance, Capacitance, Inductance, and Frequency.
4. Impart with the basic concepts of CRO and its usage for the measurement of various parameters.
5. Understand the concepts of Ammeters, Voltmeter and Multimeters.
6. Understand the importance of Display Devices and Recorders in practical fields.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply fundamental knowledge of Instrument for electrical measurements.	1,2,3	1,2,3
CO2	Distinguish analog and digital instruments.	1,2,3,5	1,2,3
CO3	Design the voltmeter and ammeter for different ranges.	1,2,3,5	1,2,3
CO4	Implement ADC and DAC using special purpose IC.	1,2,3,5	1,2,3
CO5	Determine voltage, frequency and phase shift of unknown signals using CRO.	1,2,3,5	1,2,3
CO6	Understand the concept of virtual instrumentation and display devices.	1,2,3,5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:
THEORY:

Contents
UNIT – 1 **Fundamentals of Measurement** Need of Instrumentation, General Measurement System, Classification of Instruments, Static and Dynamic characteristics of instruments, Error: limiting error, Types of Errors. Loading effect: Input impedance and admittance of load & output impedance and admittance of source, loading effects of series and shunt connected instruments, Calibration: Definition, calibration report & certification, traceability and traceability chart.
UNIT – 2 **Analog Indicating Instruments** DC galvanometer, PMMC and Moving Iron instruments, Voltmeter, Ammeter, RMS and True RMS concept, Extension of range of ammeter, design of multirange ammeter, extension of range of voltmeter, design of multirange voltmeter, series and shunt type ohmmeter, Single phase wattmeter: construction and working. **Oscilloscope:** Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch, analog storage oscilloscopes and digital storage oscilloscopes.

UNIT – 3
Digital Instruments
Introduction to digital instruments, Advantages of Digital instruments over Analog instruments, Block diagram, principle of operation, Accuracy of digital instruments, Need of ADC, ADC types like Flash, Counter, SAR and Dual-Slope, ADC Specifications, ADC Numerical, Need of DAC, DAC types like Weighted-Resistor and R-2R ladder, DAC Specifications, Its applications in digital instruments like Digital Multimeter, Digital Kilo Watt Hour meter, Digital Clamp meter.
UNIT - 4
Recording Instruments and Virtual Instrumentation
Concept and classification of recorder, Basic Strip chart recorder Types of Strip chart recorder XY Recorder, Magnetic Tape recorder, Different marking mechanism in recorder, Application of recorders, digital display methods, digital display unit. Segmental Displays: Seven segmental display, dot matrices, LED, LCD, decade counting assemblies, display systems. **Virtual Instrumentation:** Introduction to virtual instrumentation, Role of Software in Virtual Instrumentation ,Virtual Instrumentation With LabVIEW, Components of LabVIEW application.

EXTENDED LEARNING: Studying of Signal generators, Bridge Circuits for Measurement of R, L & C.

TEXT BOOKS:

1. Sawhney A. K., Electrical and Electronics Measurements and Instruments, Dhanpat Rai & Co. 02nd Ed..
2. W. D. Cooper & A. D. Helfrick, 'Electronic Instrumentation and Measurement Techniques', PHI, 4th e/d, 1987.
3. David Bell, 'Electronic Instrumentation and Measurements', PHI, 2e/d,

REFERENCE BOOKS:

1. Anand M. M. S., 'Electronic Instruments and Instrumentation Technology', PHI, 2004, 02nd Ed.
2. Kalsi H. S., 'Electronic Instrumentation', TMH, 2nd or 3rd e/d, 2004/2010.
3. R. Subburaj, ' Calibration the Foundation for ISO 9000 and TQM.
4. Bouwens A. J., 'Digital Instrumentation, McGraw-Hill, second edition.
5. Patranabis, "Principles of Electronic Instrumentation" - PHI, 2007.

Course Title	Linear Integrated Circuits Lab				**Course Type**		HC	
Course Code	B22EN0405	**Credits**	3		**Class**		**III Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	0	0	0				
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	1	2	2	-	28	50%	50%

COURSE OVERVIEW

This laboratory course is introduced for the students to explore the applications in linear ICs. The students will learn filtering concepts of various filters. Precision rectifier concepts are also introduced. Fundamental concepts in system design is introduced by designing waveform generators and PLL. The students also design the applications using industry standard simulators.

COURSE OBJECTIVE (S):

The objectives of this course are:

1. Understand and design various applications of Op-Amp and measure the physical parameters.
2. Structured systematically to upgrade graduates skills and knowledge to the more advanced in- depth skills and knowledge in electronics.
3. Infer the DC and AC characteristics of operational amplifiers and design the linear and non-linear applications using operational amplifiers.

4. Simulation and design of electronic circuits using SPICE or other analog simulators

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Design and test Op-amp Instrumentation amplifier	1,2,3,4,5,9,10	1,2,3
CO2	Design and test second-order low-pass and high pass filters using op-amp	1,2,3,4,5,9,10	1,2,3
CO3	Design and test Schmitt Trigger for different values of UTP and LTP	1,2,3,4,5,9,10	1,2,3
CO4	Design and test the waveform generators using op-amp	1,2,3,4,5,9,10	1,2,3
CO5	Construct op-voltage regulators and test for line and load regulations	1,2,3,4,5,9,10	1,2,3
CO6	Demonstrate linear and non linear applications using simulator tools.	1,2,3,4,5,9,10	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	2	2	2	2	2					2	2		3	3	1
CO2	2	2	2	2	2					2	2		3	3	1
CO3	2	2	2	2	2					2	2		3	3	1
CO4	2	2	2	2	2					2	2		3	3	1
CO5	2	2	2	2	2					2	2		3	3	1
CO6	2	2	2	2	2					2	2		3	3	1

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

COURSE CONTENT

PRACTICE SESSION:

	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Study the characteristics of negative feedback amplifiers	PC with Multisim simulation software, CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team
2	Design and Test of half wave and full wave precision rectifier	PC with Multisim simulation software, CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team
3	Design and Test Instrumentation	PC with Multisim simulation	Design, simulation and circuit

	amplifier.	software, CRO, Function Generator, and design equations	debugging. Working in a team
4	Design ,simulation and discrete circuit testing of second-order low-pass filter and high-pass filter	PC with Multisim simulation software, Analog Discovery and design equations	Design, simulation and circuit debugging. Working in a team
5	Design ,simulation and discrete circuit testing of second-order bandpass	PC with Multisim simulation software, Analog Discovery and design equations	Design, simulation and circuit debugging. Working in a team
6	Design ,simulation and discrete circuit testing of Schmitt Trigger circuit for the given values of UTP and LTP	PC with Multisim simulation software, CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team.
7	Design ,simulation and discrete circuit testing of Astable multi-vibrator circuits using IC 555 for given frequency and duty cycle	PC with Multisim simulation software, CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team
8	Design ,simulation and discrete circuit testing of a of 4-bit DAC.	PC with Multisim simulation software, CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team
9	Design ,simulation and discrete circuit testing of a rectangular and triangular wave generator	PC with Multisim simulation software, CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team
10	Design ,simulation and discrete circuit testing of integrator and differentiator circuit	PC with Multisim simulation software,CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team
11	Design ,simulation and discrete circuit testing of a voltage regulator circuit using op-Amp	PC with Multisim simulation software,CRO, Function Generator, and design equations	Design, simulation and circuit debugging. Working in a team
12	Demonstration of PLL	PC with Multisim simulation software, CRO, Function Generator, and design equations	Design ,simulation and circuit debugging. Working in a team

TEXT BOOKS:

1. David A Bell, “Operational amplifiers and Linear ICs”, PHI/Pearson, 2nd edition, 2004 2. D. Roy Choudhury and Shail B Jain, “ Linear Integrated Circuits”, New Age International, 2nd edition, 2006
3. R. Gayakwad, “Op-amps and Linear Integrated Circuits” (4/e), PHID. A. Bell, Solid state Pulse Circuits (4/e), PHI, 2009

REFERENCE BOOKS:

1. Thomas L. Floyd, David Buchla, “Basic Operational Amplifiers and Linear Integrated Circuits”, Prentice Hall, 1999
2. Bruce Carter,” Op Amps for Everyone”, ISBN: 978-0-12-391495-8, Fourth Edition.
3. BIS, ISO standards and Datasheet

JOURNALS/MAGAZINES

1. IEEE transactions on Circuits and Systems
2. https://en.wikipedia.org/wiki/List_of_linear_integrated_circuits
3. http://www.fairchildsemi.com/an/AN/AN-88.pdf
4. https://www.onsemi.com/pub/Collateral/AN-118.pdf.pdf
5. https://www.onsemi.com/pub/Collateral/AN-140.pdf.pdf

6.https://web.archive.org/web/20130502174545/http://www.fairchildsemi.com/an/AN/AN-340.pd

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/108/108108111/
2. https://www.coursera.org/lecture/electronics/2-1-introduction-to-op-amps-and-ideal-behavior-Q5Di2
3. https://www.coursera.org/lecture/electronics/2-5-active-filters-L2ASa
4. https://www.coursera.org/lecture/sensors-circuit-interface/3-basic-amplifiers-sojqu
5. https://www.coursera.org/lecture/internet-of-things-sensing-actuation/op-amps-kxEOi

6.https://static1.squarespace.com/static/60494675b50d044ae4a81842/t/604a10a95e0cc12e7de634d5/16154666 69126/analog_circuit_design_coursera.pdf

Course Title	**Analog Communication Lab**				**Course Type**		**HC**	
Course Code	**B22EN0406**	**Credits**	1		**Class**		**IV Semester**	
Course Structure			Contact	Work	Total Number of Classes Per Semester		Assessment in Weightage	
	LTP	Credits	Hours	Load				
	Lecture	-	-	-				
	Tutorial	-	-	-				
	-				Theory	Practical	**IA**	**SEE**
	Total	**1**	**2**	**2**		**28**	**50 %**	**50 %**

COURSE OVERVIEW

Analog communication laboratory is meant for experiments at the instructional level for undergraduate students. In this course students will conduct experiments to demonstrate the frequency characteristics of an IF amplifier, Amplitude modulation and demodulation, DSB-SC modulation and demodulation, pulse modulation schemes, frequency modulation and demodulation, Pre-Emphasis and De-Emphasis, mixer design. Simulation of amplitude modulation, AM-DSBSC modulation and frequency modulation using LabVIEW/MATLAB programming software. These Experiments helps students tocorrelate the concepts studied in theory and the results obtained from experiments.

COURSE OBJECTIVES:

The objectives of this course are to :

1. Demonstrate the basics of Analog Modulation/Demodulation principles
2. Provide the understanding of Pulse Modulation/Demodulation Schemes
3. Introduce the basics of Phase locked Loop (PLL), Pre-Emphasis and De-Emphasis
4. Demonstrate AM and FM techniques using LabVIEW/MATLAB programming software

COURSE OUTCOMES

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

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Design an IF Amplifier to select a particular signal in super heterodyne Receiver	1,2,3,4,5,9,10	1,2,3
CO2	Simulate and test AM/FM Modulators and demodulators	1,2,3,4,5,9,10	1,2,3
CO3	Design and test PAM,PWM, PPM modulators and Demodulators	1,2,3,4,5,9,10	1,2,3
CO4	Design and test Frequency Synthesizers using PLL	1,2,3,4,5,9,10	1,2,3

CO5	Design and test Pre-Emphasis and De-Emphasis of a given signal.	1,2,3,4,5,9,10	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	3	2	1				1	1			1	2	1
CO2	3	3	3	2	1				1	1			3	2	1
CO3	3	3	3	2	1				1	1			2	3	3
CO4	3	3	3	2	1				1	1			3	2	1
CO5	3	3	3	2	1				1	1			2	3	2
CO6	3	3	3	2	1				1	1			3	3	2

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools andTechniques	Expected Skill /Ability
1	To Study the Frequency Characteristics of IF Amplifier.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
2	To Generate Amplitude Modulationand Demodulation.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Simulation of Amplitude Modulationand Demodulation using LABVIEW software.
3	AM-Double Sideband Suppressed Carrier (DSBSC) Generation and Detection	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Simulation of DSBSC modulation and demodulation using LABVIEW software.
4	Design and test Pulse Amplitude Modulation and Demodulation circuit.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
5	Design and test Pulse Width Modulation and Demodulation.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
6	Design and test Pulse Position Modulation and Demodulation.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team

7	To Generate Frequency Modulatedwave for modulation index (β >1)	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Simulation of Frequency Modulation using LABVIEW software
8	Frequency Synthesis using PLL IC 565.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
9	Design of a Mixer circuit using BJT.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
10	To Illustrate Pre-Emphasis and De-Emphasis of a given signal.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team

EXTENDED LEARNING: Simulate Analog communication Experiments using LABVIEW software**.**

TEXT BOOKS:

1. Simon Haykins, "An Introduction to Analog and Digital Communication", John Wiley, 3rd Edition 2003.
2. Simon Haykins, "Communication Systems", John Willey 4th Edition, 2001.

REFERENCE BOOK:

1. B. P. Lathi, "Modern digital and analog Communication systems", Oxford University press, 3rd Edition, 2005.
2. Kennedy, Davis," Electronic Communication Systems ", Tata Mcgraw-Hill, 4th Edition, 1999.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://ieeexplore.ieee.org/document/1456366
2. https://ieeexplore.ieee.org/abstract/document/1054507
3. https://onlinelibrary.wiley.com/toc/10991131a/4/1
4. https://www.youtube.com/watch?v=00ZbuhPruJw
5. https://www.youtube.com/watch?v=beFoCZ7oMyY
6. https://www.youtube.com/watch?v=A6BRXPqxya0

SWAYAM/NPTEL/MOOCs:

1.https://www.coursera.org/lecture/satellite-communications/from-analog-to-digital-AUNu1
2. https://www.classcentral.com/course/swayam-analog-communication-13893
3. https://onlinecourses.nptel.ac.in/noc20_ee69/preview

Course Title	**Course Based Project on Linear Integrated Circuits**				**Course Type**		**HC(PROJ)**	
Course Code	**B22EN0407**	**Credits**	**1**		**Class**		**IV Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	0	0	0				
	Tutorial	-	-	-	Theory	Practical	**IA**	**SEE**
	Practice	1	2	2				
	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	√	√	√	√	√	
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	
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	Professional Ethics				Course Type	FC	
Course Code	B22CS0301	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	CIE	SEE
	Practice	-	-	-			
	Total	2	2	2	28	50%	50%

COURSE OVERVIEW:

The course enables e the students to imbibe and internalize the Values and Ethical Behaviour in the personal and Professional lives.

COURSE OBJECTIVE S:

1. Understand the professional Rules of conduct for Engineers.
2. Appreciate codes of conduct, professional Rules of conduct.
3. Recognize the conflict of interest and Develop strategies
4. Understand the importance of communication with all stakeholders.
5. Apply practical strategies for handling ethical dilemmas.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understanding basic purpose of profession, professional ethics and various moral and social issues.	8,9,10	
CO2	Awareness of professional rights and responsibilities of a Engineer, safety and risk benefit analysis of a Engineer	8,9,10	
CO3	Acquiring knowledge of various roles of Engineer In applying ethical principles at various professional levels	8,9,10	
CO4	Professional Ethical values and contemporary issues	8,9,10	
CO5	Apply practical strategies for handling ethical dilemmas	8,9,10	
CO6	Appreciate codes of conduct, professional Rules of conduct	8,9,10	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO5	√	√	√			
CO6	√	√	√			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

UNIT – 1

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT – 2

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT- 3

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession.

UNIT- 4

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, OxfordUniversityPress,2015.
2. Ethics in Engineering Practice &Research, CarolineWhitbeck,2e, Cambridge University Press 2015.

REFERENCE BOOKS:

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr.,Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: ManuelGVelasquez,6e,PHI, 2008.

Evaluation pattern:

1. Internal Assessment-1 will be conducted as a MCQ test for 20 Marks which covers Unit-1 and Unit-2 of the syllabus. This exam will be conducted during IA-1 examinations slot and 5 marks will be assigned to the first assignment
2. Internal Assessment-2 will be conducted as a MCQ test for 20 Marks which covers Unit-3 and Unit-4 of the syllabus. This exam will be conducted during IA-2 examinations slot and 5 marks will be assigned to the second assignment.

3. Semester End Exam will be conducted as a MCQ exam for 50 Marks which covers unit-1, unit-2, unit-3 and unit-4. This exam will be conducted during semester end examination slot.

Course Title	**Entrepreneurship**				**Course Type**		**FC**	
Course Code	B22CI0309	**Credits**	**1**		**Class**		**III/IV Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical							
	Total	**1**	**1**	**1**	**14**		**50%**	**50%**

COURSE OVERVIEW:

NEN Ignite is an entrepreneurship program based on experiential learning that aims to support startups' founders through a structured pathway from Idea Discovery to Pitch Deck.

A 14 weeks, 36-42 hours of classroom/digital, highly experiential and practice based entrepreneurship training Course, by Wadhawani Foundation and will be delivered by WF facilitators / NEN Trained Entrepreneurship Faculty.

COURSE OBJECTIVES

The objectives of this course are to:

1. Discover an entrepreneurial opportunity
2. Articulate a compelling value proposition
3. Build a sustainable business model and business plan
4. Create and validate an MVP with potential customers
5. Select an appropriate Go-to-Market Strategy
6. Pitch the business idea to different stakeholders

COURSE OUTCOMES (CO'S)

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

CO	**Course Outcomes**	**POs**	**PSOs**
CO1	Identify the different aspects that can impact their business	3,9,10,11	1
CO2	Acquire in-depth knowledge about tools to build any business idea	3,9,10,11	1
CO3	Acquire in-depth knowledge about the different growth tools to grow their business.	3,9,10,11	1
CO4	Create a financial plan for their business	3,9,10,11	1
CO5	Create a pitch deck for their business and present it to different stakeholders	3,9,10,11	1

COURSE CONTENT
THEORY

UNIT -1

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioural; entrepreneurial challenges. Taking product or service ideas to creating value: Why should one choose to become an entrepreneur, Entrepreneurial mind-set, Intrapreneurship.

Orientation for WE Ignite program, Ice Breaking session, self-work Instructions and timelines Platform Demo Introduction to Ignite program flow and milestones , Introduction to Entrepreneurship and Human centred Approach to Design Thinking , Are you enterprising?. 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

100 Rupee Venture; Debrief of Group Activity- Presentation and Sharing Learning Experience

Unit - 2

Entrepreneurial Opportunities: Opportunities. Discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering. Problem Identification and Opportunity Discovery.
Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation

Customer and Markets : Customer Discovery: Exploring Customer Personas & Market Estimation for your Ideas, Create a compelling value proposition & Competitive Advantage

UNIT- 3

Build your MVP : Building a MVP that customers Love
Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analysing business models; Business model canvas, Introduction to lean start-ups, Business Pitching
Business Model: Developing strong business models Create and present your Lean Canvas

Financial Feasibility: Introduction to Business plan and its components; Basics of Finance.

Unit 4

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

Go To market Strategy: Getting products to market: Channels & Strategies; Managing growth and Targeting Scale: Understand the Unit economics for your venture; Funding Strategy: Securing funding for your Startup and Preparing for pitch.

COURSE ARTICULATION MATRIX

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

TEXT BOOKS:

1.Wadhwani Foundation Curriculum 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. Drucker F Peter: "Innovation and Entrepreneurship", 1985.Heinemann, London.
3.Doanld F Kuratko & Richard M Hodgeth, "Entrepreneurship in the New Millennium", India Edition - South-Western,
4. Cengage Learning Entrepreneurship –by Robert D. Hisrich (Edition-9)
5.Entrepreneurship- Theory, Process & Practice –by Kuratko & Hodgetts, Thompson South-Western Publication
6.Technology Entrepreneurship Taking Innovation to the Marketplace – by Thomas N. Duening, Robert D. Hisrich and Michael A. Lechter, Elsevier

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="3">Environmental Science</td><td colspan="2">Course Type</td><td colspan="2">MC</td></tr>
<tr><td>Course Code</td><td>B22AS0403</td><td>Credits</td><td colspan="2">0</td><td colspan="2">Class</td><td colspan="2">III/IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact</td><td>Work</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practial</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Total</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td></td><td colspan="3"></td><td>16</td><td>-</td><td>50 %</td><td>50 %</td></tr>
</table>

Course Overview: Environmental Science is focussed on a holistic understanding of earth systems in order to learn from the past, comprehend the present and influence the future. It is the study of how physical, chemical and biological processes maintain and interact with life, and includes the study of how humans affect nature. As environmental science is at the cross-roads of the natural sciences, it provides an enriching alternative to a single-subject honours degree, and can open the door to an exciting range of career options. This approach enables us to tackle necessary problems, such as ensuring that human needs are met in a sustainable way, so that everyone has access to clean water and air, and the resources required for agriculture and industrial activity.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Familiar with current and emerging environmental engineering and global issues and have an understanding of ethical and societal responsibilities.
2. Recognize the need for engaging in life-long learning.

3. Study 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. Know 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, analyse and execute favourable environmental conditions and the role of individual, government and NGO in environmental protection.	7,9,10	**1**
CO2	List the causes, effects & remedial measures of environmental pollution, degradation & find ways to overcome them by suggesting the pollution controlled products.	7,9,10	**1**
CO3	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.	7,9,10	**1**
CO4	Critically analyse the ecological imbalances and provide recommendations to protect the environment.	7,9,10	**1**
CO5	Explore the condition of environmental degradation and waste management techniques and take promising measures to make our environment eco-friendly.	7,9,10	**1**
CO6	Identify new methodologies for conservation of our natural resources and ecosystem.	7,9,10	**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							2		2	2			1		
CO2							2		2	2			1		
CO3							3		2	2			1		
CO4							3		2	2			1		
CO5							2		2	2			1		
CO6							3		2	2			1		

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

COURSE CONTENTS:

THEORY:

Contents
UNIT-1 **Environment and Environmental Protection** **Basics of environment:** Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment. **Environmental protection:** Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations.
UNIT-2 **Environmental pollution, degradation & Waste management:** **Environmental Pollution:** Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Automobile Pollution-Causes, Effects & control measures. **Environmental degradation:** Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect. **Waste management:** Municipal solid waste, Bio-medical waste and Electronic waste (E-Waste).
UNIT-3 **Energy & Natural resources:** **Energy:** Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, 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. Forest wealth - Importances, Deforestation-Causes, effects and controlling measures
UNIT-4 **Ecology, ecosystem & field work:** **Ecology** - Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Components of ecosystem-abiotic and biotic. **Levels of biological diversity:** Genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity. **Field work:** Visit to waste water/sewage treatment plant (STP) and biogas plant at REVA university campus, and/or Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

TEXT BOOKS:

1. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, Co-authored & 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, 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, 3rd Edition, 2016.

EXAMINATION PATTERN:

The course is Mandatory course, As per the regulations 23-24 no IA tests or assignments for the course evaluation. Semester End Examination question paper is of MCQ pattern set for maximum marks of 50. Marks obtained is scaled down to 25.

LINKS FOR EVS ONLINE RESOURCES

Link for online	Title of the course	Course Duration
https://www.classcentral.com/course/swayam-environmental-studies-14042	**Environmental Studies**	**12 Weeks Free Online**
https://www.edx.org/course/introduction-to-environmental-science-2?index=product&search_index=product&webview=false&campaign=Introduction+to+Environmental+Science&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-science	**Introduction to Environmental Sciences**	**5hrs/Week For Weeks**
https://www.coursera.org/specializations/environmental-science?action=enroll	**Introduction to Environmental Science Specialization**	**5hrs/Week 12 Weeks**

Third year
(2022-26 Batch)

Detailed Syllabus
Semester -5

Course Title	Digital Signal Processing				Course Type		HC	
Course Code	B22EN0501	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-	Theory	Practical	IA	SEE
	-	-	-	-				
		3	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

Digital signal processing is the process of analyzing and modifying a signal to optimize or improve its efficiency or performance. It involves applying various mathematical and computational algorithms to analog and digital signals to produce a signal that's of higher quality than the original signal. Some of the applications of DSP include audio signal processing, digital image processing, speech recognition, biomedicine and more. Digital Signal Processing discusses the fundamentals of discrete-time signals, systems, and modern digital processing as well as applications for students in electrical engineering, computer engineering, and computer science.

COURSE OBJECTIVES:

The objectives of this course are:

1. Explain the concept of DFT and FFT.
2. Calculate the DFT of a sequence, relate it to the DTFT, and use the DFT to compute the linear convolution of two sequences.
3. Apply the concept of FFT algorithms to compute DFT.
4. Design IIR filter using impulse invariant, bilinear transform.
5. Describe the concept of linear filtering Technique.
6. Demonstrate FIR & IIR filters for digital filter structures.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the DFT for the analysis of digital signals	1,2,3,4,5,9,10	1,2,3
CO2	Explain the different properties of DFT	1,2,3,4,5,9,10	1,2,3
CO3	Compute DFT using FFT algorithms	1,2,3,4,5,9,10	1,2,3
CO4	Design and analyze IIR filters for DSP systems	1,2,3,4,5,9,10	1,2,3

CO5	Design and analyze FIR filters for DSP systems	1,2,3,4,5,9,10	1,2,3
CO6	Describe the significance of various filter structures.	1,2,3,4,5,9,10	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	2	2	2	3				2	2			2	2	1
CO2	3	3	2	2	3				2	2			2	2	1
CO3	2	3	2	3	3				2	2			2	2	1
CO4	3	3	3	2	3				2	2			2	2	1
CO5	3	3	3	2	3				2	2			2	2	1
CO6	3	3	3	2	3				2	2			2	2	1

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1
Discrete Fourier Transforms and its Properties The Discrete Fourier Transform (DFT), Time domain concepts of Circular time shift, time reversal, auto correlation and cross correlation. **Properties of the DFT:** Periodicity, Linearity, Circular time shift, time reversal, circular frequency shift, Circular Convolution Concept and Its DFT Property, Examples on Time and Frequency domain Symmetry Properties, auto correlation, cross correlation, Parseval's theorem.

UNIT - 2
Fast Fourier Transform Algorithms A linear filtering approach to computation of the DFT using overlap-save method, overlap – add method, efficier computation of the DFT: FFT algorithms, direct computation of the FFT. Radix–2 FFT and IFFT algorithms.
Design of IIR Filters Characteristics of commonly used analog filters and design of Butterworth and Chebyshev analog filters. Frequency transformations in the analog domain, design of IIR filters from analog filters, IIR Butterworth and Chebyshev filter design using impulse invariance, and bilinear transformation method.
Design of FIR Filters and Digital Filter Structures Design of FIR filters, Symmetric and Anti symmetric FIR Filter, Design of Linear phase FIR Filter using Window (Rectangular, Hamming, & Hanning Windows). **Implementation of Discrete Time System:** Direct Form -I, Direct Form II structures, Cascade Form Structures, Parallel Form Structures for IIR systems

TEXT BOOKS:

1.John G. Proakis, D.G. Manolakis and D.Sharma, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition, Pearson Education, 2012.

2. Sanjit K. Mitra, Digital Signal Processing, 4th edition, TMH, 2013.

REFERENCE BOOKS:

1. Sophocles J. Orfanidis, "Introduction to Signal Processing" 2nd edition, Prentice Hall, Inc, 2010
2. Oppenhiem V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 3rd edition, Pearson new international edition, 2014.
3. Lawrence R Rabiner and Bernard Gold, "Theory and Application of Digital Signal Processing", Pearson India Education Services, 2016.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. .https://www.youtube.com/watch?v=b-JxoHKv27Ye3
2. https://www.youtube.com/watch?v=5LERZVZGw60
3. https://www.youtube.com/watch?v=Ytn3fhjyxf8
4. https://www.youtube.com/watch?v=KcqJGC-SpMg
5. https://www.youtube.com/watch?v=yqrLro_ueFU
6. https://www.youtube.com/watch?v=lc6QT8VjqVc
7. https://www.youtube.com/watch?v=-10FG_DXRwY
8. https://www.youtube.com/watch?v=3QWvi8EC_DI
9. https://www.youtube.com/watch?v=twbtNKg3hrM&list=PLxWwb-b9LnpA9ycTTqC3f8PpfSLVvBndH

Course Title	Microcontroller and ARM Processor Applications				Course Type		HC	
Course Code	B22EN0502	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	0	0	0				
	-	-	-	-	Theory	Practical	IA	SEE
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50**

COURSE OVERVIEW:

Embedded systems are involved in almost every facet of modern life. This course presents an overview to ARM Cortex-M3 processor. The lessons are designed to serve students with a variety of backgrounds and they require only a minimal level of instruction sets, architecture and programming. Each lesson provides a sufficient background to help novices understand the principles that underlie the operation of processor. This course provides the students with an opportunity to conduct experiments and analyze the characteristics of different types of processor. Development environment helps to simulate and emulate the applications.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the architectural features and instruction set of 32bit microcontroller ARM Cortex M3.
2. Program ARM Cortex M3 using the various instructions and C language for different applications.
3. Study the concepts of Exceptions and interrupts for architectural Support for High level languages.
4. Familiarize the students with the knowledge of LPC1768.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller	1,2,3	1,2
CO2	Write 8051 Assembly level programs using 8051 instruction set.	4,5	1,2,3
CO3	Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051.	1,2,3,4,5	1,2,3
CO4	Interfacing of 8051 to external memory and Instruction set of 8051	1,2,3,5	1,2,3
CO5	Analyze and Compare various Processor and Controller Architectures with ARM Cortex-M3.	1,2,3,4,5	1,2,3
CO6	Apply the knowledge of programming in assembly language and C language for various applications.	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	2	1										1	2	1
CO2				3	3								2	3	3
CO3	3	2	1	3	3								2	3	2
CO4	3	2	1		3								2	3	
CO5	3	2	1	3	3								2	3	1
CO6				3	3								2	3	1

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

COURSE CONTENTS

THEORY:

Contents
UNIT – 1
Introduction: Introduction to Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von Neumann CPU architecture, 8051 Architecture, Memory, Addressing Modes, Data transfer Instructions, Stack.
UNIT – 2
Instruction Set: Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instruction. Assembler Directives. Timers and Software delay calculations. Basics of interrupts, 8051 interrupt structure. Supporting example programs in Assembly language
UNIT – 3
8051 Interfacing and Programming: Assembly language program examples on subroutine and involving loops - Factorial of an 8 bit number (result maximum 8 bit), Block move without overlap, Addition of N 8 bit numbers, Picking smallest/largest of N 8 bit numbers. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status, to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication.
UNIT – 4
ARM-32bit Microcontroller: Architecture of ARM Cortex M3, CortexM3 processor versus Cortex-M3 based MCUs, Cortex-M3 processor Applications, Registers- General Purpose Registers, Special Registers, operation modes, debugging architecture. Basic instructions set of ARM controller and application programs.

TEXT BOOK:

1. Joseph Yiu, "**The Definitive Guide to the ARM Cortex-M3**", 2nd Edition, Newnes, (Elsevier), 2010.

REFERENCE BOOKS:

1. Steave Furber, ARM system - on - chip architecture, Addison Wesley, 2000.
2. A.N. Sloss, D. Symes and C. Wright, "ARM System Developer's Guide: Design and Optimizing System Software", Morgan Kaufman Publishers, 2004.
3. Jonathan W Valvano, Embedded Systems: Introduction to ARM Cortex™-M3 Microcontroller, Volume1, CreateSpace Independent Publishing Platform, 2012.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://researchdesignlab.com/lpc1768-arm-cortex-m3-development-board.html#:~:text=The%20NXP%20LPC1768%20is%20an,popular%208%2Dbit%20prototyping%20alternatives.
2. https://www.nxp.com/products/processors-and-microcontrollers/arm-microcontrollers/general-purpose-mcus/lpc1700-cortex-m3/512kb-flash-64kb-sram-ethernet-usb-lqfp100-package:LPC1768FBD100
3. https://www.electronicshub.org/getting-started-with-lpc1768/
4. https://developer.arm.com/ip-products/processors/cortex-m/cortex-m3
5. https://www.arm.com/products/silicon-ip-cpu/cortex-m/cortex-m3
6. https://en.wikipedia.org/wiki/ARM_Cortex-M
7. st.com/content/st_com/en/arm-32-bit-microcontrollers/arm-cortex-m3.html
8. https://class.ece.uw.edu/474/peckol/doc/StellarisDocumentation/IntroToCortex-M3.pdf
9. https://www.silabs.com/mcu/32-bit/arm-cortex-m3-32-bit-microcontroller
10. https://copperhilltech.com/blog/a-brief-introduction-to-the-arm-cortex-m3-processor/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/105/106105193/
2. https://nptel.ac.in/courses/117/106/117106111/
3. https://nptel.ac.in/courses/108/102/108102045/

<table>
<tr><td>Course Title</td><td colspan="4">Digital System Design Using Verilog</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EN0503</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="7">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</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:

The course will introduce the students to the Verilog hardware description language. It will help them to learn various digital circuit modelling issues using Verilog, and some case studies. Through

this course Students will get exposure to design of digital circuits using Verilog HDL targeted to FPGA board using VLSI CAD tools.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the Verilog HDL syntax and programming structure
2. Understand behavioral and RTL modelling of digital circuits
3. Simulate, synthesize, and program their designs on a development board
4. Verify and design the digital circuit by means of Computer Aided Engineering tools which involves inprogramming with the help of Verilog HDL.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Discuss the significance of HDL and explore the design flow	1,2,3	1,2,3
CO2	Explain the Verilog programming structure and lexical conventions.	1,2,3	1,2,3
CO3	Develop Verilog programs for digital circuits using gate, dataflow, behavioral andswitch modeling levels of Abstraction.	1,2,3	1,2,3
CO4	Design and analyze the sequential and combinational logic circuits.	1,2,3	1,2,3
CO5	Describe the simulation and synthesis steps in HDL using Verilog.	1,2,3	1,2,3
CO6	Understand the dual port RAM working.	1,2,3	1,2,3

B**LOOM'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	2										3	3	2
CO5	3	3	2										3	3	2
CO6	3	3	2										3	3	2

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

COURSE CONTENT THEORY:

Contents
UNIT - 1
Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, importance of Verilog HDL. **Hierarchical Modeling Concepts:** Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. **Basic Concepts:** Lexical conventions, data types, system tasks, compiler directives. **Modules and Ports:** Module definition, port declaration, connecting ports, hierarchical name referencing
UNIT - 2
Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates. **Dataflow Modelling:** Continuous assignments, delay specification, expressions, operators, operands, operator types.
UNIT - 3
Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements. **Tasks and Functions:** Differences between Tasks and Functions, Tasks, Functions
UNIT - 4
Synthesis Basics: Synthesis steps, Verilog Synthesis information from Verilog, Mapping of Always, Signal Assignment Statement, Logical Operators, if statement, case statement, loop statement, Task and Function statement, Example of sequential circuit synthesis-FSM. **Case Study:** Dual port RAM.

TEXT BOOKS:

1. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, Pearson Education.
2. Nazeih M. Botros, “HDL Programming (VHDL and Verilog)”, John Wiley India Pvt. Ltd.2008.
3. M.D.Ciletti, “Modeling, Synthesis and Rapid Prototyping with the Verilog HDL”, PHI, 1999.

REFERENCE BOOK:

1. J Bhaskar, “A Verilog HDL Primer (3/e)”, Kluwer, 2005.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. http://in.ncu.edu.tw/ncume_ee/digilogi/vhdl/Verilog_Reference_Guide.pdf
2. https://www.xilinx.com/support/documentation/university/Viv ado-Teaching/HDL-Design/2013x/Nexys4/Verilog/docs- pdf/Vivado_tutorial.pdf
3. https://link.springer.com/content/pdf/bbm%3A978-3-642-45309-0%2F1.pdf

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/105/106105165/
2. https://www.udemy.com/topic/verilog-hdl-programming/

https://www.udemy.com/course/learn-verilog-programming-with-vivado-design-suit/

Professional Elective 2

Course Title	Automotive Embedded Systems				Course Type		SC	
Course Code	B22ENS521	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in	
	Lecture	3	3	3				
	Tutorial							
	Practice	-	-	-	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The course introduces the general topic of applications of electronics in automobiles. It also elaborates the concepts of various sensors, actuators used in the field, Communication related concepts, Exhaust after treatment systems and Automotive Instrumentation and diagnostics.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the functions of electronic systems in modern automobiles, modern electronics technology to improve the performance, safety, comfort and related issues
2. Study the principles of automotive sensors and interfacing techniques, design, model and simulate interfacing systems with sensors
3. Know the principles and functionalities of various Automotive Communication Protocols (ACPs) and Exhaust after treatment systems.
4. Know the industry standard practices for ECU design for automotives, modeling and analysis of application software for ECU design and development, design of ECUs for automobiles, design of HIL and fault diagnostics

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Design application code using proper language constructs and related coding guidelines for given system specifications.	1,2	1,2,3
CO2	Use efficient software architecture, datatypes, qualifiers, and interrupts to design and architect code.	2,3	1,2
CO3	Analyze memory layout using map files and enhance code performance using code optimization techniques	1,2,3	1,2
CO4	To understand Model-based Design workflow in Automotive Industry.	2,3,7	2
CO5	To familiarize with the Embedded Coder environment.	2,3,4,7	3
CO6	To generate Embedded Code from a Simulink Model	2,3,4,7	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	PSO 1	PSO 2	PSO 3
CO1	1	2											1	2	
CO2		2	3										1	2	
CO3	1	2	3										1	2	
CO4		2	2				1							2	
CO5		2	2				2	1							1
CO6	1	2	3										1	2	1

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1 **Embedded System Overview:** Embedded Systems in Context to Automotive, Embedded System Development Process, Building blocks of Embedded Systems, characteristics of Automotive Embedded Systems, Role of Processors / Microcontrollers in Automotive, Criteria for selecting microcontrollers in Automotive, Concept of Build process of Embedded Application, Debugging Tools.
UNIT - 2 **Introduction to ARM Microcontroller:** Overview of ARM and RISC Design Philosophy, concept of ARM cortex M-series Microcontroller, Advanced Microcontroller Bus Architecture, Introduction to STM32H7xxx Microcontroller – Features, Architecture, Memory Organization, Pin Diagram, and I/O configuration.
UNIT - 3 **Embedded Application Design:** Basic Data Types Arrays, Pointers, Storage classes, Passing Data to Functions Caller vs Callee, Structure and Bitfields, Passing Structure to Functions, Enums and Typedefs, Bit-wise Operators and Macros. Understanding the concept of HAL library and its role in embedded c programming, GPIO programming with external devices (LED, Switch, Motor control) using HAL, Configuring ADC registers, Programming timers and related control registers, applications of timer in time-sharing system, Concept of compare/capture modes, and applications of timers in PWM control, Interrupt programming with Hal – Interrupt priorities. Communication Protocol – UART
UNIT - 4 **Model-Based Design and Code Generation and Simulation-Based Testing:** V-cycle and MBD Workflow, Programming with MATLAB (m-script), Simulink Modelling of Dynamic Systems, Stateflow Modelling, Model Architecture, Data Management The architecture of an embedded application, Introduction to Auto-Code Generation, System specification, generating code, Data structures in generated code, Verification, and Validation in MBD, Simulink-based Testing (Creating Test Harness), verifying generated code.

TEXT BOOKS:

1. Yifeng Zhu, Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C: Third Edition

2. Andrew Sloss, ARM System Developer's Guide: Designing and Optimizing System Software (The Morgan Kaufmann Series in Computer Architecture and Design)

3. Andrew N. SLoss, Dominic Symes, Chris Wright., ARM System Developer's Guide

REFERENCE BOOK:

1.Programming Embedded Systems in C and C++ by Michael Barr and Anthony J. Massa.

2. Programming with STM32: Getting Started with the Nucleo-Board and C/C++ by Donald Norris

Course Resources and Reading Ref:

https://www.udemy.com/course/embedded-systems-bare-metal-programming/ ·

https://www.youtube.com/playlist?list=PL0XvCDGTtp12wpZ9QyFNfsEs3DjJnJMuD ·

https://www.edx.org/course/embedded-systems-essentials-with-arm-getting-started ·

https://www.udemy.com/course/matlab-essentials-for-engineering-and-science-students/ ·

https://www.udemy.com/course/matlabsimulink-biblego-from-zero-to-hero/ ·

https://www.udemy.com/course/model-based-development-mbd-for-automotive-using-simulink/ ·

https//www.udemy.com/course/matlab-simulink-and-stateflow/

https://www.coursera.org/learn/matlab

· https://in.mathworks.com/help/ecoder/ug/generating-code-using-embedded-coder.html

·https://www.mathworks.com/videos/automatic-code-generation-for-embedded-control-systems-106530.html

· Reference E- Book:

· E-book: Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C by Yifeng Zhu.

· E-book: Programming with STM32: Getting Started with the Nucleo-Board and C/C++ by Donald Norris.

· E-book: ARM System Developer's Guide by Andrew N. SLoss, Dominic Symes, Chris Wright.

· E-book: Programming Embedded Systems in C and C++ by Michael Barr and Anthony J. Massa.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

https://nptel.ac.in/courses/108/102/108102121/

<table>
<tr><td>Course Title</td><td colspan="3">Information Theory and Coding</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22ENS522</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>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 Weightag</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 colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</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>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

It is a concept-oriented course, which deals with the measure of information, modelling of information source, source coding and channel coding. This course enables the students to become a master in coding, detecting and correcting error and develops problem-solving skills. The student shall be able to understand and explore the state of art technology such as Viterbi decoding, modelling the source, estimating channel capacity and calculating entropy, etc.

COURSE OBJECTIVES:

The objectives of this course are to

1. Explain fundamental concept of information theory and entropy.
2. Illustrate various source coding techniques.
3. Summarize reliability of data transmission using error-control coding techniques,
4. Develop procedures for designing efficient coding schemes for controlling various types of errors in digital communication system.

COURSE OUTCOMES(COs)

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

O#	Course Outcomes	POs	PSOs
CO1	Solve the information content of dependent and independent sequences.	1,2,3	1,2,3
CO2	Apply Markoff statistical model for Information sources	1,2,3,4	1,2,3
CO3	Illustrate the efficiency and redundancy of information using various source encoding methods.	1,2,3,4	1,2,3
CO4	Develop linear block codes and binary cyclic codes for error detection and	1,2,3,4	1,2,3
CO5	Apply Viterbi and the BCJR Algorithm for communication problems	1,2,3	1,2,3
CO6	Design convolution codes for encoding	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	2	2										1	2	1
CO2	2	2	2	1									1	2	2
CO3	1	2	2	1									1	2	2
CO4	2	2	2	2									1	2	2
CO5	2	2	2										1	2	1

CO6	2	2	2										1	2	1

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

COURSE CONTENT
THEORY:

Contents
Unit-1: Fundamentals of Information Theory **Information Theory:** Measure of Information, Information content of a message, Average information content of symbols in long independent sequences, Properties of Entropy, Average information content of symbols in long dependent sequences, Markoff statistical model for information sources, Entropy and Information rate of Markoff Sources.
Unit-2: Source Coding and Data Compression: Source coding theorem, Prefix coding- Kraft-McMillan inequality theorem, Huffman coding- minimum and maximum variance, Discrete memory less channels-Binary symmetric channel, Mutual information, Properties of mutual information, Shannon-Hartley theorem and its implications, Rate of information Transmission over a Discrete channel.
Unit-3: Linear Block Codes and Binary Cyclic codes Introduction, Examples of error control coding, Methods of controlling errors, Types of errors, types of codes, Linear Block Codes (LBC): Matrix description of LBC, Error detection and Correction capabilities of Linear Block Codes, single error correcting hamming codes, Table Lookup decoding using the standard array. Binary Cyclic codes: Algebraic structure of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome Calculation, Error detection and error correction.
Unit-4: Convolutional Codes and Special Codes Convolutional encoder, Time-Domain Approach, Transform-Domain approach, Code tree, State diagram,, Minimal ,Trellis representation, MLSD and the Viterbi Algorithm and the BCJR Algorithm.

TEXT BOOKS:

1. Simon Haykin “Digital Communication Systems”, Wiley student edition, reprint: 2013. John Wiley & Sons, ISBN: 978-81-265-4231-4.

2. K. Sam Shanmugam, “Digital and Analog Communication Systems” reprint: 2014, by John Wiley & Sons. ISBN: 978-81-265-3680-1

3. Channel Codes: Classical and Modern by William Ryan, Shu Lin.

REFERENCE BOOKS:

1 Ranjan “Bose ITC and Cryptography”, , TMH, II edition, 2007
2. J. Das, S. K. Mullick, P. K. Chatterjee ,”Principles of digital communication”, Wiley, 1986 - Technology & Engineering
3. Bernard Sklar , “Digital Communications – Fundamentals and Applications” , Second Edition, Pearson Education, 2016, ISBN: 9780134724058.

SWAYAM/NPTEL/MOOCs:

1.**https://nptel.ac.in/courses/108/102/108102117/**

2.**https://www.coursera.org/learn/crypto-info-theory**

Course Title	Theory of Algorithms				Course Type		SC	
Course Code	B22ENS523	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Lecture	3	3	3				
	Tutorial							
	Practice	0	0	0	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**		**50%**

COURSE OVERVIEW:

Algorithms are the heart of computer science, and the subject has countless practical applications as well as intellectual depth. This course is an introduction to algorithms for learners with at least a little programming experience. The course is rigorous but emphasizes the big picture and conceptual understanding over low-level implementation and mathematical details. After completing this course, Student will be well-positioned to ace the technical interviews and speak fluently about algorithms with other programmers and computer scientists. Specific topics include: "Big-oh" notation, sorting and searching, divide and conquer, randomized algorithms, data structures, graph primitives.

COURSE OBJECTIVES:

The objectives of this course are:

1.Apply various aspects of Algorithm development of any Engineering challenge.

2.Analyze the Divide – conquer and Decrease-conquer approach for various problems.

3. Summarize Describe Dynamic approach for various engineering problems.

4.Summarize limitations and coping of algorithm power.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply various aspects of Algorithm development of any Engineering challenge.	1,2,3,4,12	1,2
CO2	Develop mathematical analysis for non recursive and recursive algorithms	1,2,3,4,12	1
CO3	Analyze the Divide – conquer and Decrease-conquer approach for various	1,2,4,12	1,2
CO4	Apply Dynamic programming approach to solve engineering problems.	1,2,3,4,12	1,2
CO5	Apply Greedy programming approach to solve engineering problems.	1,2,3,4,12	1,2
CO6	Summarize limitations and coping of algorithm power.	1,2,3,4,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1
Introduction to algorithms Fundamentals of algorithmic problem solving and data structures, Analysis Framework, Asymptotic Notations, Mathematical Analysis of Nonrecursive and Recursive Algorithms, Brute Force Approach: Selection sort, Bubble sort, Sequential search, and String Matching (Programing) Computation of time complexity and space complexity of an algorithm
UNIT - 2
Divide - Conquer and Decrease - Conquer Approach Divide and Conquer: Mergesort, Quicksort, Binary Search; Decrease-and-Conquer Approaches: Insertion Sort, Depth First Search and Breadth First Search. Summary of Space and time tradeoffs (Programing)
UNIT - 3
Dynamic Approach and Greedy technique Dynamic Programming: Warshall's Algorithm, Floyd's Algorithm for the All-Pairs Shortest Paths Problem, Greedy technique:Dijkstra's Algorithm and Huffman trees.
UNIT – 4
Limitations and Coping of Algorithmic Power Limitations and Coping of Algorithmic Power:Lower-Bound Arguments, Decision Trees, P, NP, and NP-Complete Problems, Backtracking, Branch-and-Bound. Computation of time complexity and space complexity of an algorithm.

TEXT BOOKS:

1. Anany Levitin: "Introduction to the Design & Analysis of Algorithms", 2nd Edition, Pearson Education, 2007.

2. Ellis Horowitz, SatrajSahni and Rajasekaran :"Computer Algorithms/C++", 2nd Edition, 2014, Universities Press.

REFERENCE BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein: "Introduction to Algorithms", 3rd Edition, PHI, 2010.

2. Alfred V. Aho , John E. Hopcroft Jeffrey D. Ullman,Addison: "The design and analysis of computer algorithms", Wesley Pub. Co., 1974.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://www.youtube.com/watch?v=STL8ESuETmM
2. https://www.youtube.com/watch?v=5g7K86jYto8
3. https://www.youtube.com/watch?v=M7Wt8rIL6SQ
4. https://www.youtube.com/watch?v=6VF2Q0pgUFI
5. https://www.youtube.com/watch?v=D6xkbGLQesk

Professional Electives 3

Course Title	Semiconductor Fabrication Technology				**Course Type**		**SC**	
Course Code	**B22ENS531**	**Credits**	**4**		**Class**		**V Semester**	
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	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50 %**

COURSE OVERVIEW:

The course is intended to provide students with fundamental knowledge in device and integrated circuits (IC's) fabrication. The class covers the modules of device fabrication (including clean room concept, cleaning procedures, diffusion, lithography, wet processing, dry etching, chemical vapor deposition, sputtering) and process integration to form IC's.

COURSE OBJECTIVES:

The objectives of this course are to:

- Understand Semiconductor Materials and Properties
- Learn Semiconductor Fabrication Processes
- Master Cleanroom Techniques and Safety Protocols
- Analyze Yield and Quality Control in Semiconductor Manufacturing
- Explore Advanced Semiconductor Technologies

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Recognize the basic operation principles of semiconductor fabrication equipment	1,2	1,2,3
CO2	Understand the process modules available in IC fabrication	1,2	1,2,3
CO3	Understand the process of Oxidation and Lithography	1,2	1,2,3
CO4	Familiarize with process of chemical vapor deposition techniques and silicon oxidation	1,2,4	1,2,3
CO5	Appreciate the process of Metal Film Deposition and Plasma and Rapid Thermal Processing for IC fabrication	1,2,4	1,2,3
CO6	Illustrate the annealing process and techniques in semiconductor	1,2,4	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											1	1	1
CO2	3	2											2	1	2
CO3	3	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

Contents
UNIT – 1 **Introduction to Semiconductor material:** Types of solids, the atomic bonding,Imperfections and Impurities in solids **Introduction to IC Technology:** Basic fabrication steps and their Importance. **Environment of IC Technology:** Concepts of Clean room and safety requirements, Concepts of Wafer cleaning processes and wet chemical etching techniques.
UNIT – 2 **Impurity Incorporation:** Solid State diffusion modeling and technology; Ion Implantation modeling, technology and damage annealing, characterization of Impurity profiles **Oxidation:** Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films, Oxidation technologies in VLSI and ULSI, Characterization of oxide films, High k and low k dielectrics for ULSI. **Lithography:** Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI, Mask generation.
UNIT – 3 **Chemical Vapour Deposition Techniques:** CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; **Epitaxial growth of silicon:** modeling and technology.
UNIT – 4 **Metal Film Deposition:** Evaporation and sputtering techniques, Failure mechanisms in metal interconnects Multi-level metallization schemes. **Pasma and Rapid Thermal Processing:** PECVD, Plasma etching and RIE techniques; RTP techniques for annealing, growth and deposition of various films for use in ULSI.

TEXT BOOKS

1. S.M.Sze(2nd Edition)"VLSI Technology", McGraw Hill Companies Inc.

2. C.Y. Chang and S.M.Sze (Ed), **"**ULSI Technology**"**, McGraw Hill Companies Inc.

REFERENCES TEXT BOOKS

1.Stephena, Campbell, **"**The Science and Engineering of Microelectronic Fabrication**"**, Second Edition, Oxford University Press.

2.James D.Plummer, Michael D.Deal, "Silicon VLSI Technology" Pearson Education

3. Semiconductor Physics and Devices: Basic Principles" by Donald A. Neamen, McGraw-Hill

<table>
<tr><td>Course Title</td><td colspan="4">Photonics and Optical Networks</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22ENS532</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">V 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>0</td><td>0</td><td>0</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>0</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

Photonics and Optical Networks explores the transmission, manipulation, and detection of light for communication and sensing applications. This interdisciplinary field integrates physics, engineering, and materials science to develop advanced technologies such as fiber optics, lasers, and photonic devices. Students delve into topics like optical waveguides, modulation techniques, and network architectures crucial for high-speed data transmission over long distances. Practical applications range from telecommunications and data centers to medical imaging and environmental monitoring. The course equips learners with the theoretical foundations and practical skills necessary to innovate in this rapidly evolving domain, pivotal for the future of global communication infrastructure

COURSE OBJECTIVES:

The objectives of this course are to:

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the concept of optical transitions in semiconductor materials	1,2,3	1,2,3
CO2	Explain the theory of propagation of light in planar and cylindrical waveguides	1,2,3	1,2,3
CO3	Describe the formation of modes in a planar optical waveguide	1,2,3	1,2,3
CO4	Study the Transmission characteristics of optical fibers	1,2,3	1,2,3
CO5	Examine the loss mechanisms in optical fibers and to compute various losses	1,2,3	1,2,3

CO6	Familiarize Fabrication and characterization of various optical fibre components	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										1	1	1
CO2	3	2	1										2	1	2
CO3	3	2	2										2	1	2
CO4	3	2	2										2	1	2
CO5	3	2	1										2	1	2
CO6	3	2	2										2	1	2

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1 **Optical properties of semiconductors**- Radiative and non-radiative recombination, band to band recombination, exciton absorption, donor- acceptor and impurity band absorption, long wavelength absorption, Relation between absorption and emission –stokes shift in optical transitions, near band gap transitions, Deep level transitions, Auger recombination, Opto-electronic detectors-Thermal detectors, Photoconductive detectors
UNIT – 2 **Optical waveguides**- numerical aperture, Modes in planar waveguides, Goos-Hanchen effect, evanescent field. Cylindrical fibres. Step index and graded index fibres, single mode and multimode fibres, cut of wavelengths, Integrated Optics, channel waveguides, electro optic waveguides, i/p and o/p couplers, electro-optic network and magneto-optic modulators applications of integrated optics - lenses, grating, spectrum analysers.
UNIT – 3 **Transmission characteristics of optical fibre**- attenuation, absorption and scattering losses, nonlinear losses, wavelengths for communication, bend losses, dispersion effects in optical fibres- material , waveguide dispersions, modal birefringence and polarization maintaining fibres. Nonlinear effects in optical fibres - Self phase modulation, cross phase modulation, stimulated Raman scattering, stimulated Brillouin scattering.
UNIT – 4 **Optical fibre measurements** – Attenuation, loss dispersion band width, refractive index profile. OTDR. Testing of optical fibre systems, eye pattern techniques. Fabrication and characterization of silica,polymer fibres and photonic crystal fibres. Erbium doped fibres. Fibre components – couplers, connectors, Packaging, Splicers, Cable, Fiber joints,

fiber polishing, Industrial, medical and technological applications of optical fibre.

Texbooks

1. Semiconductor optoelectronic devices- Pallab Bhattachraya, PHI, ISBN-978-81203-2047-5 (2009) (Text)
2. Semiconductor optoelectronics- Jasprit singh, Tata Mc Graw Hill (1995) (Text)
3. John M. Senior, "Optical Fiber Communications", Pearson Education, 3rd Edition, 2009
4. Optical Fibre communication systems - J. Gowar, Prentice Hall India (1995)

Reference Books

1. Gerd Keiser "Optical Fiber Communications", TMH, 4th Edition, 2008.
2. D.K. Mynbaev, S.C. Gupta and Lowell L. Schemer, "Fiber Optic Communications", Pearson Education, 2005
3. Fibre optic communication - J. Palais, Prentice Hall India (1988)
4. Fundamentals of Fibre Optic Telecommunication -B. P. Pal., Wiley Eastern (1994)

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/106/108106167/
2. https://nptel.ac.in/courses/117/104/117104127/

<table>
<tr><td>Course Title</td><td colspan="4">Object-Oriented Programming in C++ with Data Structures</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22ENS533</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">V 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>0</td><td>0</td><td>0</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>0</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

The purpose of this course is to provide the solid foundations in the basic concepts of data structures algorithms and C++ programming language. The Data Structures and C++ Programming Language are a very important to develop Application Software, System Software, Operating Systems, and Network Simulators as it employees Object Oriented Programming (OOP) aspect. This course has important features of OOP like Polymorphism, Inheritance which are not present in C Programming Language. Survey of fundamental data structures (array, linked lists, queue, stack) and how to use them in C++. This course then delves deeper into the design, analysis and implementation of such data structures.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Provide insights into the role of programming Languages like C and C++ in design and development.
2. Provide a concise but through introduction to the fundamental concepts of Classes, Objects,

Inheritance and polymorphism in C++.
3. Discuss insights into the basic concepts of data structures and algorithms.
4. Implement basic concepts about arrays, stacks, queues, and linked lists

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain C++ data types and operators	1,2,3	1,2,3
CO2	Explain object-oriented software engineering and Use concept of classes and objects in writing object- based programs	1,2,3,5	1,2,3
CO3	Use the concept of inheritance in writing object-oriented programs.	1,2,3,5	1,2,3
CO4	Identify and classify various types of data structures	1,2,3,5	1,2,3
CO5	Write C++ programs to implement data structures like array, stack, queue, linked list and Trees.	1,2,3,5	1,2,3
CO6	Write C++ program to demonstrate the concept of files	1,2,3,5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents

UNIT – 1 The Basic C++ Language, Concepts of Object-Oriented Programming: The General Form of a C++ Program, Datatypes, Operators, Branching and Looping Statements, Dynamic Memory Allocation. OOP Concepts: Procedure Oriented vs Object-Oriented Programming, Features of Object-Oriented Programming, Class, Object, Data Member, Member Functions NOTE: Demonstration of Simulation of code using standard tools.
UNIT – 2 OOP Concepts and Features: Constructors and its Types, Destructors. Inheritance: Different types of Inheritances, Single Inheritance – Public, Private and Protected. Multiple Inheritance. Polymorphism: Introduction, Compile Time Polymorphism (function overloading) and Run Time Polymorphism (Virtual Functions). Operator Overloading: + operator NOTE: Demonstration of Simulation of code using standard tools.
UNIT – 3 Introduction and Linear Data Structures: Stack & Queues: Introduction to Data Structure: Types of Data Structure, Arrays: Single Dimensional Array and its operations, Stack: Concept, operations, Array Representation of Stack, Applications; Queues: Concept, Operations, Array Representation of Simple Queue, Circular Queue, Applications; NOTE: Demonstration of Simulation of code using standard tools.
UNIT – 4 Linear Data Structure: Linked List Array Vs Linked List, Linked List concept, Operations on Linked List, Types of Linked List, Application of Linked List. Introduction to Trees, Concept of Files. NOTE: Demonstration of Simulation of code using standard tools.

PRACTICE SESSIONS:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1.	a. Write a source code in C++ to generate all even and odd numbers between 1 and N. Value of N should be read at runtime. b. Write a source code in C++ to generate all the prime numbers between 1 to 20.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming Concepts
2.	a. Write a source code in C++ to read an array of size 10 at runtime and to find the largest and smallest number in the array. b. Write a source code in C++ to read an array of size 10 at runtime and to search an element within the array. Use any searching technique.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming Concepts and basic Data Structures.
3.	a) Write a source code in C++ to find the factorial of N using recursive functions. b) Write a source code in C++ to illustrate the concepts of parameter passing techniques in functions using Pass by Value and Pass by reference.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming Concepts
4	Write a source code in C++ to create a datatype “Student” with data members Name, Age and SRN. Perform operations of standard input and output on an object of Student class. Incorporate features of encapsulation and data abstraction.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming and OOP Concepts
5	Write a source code in C++ to create a datatype “Human” with data members Name, Age and Gender. Perform operations of standard input and output on an array of 5 objects. Incorporate features of encapsulation and data abstraction.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming and OOP Concepts

6	a) Write a source code in C++ to illustrate the need for Constructors. b) Write a source code in C++ to illustrate the need for new and delete expression.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming and OOP Concepts
7.	Write a source code in C++ to illustrate the need for a) Single Inheritance b) Multiple Inheritance.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming and OOP Concepts
8.	Write a source code in C++ to illustrate: a) Different types of implementations of Compile Time Polymorphism b) Runtime polymorphism.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming and OOP Concepts
9.	Write a source code in C++ to illustrate the need for overloading the operator "+" to perform addition on multiple data members.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming and OOP Concepts
10.	a) Write a source code in C++ to perform file handling operations. b) Write a source code in C++ illustrate the concept of Exception Handling.	Algorithms/Flowcharts, C++ Source Code, C++ Compiler	Procedural Programming

TEXT BOOKS:

1. Stanley B. Lippmann, JoseeLajore: "C++ Primer", Pearson Education, 4th Edition, 2005
2. Herbert Schildt , "The Complete Reference C++", McGraw-Hill, 4thEdition, 2003.
3.

REFERENCE BOOKS

4. Bjarne Stroustrup, " The C++ Programming Language", Pearson Education, 4th Edition, 2003.
5. R.G.Dromey, "How to Solve it by Computer", Pearson, 2nd Edition, 2015.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. Web: https://www.tutorialspoint.com/cplusplus/index.htm
2. Journal: "A Study of Course Assessment on C++ Programming ", by Spinger.
3. link: https://link.springer.com/chapter/10.1007/978-3-642-35452-6_39

Course Title	**Digital Signal Processing Lab**				**Course Type**		**HC**	
Course Code	B22EN0504	**Credits**	1		**Class**		**V Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in	
	Lecture							
	Tutorial	-	-	-				
	Practice	1	2	2	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
		1	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OBJECTIVES:

The objectives of this course are:

1. Explain the concept of DFT and FFT.

2. Calculate the DFT of a sequence, relate it to the DTFT, and use the DFT to compute the linear convolution of two sequences.
3. Apply the concept of FFT algorithms to compute DFT.
4. Design IIR filter using impulse invariant, bilinear transform.
5. Describe the concept of linear filtering Technique.
6. Demonstrate FIR & IIR filters for digital filter structures.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply DFT for the analysis and interpret the frequency content of Discrete Time Signal	1,2,3,4,5,9,10	1,2,3
CO2	Calculate the Circular Convolution of Discrete Time Signals and verify the properties of DFT	1,2,3,4,5,9,10	1,2,3
CO3	Compare the two signals by computing correlation in time and frequency	1,2,3,4,5,9,1	1,2,3
CO4	Design and analyze IIR and FIR	1,2,3,4,5,9,1	1,2,3
CO5	Integrate CCS studio for real time implementation of DSP Experiments on DSP processor.	1,2,3,4,5,9,10	1,2,3
CO6	Implement the Convolution and DFT computation on DSP processor	1,2,3,4,5,9,1	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

List of Challenging Experiments (Indicative)		
1.	Analysis of continuous time and discrete time signals.	2 hours

2.	Consider a symmetric square wave with frequency 100 Hz. Plot the 4-term,10-term and 25-term Fourier series approximations. Compare the FS approximations with the actual square wave. Observe the approximationbehavior at the points of discontinuity.	2 hours
3.	Study the effects of signal length and windowing on the spectrum of a signal computed with FFT.	2 hours
4.	Plot the frequency response and impulse response of an ideal discrete-time low-pass filter.	2 hours
5.	Generate a sinusoidal signal which contains 50Hz, 70Hz, 100Hz and 120Hz frequencies. Analyse the frequency components present in the signal with and without AWGN for a SNR of 0.6. Obtain the plot and comment on the results.	2 hours
6	Signal processing methods for Music Signals using DSP Processor	2 hours
7.	Signal processing mechanisms for Bio-Signals using DSP processor	2 hours

PRACTICE SESSION:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	Perform the Linear convolution of any two given sequences in time domain.	**MATLab/Octave:**	Design and simulation Working in a team
2	Computation of N point DFT of a given sequence using the definition of DFT and plot magnitude and phase spectrum, and verify using built in function (using FFT).	**MATLab/Octave:**	Design and simulation Working in a team
3	Perform the Circular convolution of two given sequences in time domain.	**MATLab/Octave:**	Design and simulation Working in a team
4	Perform Circular convolution of any two given sequences in frequency domain by using DFT and IDFT.	**MATLab/Octave:**	Design and simulation Working in a team
5	Obtain the Auto correlation and cross correlation of a given sequence and verify its properties.	**MATLab/Octave:**	Design and simulation Working in a team
6	Verification of Sampling theorem.	**MATLab/Octave:**	Design and simulation Working in a team
7	Design of digital Low-pass and High-pass Butterworth IIR filter to meet the given specifications using Bilinear transformations.	**MATLab/Octave:**	Design and simulation Working in a team
8	Design of digital Low-pass and High-pass Chebyshev IIR filter to meet the given specifications using Bilinear transformations.	**MATLab/Octave:**	Design and simulation Design and simulation Working in a team
9	Design of digital Low-pass FIR filter to meet the given specifications using windowing technique.	**MATLab/Octave:**	Design and simulation Working in a team
	List of Experiments using DSP Processor:		

10	Linear convolution of two given sequences.	**DSP Processor and CCS Studio**	Design and simulation Working in a team
11	Circular convolution of two given sequences.	**DSP Processor and CCS Studio**	Design and simulation Working in a team
12	Computation of N-point DFT of a given sequence.	**DSP Processor and CCS Studio**	Design and simulation Working in a team
13	Solving a linear constant coefficient difference equation.	**DSP Processor and CCS Studio**	Design and simulation Working in a team

TEXT BOOKS:

1. Proakis & Monalakis, Digital signal processing – Principles Algorithms & Applications, PHI, 4th Edition, New Delhi, 2007.

REFERENCE BOOKS:

1. Oppenheim & Schaffer, Discrete Time Signal Processing, PHI, 2003.
2. S.K. Mitra, Digital Signal Processing, Tata Mc-Graw Hill, 2nd Edition, 2004.
3. Sanjit K Mitra, Digital signal Laboratory using MATLAB, MGH Edition.2000.
4. Ashok Ambardar, Digital signal processing: A modern Introduction, Cengage Learning, 2009.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. .https://www.youtube.com/watch?v=b-JxoHKv27Ye3
2. https://www.youtube.com/watch?v=5LERZVZGw60
3. https://www.youtube.com/watch?v=Ytn3fhjyxf8
4. https://www.youtube.com/watch?v=KcqJGC-SpMg
5. https://www.youtube.com/watch?v=yqrLro_ueFU
6. https://www.youtube.com/watch?v=lc6QT8VjqVc
7. https://www.youtube.com/watch?v=-10FG_DXRwY
8. https://www.youtube.com/watch?v=3QWvi8EC_DI
9. https://www.youtube.com/watch?v=twbtNKg3hrM&list=PLxWwb-b9LnpA9ycTTqC3f8PpfSLVvBndH

Course Title	**Digital System Design Using Verilog Lab**				**Course Type**		**HC**	
Course Code	B22EN0505	**Credits**	**1**		**Class**		**V Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-				
	Practice	1	2	2	Theory	Practica	**IA**	**SEE**
	-							

						I		
	Total	**1**	**2**	**2**	**-**	**28**	**50 %**	**50%**

COURSE OVERVIEW:

The course will introduce the students to the Verilog hardware description language. It will help them to learn various digital circuit modelling issues using Verilog, and some case studies. Through this course Students will get exposure to design of digital circuits using Verilog HDL targeted to FPGA board using VLSI CAD tools.

COURSE OBJECTIVES:

The objectives of this course are to

1.Understand the Verilog HDL syntax and programming structure

2. Know behavioral and RTL modelling of digital circuits

3. illustrate the design process of Flip flops, Synchronous & Asynchronous Counters

4.To verify and design the digital circuit by means of Computer Aided Engineering tools which involves inprogramming with the help of Verilog HDL on FPGA.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate the FPGA design flow by using XILINX ISE Design suite	1,2,3,4,5	1,2,3
CO2	Describe the simulation and synthesis steps in HDL	1,2,3,4,5	1,2,3
CO3	Develop a Verilog code for combinational and sequential circuits and all basic logic using gate, dataflow, behavioral modeling levels of abstraction.	1,2,3,4,5	1,2,3
CO4	Design and analyze the sequential and combinational logic circuits using Xilinx ISE by using Verilog HDL code.	1,2,3,4,5	1,2,3
CO5	Analyze the synthesis net-list after synthesizing the Verilog code for sequential and combinational circuits	1,2,3,4,5	1,2,3
CO6	Demonstrate the interfacing of seven segment display and DAC with FPGA to control the various operations.	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	2	1	1	3				2	2			1	2	1
CO2	3	3	3	1	3				2	2			3	2	1
CO3	3	3	2	1	3				2	2			3	3	2
CO4	3	3	2	1	3				2	2			3	3	2
CO5	3	3	2	1	3				2	2			3	3	2
CO6	3	3	2	1	3				2	2			3	3	2

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

COURSE CONTENT

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Logic gates	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
2	2 to 4 Decoder, 8 to 3 Encoder	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
3	8 to 1 Multiplexer, 1 to 8 De-multiplexer	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
4	4 bit Binary to Gray converter	Xilinx, Modelism and FPGA board	Design and circuit debugging.Working in a team
5	1bit and 2 bit Comparator	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
6	4 & 32 bit ALU	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
7	D, T, S-R, J-K Flip flop design	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
8	4bit Synchronous reset & Asynchronous reset binary counters	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
9	RTL Description for Newspaper Vending Machine FSM	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
10	Display messages on the 7-segment display	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
11	Generation of square waveform using DAC	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team

TEXT BOOKS:

1.Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, Pearson Education, Second EditionDavid A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.

2.M.D.Ciletti, “Modeling, Synthesis and Rapid Prototyping with the Verilog HDL”, PHI, 1999.

REFERENCE BOOK:

1.J Bhaskar, “A Verilog HDL Primer (3/e)”, Kluwer, 2005.

Course Title	Microcontroller and ARM Processor Applications Lab				Course Type		HC	
Course Code	B22EN0506	Credits	1		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practica	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 for the given application and program them accordingly	1,2,3,5	1,2,3
CO4	Conduct the interfacing experiments, follow experimental procedures, and collaborate with peers to accomplish tasks.	1,2,3,5	1,2,3
CO5	Write the ARM Processor assembly language programs to familiarize data transfer between internal and external memory.	1,2,3,5,9	1,2,3

CO6	Write the ARM Processor assembly language programs to perform data transfer operations.	1,2,3,10	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	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	2	3		3				3				2	2	2
CO6	2	1	2							3			1	1	1

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	Write an ARM ALP to transfer block of data from internal to external memory and vice versa		Python programming
10	Write an ARM ALP to exchange data		Python programming
11	Write an ALP to perform. a. Addition of two 32-bit numbers		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.

Detailed Syllabus
Semester- 6

<table>
<tr><td colspan="2">Course Title</td><td colspan="4">Microwave and Antennas</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td colspan="2">Course Code</td><td>B22EN0601</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
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<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">IA</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 to understand the fundamental principles involved in design, analysis of RF and Microwave Wave guides, Microwave amplifiers and theory behind the working of Microwave passive components like Directional coupler, Magic Tee, cavity resonator and its applications. This course gives perception of Microwave Solid state devices and its applications. This fundamental knowledge on Microwave design helps to explore and apply the techniques in design of RF and Microwave systems.

This course also introduces to understand the principle involved in Radiation mechanism in Antenna, which is a primary component in Wireless communication system. The course defines all related antenna terminologies for evaluation of performance of different structures of antennas and to comprehend the fundamental and advanced topics in Antenna and its properties, which in turn with Communication Engineering designs. After studying this Course the student will be able to develop the analytical skills in designing the antenna and acquaint with the industry requirements in Telecom defense and Space organization regarding antenna design and analysis.

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the structure and the various electrical parameters related to Microwave transmission lines and Wave-guides.
2. Apply the knowledge of microwave theory in distinguishing the applications of Microwave passive and active devices.
3. Understand the Design of Microwave amplifiers, Filters and Microwave Measurements
4. Understand the basic terminologies related to antenna in wireless communication applications
5. Acquainted with design of Micro strip patch antennas and feeding mechanism.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Categorize the features of Microwave waveguides	1,2,3,4	1,2,3
CO2	Identify Microwave passive and active devices for several applications.	1,2,3,4	1,2,3
CO3	Design Microwave amplifiers and Filters	1,2,3,4	
CO4	Describe the process of microwave measurements	1,2,3,4	1,2,3

CO5	Analyze the various performance parameters related to antenna in wireless communication applications	1,2,3,4	1,2, 3
CO6	Analyze The Micro strip patch antenna , Smart Antenna and feeding mechanism	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	3	3	2								2	3	3	1
CO2	3	3	3	2								2	3	3	1
CO3	3	3	3	2								2	3	3	1
CO4	3	3	3	2								2	3	3	1
CO5	3	3	3	2								2	3	3	1
CO6	3	3	3	2								2	3	3	1

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1 **Microwave Wave Guides :** Concept of Mode, TE and TM modes, features of TEM , Rectangular Waveguide Construction, Losses associated with Microwave Transmission**.** **Microwave Passive Components and Active Devices:** Scattering Parameters**,** directional Coupler, E plane TEE, H plane TEE, Power Divider, Magic TEE, cavity resonator, GUNN diode, PIN diode, Parametric amplifier,Reflex klystron oscillator
UNIT – 2 **Microwave Design Principles**: Impedance Matching, Smith chart , Microwave Filter design, Microwave Amplifier Design Microwave low noise amplifier (fundamentals) **Microwave Measurements**: Power , frequency and Impedance measurements at microwave frequency, Network
UNIT – 3 **Antenna fundamental Concepts :** Concept of Radiation, Radiation pattern, Directivity, Gain, Effective aperture, polarization, near and far field regions input impedance, efficiency, Friis transmission Equation illustrative examples

UNIT – 4

Microstrip and Smart Antennas; Basic Characteristics of Microstrip antennas, feeding methods, Methods of analysis, Design of rectangular and Circular patch antenna. Concept and benefits of Smart antennas, fixed weight beam forming basics, Adaptive beam forming.

TEXT BOOKS:

1. John D. Ryder, "Networks, Lines and Fields", PHI, 2009.
2. Samuel Y. Liao, "Microwave Devices and Circuits", Pearson education, 3rd Edition, 2011.
3. Reinhold.Ludwig and Pavel Bretshko 'RF Circuit Design", Pearson Education, Inc., 2006.
4. Constantine Balanis A., "Antenna Theory: Analysis and Design", John Wiley and Sons, 3rd Edition, 2012.
5. John d. Krauss, "Antennas and Wave propagation" McGraw-Hill International 4th Edition, 2010

REFERENCE BOOK:

1. Robert. E.Collin, "Foundation of Microwave Engg" Mc Graw Hill,2001.
2. D.M.Pozar, "Microwave Engineering.", John Wiley & sons, Inc., 2006.
3. John d. Krauss, "Antennas and Wave propagation" McGraw-Hill International 4th Edition, 2010

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES

1.IEEE Transactions on antennas and Propagation
2. IEEE Transactions on Microwave Theory and Techniques
3.IEEE Microwaves and Wireless components letters
4.IEEE antennas and Wireless propagation letters
5.International journal of Antennas and propagation

SWAYAM/NPTEL/MOOCs:

1. **https://onlinecourses.nptel.ac.in/noc20_ee20/**
2. **https://www.coursera.org/learn/microwave-antenna**
3. https://www.classcentral.com/course/rf-mmwave-circuit-design-32152
4. https://www.3ds.com/products-services/simulia/training/course-descriptions/cst-studio-suite-microwave-and-antenna/
5. https://www.colorado.edu/ecee/academics/online-programs/ms-ee-coursera/curriculum/electromagnetics-rf-microwaves-and-remote

Course Title	**Digital Communication**				**Course Type**		**HC**	
Course Code	B22EN0602	**Credits**	3		**Class**		**VI Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**		**0%**	**50%**

COURSE OVERVIEW:

This **course** presents the principles and techniques fundamental to the analysis and design of **digital communication** systems. It focuses on the basic building blocks of a **digital communication** system (channel encoder/decoder, **digital** modulator/demodulator and channel characteristics). It is a concept-oriented course, which deals with the digital signal transmission, reception and procedure of converting analog to digital signal. This course enables the students to become a digital communication engineer and develops problem-solving skills. The student shall be able to understand and explore the state of art technology such as digital video, digital voice, Wireless communication industry etc.

COURSE OBJECTIVES:

The objectives of this course are to

1. Introduce the fundamentals of Sampling, quantization, PCM, DPCM and DM modulation methods.
2. Familiarize with several modulation methods like BASK, BFSK, BPSK, QPSK, DPSK schemes, draw signal space diagrams, and compute spectra of modulated signals.
3. Compute the probability of error for several demodulators, and compare modulation methods based on the error rate and spectral efficiency.
4. Familiarize the optimum receivers used for digital modulation techniques.
5. Present the effect of inter symbol interference in digital transmission and get acquainted with spread spectrum techniques

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the different blocks and its functionalities of various blocks of Digital Communication	1,2,3,4	1,2,3
CO2	Describe the importance of sampling and quantization on signals.	1,2,3,4	1,2,3
CO3	Differentiate PCM, Delta, Adaptive delta modulation techniques.	1,2,3,4	1,2,3
CO4	Compare the performance parameters of different Digital modulation Techniques	1,2,3,4	1,2,3
CO5	Classify different Multiple access schemes based on applications	1,2,3,4	1,2,3
CO6	Interpret the Spread spectrum techniques in digital communication system	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	1	1									1	2	1
CO2	2	3	1	1									3	2	1
CO3	2	2	3	1									2	3	1
CO4	3	3	2	1									3	2	1
CO5	2	2	3	1									2	3	1
CO6	2	2	3										2	3	1

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

COURSE CONTENT

Contents
UNIT – 1
Digital Communication Fundamentals, Sampling and Quantization: Digital communication-advantage, medium of transmission, block diagram of digital communication, Sampling theorem, Natural sampling, Flat top sampling, sample and hold circuit, Quadrature sampling of band pass signal, Pulse Code Modulation, Quantization noise and SNR ,Robust quantization
UNIT - 2
Waveform Coding Techniques: Time division multiplexing, Line coding , Differential pulse code modulation, Delta modulation, Adaptive delta modulation, Coding speech at Low bit rate, Introduction of Delta modulation errors (granular and slope overload).
UNIT – 3
Digital Modulation Techniques: Coherent binary modulation techniques with constellation diagrams-Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Phase Shift Keying, Bit error rate derivation for ASK, FSK,PSK,QPSK, Non-coherent binary modulation techniques-DPSK, correlation receiver, matched filter, detection of signals with unknown phase in noise.
UNIT - 4
Baseband Shaping and Multiple Access Technologies: Synchronization, Inter symbol interference: Nyquists criterion for distortion less base band binary transmission, Eye pattern, Radio broadcasting, Multiple access-TDMA, FDMA, CDMA, Spread spectrum –Pseudo noise sequence, Notion of spread spectrum, DSSS- Direct sequence spread spectrum, FHSS-Frequency Hop spread spectrum, application of spread spectrum.

Text Books:

1. Simon Haykin, "**Digital Communication Systems**", John Wiley publication, 3rd edition, 2008.
2. Simon Haykin, "**Digital and Analog Communication Systems**", John Wiley publication, 3rd edition, 2008.
3. Joachim Speidel **"Introduction to Digital Communication**",Springer publications, 2nd edition, 2018.

REFERENCE BOOKs:

1.K. Sam Shanmugam, "**An introduction to analog and digital Communication system**", John Wiley publication, 3rd edition, 2008.
2.Bernad Sklar, "Digital **Communication**", Pearson education 2007.
3.T L Singal, **"Digital Communication"**, McGraw Hill Education 2015

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

https://www.sciencedirect.com/journal/digital-communications-and-networks
https://www.youtube.com/watch?v=Z0Ylnk8zXRo
https://www.youtube.com/watch?v=Z0Ylnk8zXRo
https://www.youtube.com/watch?v=iQaFDpiNOlA
https://www.youtube.com/watch?v=aKl17gw_nfU
https://www.youtube.com/watch?v=7DoNXi4g_Bg
https://www.youtube.com/watch?v=PFbm-jsTIpA
https://www.youtube.com/watch?v=lCnc8rG1BPc
https://www.youtube.com/watch?v=ZTKDZ6QPMlE
https://www.youtube.com/watch?v=BkThmLtjQpE
https://www.youtube.com/watch?v=MqnzaHsQ90U
https://www.youtube.com/watch?v=PUQMKrtUYz8
6. https://www.colorado.edu/ecee/academics/online-programs/ms-ee-coursera/curriculum/electromagnetics-rf-microwaves-and-remote

<table>
<tr><td>Course Title</td><td colspan="4">CMOS VLSI Circuits</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EN0603</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5"></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">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td>IA</td><td>SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td><td>50 %</td><td>50 %</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td></td><td></td><td></td></tr>
</table>

COURSE OVERVIEW:
The course introduces basic theories and techniques of digital VLSI design using CMOS and its variants. The student will understand how the digital circuits can be integrated into the semiconductor chip (ICs). The students will develop the skills required to become VLSI designers, researchers and design tool builders. The course is conceptual, problematic and application oriented.

COURSE OBJECTIVES:
The objectives of this course are:
1 Understand the characteristics of CMOS circuits.
2 Provide knowledge to design integrated circuits using Computer Aided Design (CAD) Tools.
3 Describe the general steps required for processing of ICs.
4 Design of digital sub blocks of integrated circuits.
5 Introduce the concepts and techniques of modern integrated circuit design and testing.

COURSE OUTCOMES(COs)
On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the steps involved in fabrication of nMOS and pMOS device	1,2,3,5	1,2,3

CO2	Demonstrate the working of CMOS Inverter circuits on the basis of their operation and working	1,2,3,5	1,2,3
CO3	Correlate the electrical properties of various MOS and BICMOS circuits and build the circuits.	1,2,4,5	1,2,3
3CO4	Sketch the physical design/layouts in CMOS and nMOS technology	2,3,4,5	1,2,3
CO5	Design of memories with efficient architectures to calculate and improve access times, power consumption	2,3,4,5	1,2,3
CO6	Apply verification and Testing principles to verify the characteristics of Digital Circuits	1,4,5	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	1	2	3	3	3								1	2	1 3
CO2	1	2	3	3	3								1	2	1
CO3	2	1		3	2								1	2	1
CO4		2	3	1	2								1	2	1 3
CO5		2	3	1	2								1	2	1
CO6	1			2	3								2	1	1

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

COURSE CONTENT

THEORY:

Contents

UNIT - 1

Basic MOS Technology: Moore's law, speed power performance, nMOS fabrication, CMOS fabrication: n-well, pwell processes, BiCMOS, Comparison of bipolar and CMOS.

MOS Transistor Theory: Introduction, MOS Device Design Equations, second order effects, The Complementary CMOS Inverter – DC Voltage Transfer Characteristics, Noise margin. Pass transistors transmission Gate, numerical on pass transistors and TGs, CMOS Tristate Inverter.

.

UNIT - 2

Basic Electrical Properties of MOS And BiCMOS Circuits: nMOS inverter, Determination of pull up to pull down ratio: nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, BiCMOS inverters, latch up. , Pseudo-nMOS logic, Dynamic CMOS logic, clocked CMOS logic, Pass transistor logic, CMOS domino logic cascaded voltage switch logic (CVSL).

Basic Circuit Concepts: Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter delay, super buffers, BiCMOS drivers.

UNIT - 3

MOS Circuit Design Processes: MOS layers, stick diagrams, nMOS design style, CMOS design style Design rules and layout & Scaling of MOS Circuits: λ - based design rules, scaling factors for device parameters.

UNIT - 4

Memory: Timing considerations, Memory elements, Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, JK Flip-flop, D Flip-flop circuits, 4*4 RAM arrays, practical aspects and testability: performance optimization and CAD tools for design and simulation

TEXT BOOKS:

1. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design- a circuits and systems perspective", 2thEdition, Addison-Wesley, 2010.
2. Sung- Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, 3rd Edition, 2007.
3. Douglas A Pucknell, Kamran Eshraghian "Basic VLSI DESIGN" , EEE 3rd Edition
4. Sedra/Smith "Microelectronic circuits", Oxford,, 5th Edition,2007.

REFERENCE BOOK:

1. R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", John Wiley India Pvt. Ltd, 2008.
2. Wayne Wolf, "Modern VLSI Design: System on Silicon", Prentice Hall PTR/Pearson Education, 2 nd Edition, 1998.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. http://www.doe.carleton.ca/~len/477W2003/LectureNotes/January_10_2003.pdf
2. CMOS Inverter Transfer Characteristics, NPTEL courses, https://www.youtube.com/watch?v=fqiYu6IOtmU
3. https://rmd.ac.in/dept/ece/Supporting_Online_%20Materials/6/VLSI/unit1.pdfb) Stick
4.https://www.youtube.com/watch?v=_j-YEdsVV74&list=PL018645397D9487AF
5. https://www.youtube.com/watch?v=KrqyvpU9Cu0
6. https://www.researchgate.net/publication/304532897_MOS_Field-Effect_Transistor_MOSFET

7. http://www.cmosvlsi.com/lect1.pdf

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/117/101/117101058/
2. https://nptel.ac.in/courses/117/101/117101058/
3. https://nptel.ac.in/courses/108/106/108106158/
4. https://nptel.ac.in/courses/117/103/117103125/

Course Title	**Control Engineering**				**Course Type**		**HC Integrated**	
Course Code	**B22EN0604**	**Credits**	**4**		**Class**		**V I Semester**	
Control Engineering	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	1	2	2	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	LTP	**4**	**5**	**5**	**42**	**28**	**50 %**	**50 %**

COURSE OVERVIEW:

This course covers the transfer function modelling and state space modelling of electrical and mechanical system . The dynamic and steady state time domain response system is discussed. This course also covers stability criteria and stability analysis of system by root locus, RH criteria ,Bode plot and Nyquist plot. The state space modelling methods in different canonical form and transformation from transfer function model to state space and vice versa and different methods of calculating state variable and calculating output variable is covered. The concept of controllability and observability and discrete control system design using state space is briefly discussed.

COURSE OBJECTIVES:

The objectives of this course are:

1. Explain modeling of system and to find overall gain of complex system by applying standard reduction technique.
2. Introduce the basic building blocks of digital control systems.
3. Explain time response of first order and second order system and to find system response to test input signals.
4. Explain stability criteria requirement of system in Laplace domain and different stability analysis methods
5. Provide a detailed understanding of state space modelling, analysis and design of discrete control system.

COURSE OUTCOMES(COs)

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

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Model the simple mechanical and electrical systems and analyze using simulation tool	1,2,3,4,5,9,10	1,2

CO2	Find time domain response of system for test input signals analytically and select suitable controller for desired time response and verify the result using simulation tools .	1,2,3,4,5,9,10	1,2
CO3	Determine the stability of system by applying frequency domain analysis method and verify the result using simulation tools.	1,2,3,4,5,9,10	1,2
CO4	Determine the stability of system by applying Time domain analysis method and verify the result using simulation tools.	1,2,3,4,5,9,10	1,2
CO5	Design closed loop state model for given time domain specification and verify the result using simulation tools.	1,2,3,4,5,9,10	1,2
CO6	Analyze the examples designed using state-space method	1,2,3,4,5,9,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT - 1
Modeling of Systems : Modeling and writing Transfer function (Both Electrical & Mechanical), Block Diagram representation, Signal flow graph. Case Study. Introduction to Digital Control System, Case study

UNIT - 2
Time Domain Stability Analysis: Performance of feedback control system, Test input signals, performance of first order, second order system(No derivation), steady state errors. Concept of stability, S-plane Root location, RH Criteria, Relative Stability. Root locus: Introduction to root locus, Procedure and problems, Effect of addition of pole zero to open loop systems. Tuning rules for PID controllers, Computational Approach, Modification schemes, Zero-placement approach to improve response characteristics. Case study .
UNIT - 3
Frequency Domain Stability Analysis: Introduction to Bode plots Performance measurement from Bode plots, problems on Bode plots case study. Introduction to Nyquist criteria, Relative Stability, Comparison (Time domain & frequency domain), Problems on Time domain & frequency domain, case study.
UNIT - 4
State space analysis of Discrete time Systems : Introduction, state space representation of discrete time systems, pulse-transfer function matrix, discretization of continuous-time state space equation, Liapunov Stability analysis, controllability, Observability, useful transformations in state space analysis and design, design via pole placement, servo systems.

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Introduction to Control Systems And Simulation tool.	Simulation tool.	Building of Systems and analysis of Simulated output. Oral & Written communication skill.
2	Time Response analysis of first order system.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.
3	Time Response analysis of second order system.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.
4	Stability Analysis based on Pole position.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.
5	Study and time domain analysis of PID Controllers.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.

6	Stability Analysis of system using Bode Plot.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.
7	Steady State error analysis of control systems.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.
8	Design of feedback controller using Root locus method.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.
9	Stability Analysis of a system using Nyquist Plot.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.
10	Study and analysis of Controller design using State-Space method.	Simulation tool and design equations.	Analysis methods and procedures using Simulation tool. Oral & Written communication skill.

TEXT BOOKS:

1. J. Nagarath and M.Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, Fourth edition – 2005
2. K. Ogata, "Modern Control Engineering ", Pearson Education Asia/ PHI, 4thEdition, 2002
3. K.Ogata, " Discrete-Time Control Systems", Prentice-Hall International/PHI, 2nd Edition,
4. Benjamin C Kuo, "Digital Control System", Oxford University Press, 2nd Edition, 2007

REFERENCE BOOK:

1. W.Bolton, "Instrumentation and control Systems", Addison Wesley Publishing, ISBN: 0 2 -0 1997.
2. Richard Dorf& Robert H Bishop, "Modern Control Systems", Addison Wesley Publishing; ISBN: 0-201-32677-9, 2008.
3. Benjamin C. Kuo and Farid Golnaagi, "Automatic Control Systems", Wiley Student 8 th Edition, 2009. 4. Joseph J Distefano III et al., Schaum'sOutlines, "Feedback and Control System", TMH, 2 nd Edition 2007.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://electronicscoach.com/time-domain-analysis-of-control-system.html#:~:text=Time%20Domain%20Analysis%20of%20Control%20System%20The%20analysis,analyzed%20in%20frequency%20as%20well%20as%20time%20domain.
2. https://www.electrical4u.com/time-domain-analysis-of-control-system/
3. https://www.tutorialspoint.com/control_systems/control_systems_stability_analysis.htm
4. https://edurev.in/studytube/Chapter-5-Stability-Analysis-Of-Control-Systems-No/c11204e3-f86f-4851-bc0c-f2363917ee2a_t
5. https://www.tutorialspoint.com/control_systems/control_systems_construction_root_locus.htm
6. https://electronicscoach.com/bode-plot.html

7. https://www.electrical4u.com/nyquist-plot/
8. https://www.elprocus.com/the-working-of-a-pid-controller/#:~:text=%20Types%20of%20PID%20Controller%20%201%20ON%2FOFF,are%20available%20in%20the%20market.%20These...%20More%20
9. https://electricalacademia.com/control-systems/state-space-representation-and-analysis-state-space-modeling/
10. https://www.sciencedirect.com/topics/engineering/state-space-representation

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://nptel.ac.in/courses/108/107/108107115/
3. https://nptel.ac.in/courses/108/104/108104049/
4. https://nptel.ac.in/courses/108/102/108102097/

Course Title	**Microwaves and Antenna Lab**				**Course Type**		**HC**	
Course Code	B22EN0605	**Credits**	0 1		**Class**		**VI Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	**IA**	**SEE**
	Practica l	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OVERVIEW:

The course introduces basic theories and techniques of Microwave active and passive components, The basic theory and techniques involved in understanding various types of antennas. The student will understand how the performance parameters for microwave components and antennas can be calculated and validated. The students will develop the skills handling high frequency equipment required to become RF Engineers, designers, and searchers .

COURSE OBJECTIVES:

The objectives of this course are:

- Understand the working of Microwave generators like Klystron Tube, GUNN diode and Voltage controlled Oscillators.
- Understand the working of microwave passive components like Directional couplers, Power dividers
- Relate the various parameters of Inverse square law.
- Study the radiation characteristics of different types of antenna.
- Understand frequency scanning and polarization of antennas.

COURSE OUTCOMES(COs)

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

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Demonstrate the frequency characteristics of various microwave sources	1,2,3,4,5,9,10	1,2,3
CO2	Find the different performance parameters of microwave directional	1,2,3,4,5,9,10	1,2,3
CO3	Measure the generated frequency and wave length of Klystron tube, GUNN	1,2,3,4,5,9,10	1,2,3

CO4	Demonstrate Inverse square law	1,2,3,4,5,9,10	1,2,3
CO5	Measure VSWR, Reflection Coefficient of Given antenna.	1,2,3,4,5,9,10	1,2,3
CO6	Measure of Co Polarization and Cross Polarization level of an antenna	1,2,3,4,5,9,10	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	2	2	3	3	2				2	2			1	2	3
CO2	2	2	3	3	2				2	2			1	2	
CO3	2	2	3	3	2				2	2			1	2	
CO4	2	2	3	3	2				2	2			1	2	3
CO5	2	2	3	3	2				2	2			1	2	
CO6	2	2	3	3	2				2	2			2	1	

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

PRACTICE SESSION:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	Identification and study Microwave Components in a microwave bench	Microwave Bench, VSWR meter , CRO Microwave passive and Active components	Identification of Microwave passive and active components
2	Measurement of frequency of microwave source and demonstrate relationship among frequency, free space wave length and guided wave length.	Microwave Bench, VSWR meter , CRO Theoretical concepts, Computing equations	Microwave frequency, power , voltage , VSWR measurements

3	Measurement of insertion loss and isolation loss of directional coupler	Microwave bench, VSWR meter , CRO, Dire tonal coupler, Computing equations	Measurement of S parameters
4	Study of VCO characteristics like Tuning voltage Vs frequency, Frequency Vs power output up to 10GHz	Voltage Controlled Oscillator, Power meter Theoretical concepts, computing equations	Measurement of power and frequency at microwave S band frequency
5	Study the characteristics of GUNN oscillator	Microwave bench, CRO, VSWR meter	Understanding of behavior of microwave active devices and property of negative resistance property
6	Measure the variation of Field Strength/Inverse Square Law.	Microwave source, power meter patch antenna, Theoretical Concepts, computing equations	Prove theoretical concepts practically
7	Measure VSWR, Reflection Coefficient of Given antenna.	Microwave bench, VSWR meters, CRO Theoretical Concepts, computing equations	Measurement of VSWR parameter for different loads
8	Determine Gain, directivity, Band Width of a given Micro strip Patch Antenna	VCO, power meter, Micro strip patch antenna Theoretical Concepts, computing equations	Draw radiation pattern of antenna, measurement of various performance parameters
9	Study frequency scanning of an array antenna	VCO, power meter, Micro strip patch antenna Theoretical Concepts, computing equations	Draw radiation pattern of antenna, measurement of various performance parameters
10	Measure of Co Polarization and Cross Polarization level of an antenna	VCO, power meter, Micro strip patch antenna Theoretical Concepts, computing equations	Draw radiation pattern of antenna, measurement of various performance parameters

TEXT BOOKS:

4. John D. Ryder, “Networks, Lines and Fields”, PHI, 2009.
5. Samuel Y. Liao, “Microwave Devices and Circuits”, Pearson education, 3rd Edition, 2011.
6. Reinhold.Ludwig and Pavel Bretshko ‘RF Circuit Design”, Pearson Education, Inc., 2006.
7. Constantine Balanis A., “Antenna Theory: Analysis and Design”, John Wiley and Sons, 3rd Edition, 2012.
8. John d. Krauss, “Antennas and Wave propagation” McGraw-Hill International 4th Edition, 2010

REFERENCE BOOK:

1.Robert. E.Collin, “Foundation of Microwave Engg” Mc Graw Hill,2001.

2. D.M.Pozar, “Microwave Engineering.”, John Wiley & sons, Inc., 2006.

3.John d. Krauss, “Antennas and Wave propagation” McGraw-Hill International 4th Edition, 2010

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

7. IEEE Transactions on antennas and Propagation
8. IEEE Transactions on Microwave Theory and Techniques
9. IEEE Microwaves and Wireless components letters
10. IEEE antennas and Wireless propagation letters
11. International journal of Antennas and propagation

SWAYAM/NPTEL/MOOCs:

1. **https://onlinecourses.nptel.ac.in/noc20_ee20/**
2. **https://www.coursera.org/learn/microwave-antenna**
3. https://www.classcentral.com/course/rf-mmwave-circuit-design-32152
4. https://www.3ds.com/products-services/simulia/training/course-descriptions/cst-studio-suite-microwave-and-antenna/
5. https://www.colorado.edu/ecee/academics/online-programs/ms-ee-coursera/curriculum/electromagnetics-rf-microwaves-and-remote

<table>
<tr><td>Course Title</td><td colspan="4">Digital Communication Lab</td><td colspan="2">Course Type</td><td colspan="2"></td></tr>
<tr><td>Course Code</td><td>B22EN0606</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">VI 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 Weightag</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</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 aims at providing the concept of designing and testing of various types pulse and Digital modulation, demodulation schemes. Students are conducting experiments on optical fibre kits and measure some performance parameters**.**

COURSE OBJECTIVES:

The objectives of this course are to:

1. Demonstrate the Digital communication experiments.
2. Verify Sampling theorem for different frequencies.
3. Demonstrate different waveform coding techniques.
4. Demonstrate different digital modulation techniques.
5. Demonstrate losses and multiplexing techniques over an OFC.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Conduct experiment to verify Sampling theorem for various sampling	1,2,3,4	2,3
CO2	Test Delta and Adaptive Delta modulation and Demodulation Circuits	1,2,3,4	2,3
CO3	Design and test Time Division Multiplexing circuits	1,2,3,4	2,3
CO4	Design and test ASK,FSK and QPSK signals	1,2,3,4	2,3
CO5	Demonstrate Optical fiber characteristics	1,2,3,4	2,3
CO6	Design and test Pulde CodeModulation and Demodulation	1,2,3,4	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

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

COURSE ARTICULATION MATRIX

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

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	To Study Verification of Sampling Theorem	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
2	To Generate Delta Modulation	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
3	Adaptive Delta Modulation	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
4	Design and test TDM of two band limited Signals	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
5	To Generate ASK generation and verify detection	Measuring instruments (Ammeter,Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
6	FSK generation and detection	Measuring instruments (Ammeter,Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
7	PSK generation and detection	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
8	To Illustrate Line Coding and Decoding	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
9	DPSK generation and detection	Measuring instruments (Ammeter,	Design and circuit debugging.

		Multimeter, CRO) and design equations	Working in a team
10	QPSK generation and detection	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
11	PCM generation and detection using a CODEC chip	Measuring instruments (Ammeter,Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
12	Demonstration of Line codes using LABVIEW software	LABVIEW software	Schematic and simulation
13	Demonstration of ASK,FSK and PSK using LABVIEW / MATLAB Software	LABVIEW/MATLAB	Schematic, simulation, coding

TEXT BOOKS:

1.Simon Haykin, "**Digital Communication Systems**", John Wiley publication, 3rd edition, 2008

2.Simon Haykin, "**Digital and Analog Communication Systems**", John Wiley publication, 3rd edition, 2008.

REFERENCE BOOKS:

1. K. Sam Shanmugam, "**An introduction to analog and digital Communication system**", John Wiley publication, 3rd edition, 2008.

2. Bernad Sklar, "Digital **Communication**", Pearson education 2007.

T L Singal, **"Digital Communication"**,
McGraw Hill Education 2015

Course Title	**CMOS VLSI Circuits lab**				**Course Type**		**HC**	
Course Code	**B22EN0607**	**Credits**	0		**Class**		**VI Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	**IA**	**SEE**
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OVERVIEW:

The course introduces basic theories and techniques of digital VLSI design using CMOS and its variants. The student will understand how the digital circuits can be integrated into the semiconductor chip (ICs). The students will develop the skills required to become VLSI designers, researchers and design tool builders. The course is conceptual, problematic and application oriented.

COURSE OBJECTIVES:

The objectives of this course are:

- Understand the design of sequential and combinational circuit design using Verilog HDL
- Illustrate the power, delay and area estimation of CMOS circuits using CADENCE tool
- Develop the CMOS Digital and Analog circuits using schematic and layout
- Study post layout RC extraction and power analysis process

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop the digital circuits using Verilog HDL and perform Area, power and delay analysis.	1,2,3,4,5	1,2
CO2	Demonstrate the physical design process of Digital Integrated circuits using ASIC Design flow	1,2,3,4,5	1,2
CO3	Design the analog CMOS circuits and explore, analyze the electrical characteristics using CADENCE tool	1,2,3,4,5	1,2
CO4	Develop schematic of various digital and analog CMOS circuits and	1,2,3,4,5	1,2
CO5	Design layout of various digital and analog CMOS circuits and perform various simulations using CADENCE tools	1,2,3,4,5	1,2
CO6	Illustrate the post layout RC and power estimation of CMOS circuits using CADENCE tools	1,2,3,4,5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

PRACTICE SESSION:

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

1	PART A: Write Verilog Code for CMOS Inverter and its Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
2	Write Verilog Code for CMOS Buffer and its Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
3	Write Verilog Code for transmission gate and its Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
	Write Verilog Code for basic/universal gate and its Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
5	Write Verilog Code flip flops-RS,D,JK,MS,T and their Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
6	Write Verilog Code for serial and parallel adder and its Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
7	Write Verilog Code for 4-bit counter (synchronous and asynchronous counter) and its Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
8	Write Verilog Code for adder circuits(full adder cascading to build 4-bit parallel adder-RCA) and its Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.
1	**PART B**: Design the circuit of CSA with given specifications, completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for LVS	Cadence Virtuoso tool	As part of a team effort, design a schematic and conduct analysis.

2	Design the circuit of CDA with given specifications, completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC c. Check for LVS	Cadence Virtuoso tool	As part of a team effort, design a schematic and conduct analysis.
3	Design an op-amp with given specification using given differential amplifier Common source amplifier in library and completing the design flow mentioned below: a. Draw the schematic and verify the following i) DC Analysis ii). AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC	Cadence Virtuoso tool	As part of a team effort, design a schematic and conduct analysis.
4	Design a 4 bit R-2R based DAC for the given specification and completing the design flow mentioned using given op-amp in the library. a. Draw the schematic and verify the following i) DC Analysis ii) AC Analysis iii) Transient Analysis b. Draw the Layout and verify the DRC, ERC	Cadence Virtuoso tool	As part of a team effort, design a schematic and conduct analysis.

TEXT BOOKS:

1. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design- a circuits and systems perspective", 2thEdition, Addison-Wesley, 2010.
2. Sung- Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, 3rd Edition, 2007.
3. Douglas A Pucknell, Kamran Eshraghian "Basic VLSI DESIGN" , EEE 3rd Edition
4. Sedra/Smith "Microelectronic circuits", Oxford,, 5th Edition,2007.

REFERENCE BOOK:

1. R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", John Wiley India Pvt. Ltd, 2008. 2. Wayne Wolf, "Modern VLSI Design: System on Silicon", Prentice Hall PTR/Pearson Education, 2 nd Edition, 1998.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. http://www.doe.carleton.ca/~len/477W2003/LectureNotes/January_10_2003.pdf
2. CMOS Inverter Transfer Characteristics, NPTEL courses, https://www.youtube.com/watch?v=fqiYu6IOtmU
3.https://rmd.ac.in/dept/ece/Supporting_Online_%20Materials/6/VLSI/unit1.pdfb) Stick
4.https://www.youtube.com/watch?v=_j-YEdsVV74&list=PL018645397D9487AF
5.https://www.youtube.com/watch?v=KrqyvpU9Cu0
6. https://www.researchgate.net/publication/304532897_MOS_Field-Effect_Transistor_MOSFET
7. http://www.cmosvlsi.com/lect1.pdf

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/117/101/117101058/
2. https://nptel.ac.in/courses/117/101/117101058/
3. https://nptel.ac.in/courses/108/106/108106158/
4. https://nptel.ac.in/courses/117/103/117103125/

Course Title	Mini Project				Course Type		HC	
Course Code	B22EN0608	Credits	2		Class		VI Semester	
Research based project	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	0	0	0				
	Tutorial	0	-	-	Theory	Practical	CIE	SEE
	Practical	2	4	4				
	Total	**2**	**4**	**4**	**0**	**52**	**50%**	**50%**

COURSE OBJECTIVES:

The objectives of this course are to:

1. Make students to observe research in the real world
2. Make a presentation of research methods and approaches
3. Show experimental procedures and real exercises of computational issues in scientific disciplines.
4. Ask students to read and perform searches from the bibliography of a research paper, analyzing figures, diagrams, tables and simulators presented in the paper
5. Introduce students to a peer review of a research process

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Practice acquired knowledge within the chosen area of technology for project development.	7,8,9,10,11,12	1,2,3,
CO2	Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach	7,8,9,10,11,12	1,2,3,
CO3	Reproduce, improve and refine technical aspects for engineering projects.	7,8,9,10,11,12	1,2,3,
CO4	Work as an individual or in a team in development of technical projects.	7,8,9,10,11,12	1,2,3,
CO5	Communicate and report effectively project related activities and findings	7,8,9,10,11,12	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	✓	✓	✓	✓		
CO3	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		

CO5	✓	✓	✓	✓		
CO6	✓	✓	✓	✓		

COURSE ARTICULATION MATRIX:

Mapping of Course Outcomes with Program Outcomes

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

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

Course Title	**Indian Knowledge System**				**Course Type**		**MC**	
Course Code	B24ED0501	**Credit**	**0**		**Class**		**V/VI semester**	
Course Structure	LTP	Credit	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	-	1	1				
	Tutorial	-	-	-	Theory	Practical	**CIE**	**SEE**
	Practical	-	-	-				
	Total	**-**	**1**	**1**	**16**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The Indian Knowledge Systems comprise of Jnan, Vignan, and Jeevan Darshan that have evolved out of experience, observation, experimentation, and rigorous analysis. This tradition of validating and putting into practice has impacted our education, arts, administration, law, justice, health, manufacturing, and commerce. This has influenced classical and other languages of Bharat, that were transmitted through textual, oral, and artistic traditions. “Knowledge of India” in this sense includes knowledge from ancient India and, its successes and challenges, and a sense of India’s future aspirations specific to education, health, environment and indeed all aspects of life.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To provide a roadmap for systemic study of Indian knowledge system
2. To introduce students to the science and technological advancements related to Indian tradition.
3. To help students understand the Indian architecture, fine arts and agricultural system.

4. To help learners understand India's rich legacies influence on the world heritage

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Gain conceptual understanding of Indian culture and traditions.	6,8,10	
CO2	Appreciate the science and technological advancements in ancient India.	6,8,10	
CO3	Describe various ancient theories related to health, well- being and mindfulness	6,8,10	
CO4	Comprehend the Indian architecture, town planning, art and music.	6,8,10	
CO5	Understand India as a land united by cultural diversity.	6,8,10	

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	✓					

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

COURSE ARTICULATION MATRIX:

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

Contents
. **Introduction to IKS** Bharatavarsha-A Land of Rare Natural Endowments: Largest cultivable area in the world. Protected and nurtured by Himalayas. The Sindhu-Ganga plain and great coastal plains. The great rivers of India-Abundant rains, sunshine and warmth, vegetation, animals and mineral wealth. Most populous country in the world. India's prosperity held the world in thrall. Splendid geographical isolation of India and the uniqueness of Indian culture. Culture – Indus Valley Civilization and early cultural practices, The Vedic culture, Influence of Buddhism and Jainism on Indian Culture, Influence of Islam and Christianity, Indian Cultural Renaissance of the 19th Century Foundational literatures-Vedas, Ramayana, Mahabharata and the Puranas **Contribution of ancient India to Mathematics, Astronomy and Health Science** Development of Science in Ancient India- Mathematics, Astronomy and Health Science. Mathematics- Numbers, fractions and geometry in the Vedas. Decimal nomenclature of numbers in the Vedas Zero and Infinity Simple constructions from Sulba-sutras.Science- Kanad, Varahamihira, Nagarjuna. Important texts of Indian mathematics Brief introduction to the development of algebra, trigonometry and calculus. Astronomy- Ancient records of the observation of the motion of celestial bodies in the Vedic corpus. Sun, Moon, Nakshatra & Graha. Astronomy as the science of determination of time, place and direction by observing the motion of the celestial bodies. The motion of the Sun and Moon. Motion of equinoxes and solstices Elements of Indian calendar systems as followed in different regions of India. Health Science- Vedic foundations of Ayurveda. Ayurveda is concerned both with maintenance of good health and treatment of diseases. Basic concepts of Ayurveda. The three Gunas and Three Doshas, Pancha-mahabhuta and Sapta-dhatu. The importance of Agni (digestion). Six Rasas and their relation to Doshas Ayurvedic view of the cause of diseases. Dinacharya or daily regimen for the maintenance of good health, Ritucharya or seasonal regimen Important Texts of Ayurveda Selected extracts from Astängahrdaya (selections from Sätrasthana) and Susruta-Samhita (sections on plastic surgery, cataract surgery and anal fistula).

TEXT BOOKS:

1. Sundararajan K.R., Hindu Spirituality - Vedas through Vedanta, Cross Road Publications, New York, 1997.
2. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992
3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998
4. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.
5. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018
6. Baladev Upadhyaya, Samskrta Sastrom ka lihas, Chowkhambha, Varanasi, 2010.
7. D. M. Bose, S. N. Sen and B. V Subbarayappa, Eds, A Concise History of Science in India, 2nd Ed. Universities Press, Hyderabad, 2010.
8. Astangahrdaya, Vol 1. Sutrasthana and Sarirasthana, Translated by K. R. Srikantha Murthy.Vol. I, Krishnadas Academy. Varanasi, 1991.
9. Dharampal, Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021.
10. JK. Bajaj and M. D Srinivas, Indian Economy and Polity in Eighteenth century Chengalpattu, in J. K. Bajaj ed., Indian Economy and Polity, Centre for Policy Studies, Chennai, 1995, pp. 63-84.
11.. J. K. Bajaj and M. D Srinivas, Annam Bahu Kurvita Recollecting the Indian Discipline of Growing

and Sharing Food in Plenty, Centre for Policy Studies, Chennai, 1996.

Professional Elective-4

Course Title	VLSI design and verification				Course Type		SC	
Course Code	B22ENS641	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	IA	SEE
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

This course focuses on providing detailed knowledge in VLSI design starting from sequential and combinational design, hardware descriptive languages, verification, implementation. In this process the student will understand the entire logic design process and will be able to take on the challenges posed by the even demanding chip design industry.

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the concepts of combinational circuit design concepts.
2. Understand the concepts of sequential circuit design concepts.
3. Understand the Verilog HDL and operators for Verilog Programming.
4. Understand the Verilog modelling at Programming level.
5. Understand System Verilog Language and Demonstrate How to Build Verification Environment for Performing Verifications of VLSI Circuits.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop the code for combinational circuits using Verilog	1,2,3,12	1,2,
CO2	Design the sequential circuits and code in Verilog	1,2,3,12	1,2,
CO3	Interpret all the operators in verilog and apply it for both combinational and sequential circuits	1,2,3,12	1,2,3
CO4	Construct the code using Tasks and Functions	1,2,3,4,5,12	1,2,
CO5	Analyze and verify its functionality using UVM test bench.	1,2,3,4,5,12	1,2,
CO6	Develop the test bench and verify to specification, code and functionality coverage	1,2,3,4,5,12	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

Unit – 1

Combinational & Sequential Logic Circuit Design : Design, Analysis and synthesis of Combinational Circuits: Encoder, Decoder, Multiplexer, Comparators, simple processor Circuits and their Implementation Using Verilog.

Design, Analysis and synthesis of Sequential circuits: Flip Flops, Shift Registers, Counters and Finite state machines (Mealy and Moore types) and their implementation Using Verilog.

NOTE: Simulation of specific topics to be shown in the class using tools

Unit – 2

System Verilog: Different Data Types, User-Defined and Enumerated Types, String Data Types, Event Data Types, Nets, Reg, Logic, Type Casting, Constants, Attributes.

Array: Packed Array and Unpacked Array, Dynamic, Associate Array, Its Methods, QUEUE Operators and Expressions.

Control Structure: If-Else, Switch, Loop, Tasks, functions, Enhancements to tasks and functions, Task and function argument passing, Import and export functions.

NOTE: Simulation of specific topics to be shown in the class using tools

Unit – 3

System Tasks and System Functions: Combinational Logic, Latch Logic, Sequential Logic, Fork Join (Join, Join_Any, Join_None), Event Controls, Process Control.

UVM Basics: UVM TB Architecture, Creating UVCs and Environment, Creating agent, UVM simulation phases, Test Flow.

NOTE: Simulation of specific topics to be shown in the class using tools

Unit – 4

Creating and Using UVM Testbench: Configuring UVM Environment, UVM Sequences, UVM Sequencers, Connecting DUT-Virtual Interfaces, Virtual Sequences and Sequencers, Transaction Class, Register Abstraction Layer (RAL) model, UVM factory and factory registration.

Use of Verification Components: Test Plan and Coverage, Creating Test Plan from Specification Coverage, Code Coverage and Functional Coverage.

NOTE: Simulation of specific topics to be shown in the class using tools

TEXT BOOKS:

1. Palnitkar, Samir. "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education India, 2003.
2. T2: C. Spear, "System Verilog for verification: A Guide to Learning the Testbench Language Features," Springer Science & Business Media, 2012.
3. Navabi, Zainalabedin, and Yuwen Xia. "Verilog Digital System Design: Register Transfer Level Synthesis, Testbench, and Verification", McGraw-Hill, 2006
4. Mishra, Kishore K. "Advanced chip design: Practical examples in Verilog", Create Space Independent Publishing Platform, 2013.
5. Sutherland, Stuart, Simon Davidmann, and Peter Flake, "SystemVerilog for Design Second Edition: A Guide to Using System Verilog for Hardware Design and Modeling", Springer Science & Business Media, 2006
6. R. Salemi, "The UVM Primer: A Step-By-Step Introduction to The Universal Verification Methodology" Boston Light Press, 2013
7. V.R. Cooper, "Getting Started with UVM: A Beginner's Guide," Austin: Verilab Publishing, 2013
8. H. Height, "A Practical Guide to Adopting The Universal Verification Methodology (UVM)" Lulu. Com, 2010

REFERENCE BOOK:

1. Bhasker, Jayaram. "Verilog HDL Synthesis: A Practical Primer", Star Galaxy Publishing, 2008.
2. Wolf, Wayne. FPGA-Based System Design". Pearson education, 2004.
3. Ciletti, Michael D, "Advanced Digital Design with the Verilog HDL", Vol. 1. Upper Saddle River: Prentice Hall, 2003.

Course Title	**Cryptography and Network Security**				**Course Type**		**SC**	
Course Code	B22ENS642	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Lecture	3	3	3				
	Tutorial							
	Practice	-	-	-	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

It is a concept-oriented course, which deals with principles and practice of cryptography and network security. The course enables student to become master in different encryption techniques such as DES, AES, RSA etc. The student will have knowledge of attacks in distributed system and its counter measures. The student shall be able to explore the state of art technology such as hash functions, authentications, Key management, Key exchange, signature schemes, Transport layer security, web security, etc.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Summarize classical encryption techniques.
2. Explain public key cryptography techniques.
3. Illustrate Hash function, MAC's and Digital signature.

4. Explain various key management technique and transport layer security

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate different types of symmetrical encryption techniques.	1,2,3,4	1,2,3
CO2	Solve different types of public key cryptography.	1,2,3,4	1,2,3
CO3	Understand threats and security mechanisms of Hash function, MAC's and Digital signature.	1,2,3,4	1,2,3
CO4	Demonstration of Secure Hash algorithm.	1,2,3,9	1,2,3
CO5	Analyze the knowledge of key management and transport layer security.	1,2,3,4	1,2,3
CO6	Apply X.509 Certificates to the distribution of Public Keys	1,2,3,4,9	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	3	2	2									1	2	1
CO2	2	3	3	2									1	2	1
CO3	2	2	3	3									1	2	1
CO4	2	2	2						1				1	2	1
CO5	2	3	3	2									1	2	1
CO6	1	2	2	1					1				1	2	1

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

COURSE CONTENT

THEORY:

Contents
Unit-1:
Encryption Techniques & DES: Security attacks and security mechanisms. Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machines, Steganography. Data Encryption Standard (DES): DES encryption and decryption, Strength of DES, Block Cipher design principles.
UNIT - 2
AES and Public-Key Cryptography : AES: Structure, transformation functions, key expansion. Public-Key Cryptography: Principles of public key cryptosystems, RSA Algorithm, Diffie Hellman key exchange, Elgamal cryptographic system, Elliptic curve arithmetic

UNIT - 3
Hash Functions, MACs and Digital Signature: Cryptographic Hash Functions: Two Simple Hash Functions, Requirements and Security, Hash function based on cipher block chaining, Secure Hash Algorithm, Message authentication requirements. Message authentication functions: Requirements of MAC, Security of MACs, MAC based on hash functions: HMAC, Digital Signatures.
UNIT - 4
Key Management and Transport Layer Security Key management: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, distribution of public keys. X.509 Certificates, Transport-layer security**:** Web Security Considerations, Secure Sockets Layer, TLS, HTTPS, Secure Shell(SSH)

TEXT BOOK:

1. William Stallings, "**Cryptography and Network Security, Principles and Practice**", 6th edition, Pearson/Prentice Hall, 2011.

REFERENCE BOOKS:

1. Atul Kahate, "**Cryptography and Network Security**", 2nd edition, Tata McGraw Hill, 2007
2. Eric Maiwald, "**Fundamentals of Network Security**", McGraw-Hill, 2003

Course Title	**Database Management Systems**				**Course Type**		**SC**	
Course Code	B22ENS643	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are:

1. Provide a knowledge of Database architecture
2. Provide students to understand and use a relational database system
3. Introduction to Databases, Conceptual design using ERD,
4. Functional dependencies and Normalization, Relational Algebra are covered in detail.

Students learn how to design and create a good database and use various SQL operations

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Design conceptual entity relationship diagrams for the real world	1,2,3	1,2,3
CO2	Make use of the concepts of relational algebra to solve quarries over	1,2,3	1,2
CO3	Construct the database for given real world application and solve quarries over it using SQL commands.	1,2,3	1,2
CO4	Develop an optimized database using design guidelines and normalization techniques	1,2	1,2
CO5	Construct the physical and logical database designs, database modelling, relational, hierarchical and network models.	1,2,3,4	1,2,3
CO6	Relate conceptual model to relational model and formulate relational algebra quarries.	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	1										1	2	
CO2	2	1	1										3	1	
CO3	2	2	1										3	3	2
CO4	2	2											3	2	
CO5	2	2											3	2	
CO6	2	1	2										3	1	2

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

COURSE CONTENT

THEORY:

Contents
UNIT - 1
Introduction to databases and Conceptual Modelling
Introduction, characteristics of the database approach, data models, schemas, instances, database languages and interfaces, Using high-level conceptual data models for database design, a sample database application, entity types, attributes, keys, relationship types, weak entity types, ER diagrams, naming conventions, design issues.

UNIT - 2

Relational Data Model and Relational algebra

Relational model concepts, relational model constraints and relational database schemas, update operations, transactions, dealing with constraint violations, unary relational operations, select and project, relational algebra operations from set theory, binary relational operations, join and division, additional relational operations, examples of queries in relational algebra

UNIT - 3

SQL

SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, insert, delete, update statements in SQL, additional features of SQL, schema change statements in SQL, Retrieving data using the SQL Select Statement, Restricting and sorting data, Using Single row functions, Joins, More complex SQL retrieval queries, views in SQL.

UNIT - 4

Database Design Theory and Normalization Informal design guidelines for relation schemas, Functional dependencies, and Normal forms based on primary keys, General definitions of second and third normal forms, Other Normal forms.

Transactions and Recovery: The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions. Introduction to recovery, Recovery Concepts, Shadow Paging, The Aries Recovery Algorithm

TEXT BOOKS:

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

REFERENCE BOOK:

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

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/database-management-systems/
2. https://www.udemy.com/course/introduction-to-database-management-systems-dbms/
3. https://onlinecourses.nptel.ac.in/noc21_cs04/preview

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE to Other Departments

Open Elective

Course Title	Consumer Electronics				Course Type		OE	
Course Code	B22ECO501	Credits	3		Class		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 DESCRIPTION:

This course offers a comprehensive exploration of theoretical concepts related to waves, audio systems, television systems, telecommunication systems, and office electronics and home appliances. Through engaging discussions and in-depth analysis, students will develop a strong understanding of the fundamental principles and applications in these areas. By the end of the course, students will be equipped with the knowledge to comprehend and critically evaluate the functioning and characteristics of various electronic systems, enabling them to make informed decisions and effectively communicate within the field.

COURSE OBJECTIVES:

1. To understand the nature and characteristics of mechanical waves.
2. To analyze the working principles of different loudspeakers used in audio systems.
3. To compare the various principles of TV communication
4. To Compare and contrast different telecommunication systems and their characteristics.
5. To develop a comprehensive understanding of electronic systems used in offices and homes.

COURSE OUTCOMES

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify different types of waves and their characteristics.	1,2,3	1,2
CO2	Describe the working principles of various microphones and Loudspeakers	1,2,3	1,2
CO3	Compare different television standards and their applications.	1,2,3,8	1,2
CO4	Demonstrate an understanding of the characteristics and principles of telecommunication systems	1,2,3,10	1,2
CO5	Explain the functionality of various home/office appliances	1,2,3,10	1,2

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

CO4	✓	✓				
CO5	✓	✓				

COURSE ARTICULATION MATRIX

Course Code	POs /Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO1 2	PSO 1	PSO2	PS O 3
	CO1	3	2	1										1	1	
	CO2	3	3	1										2	1	
	CO3	3	3	1					1					2	1	
	CO4	3	2	1							1			1	1	
	CO5	3	3	1							1			1	1	

Contents

UNIT – 1

Introduction Waves: Mechanical Waves, Types of Waves, Longitudinal Waves, Wave Properties.

Audio Systems: Microphones: characteristics of microphones, Carbon microphone, Ribbon microphones, Dynamic microphones and condenser microphones, Hearing aids, loud speakers: crystal, electrostatic, permanent magnet loud speakers, Magnetic recording and reproduction, Optical recording and reproduction.

UNIT – 2

Television Systems: Elements of TV communication system, Monochrome TV standards, aspect ratio, persistence of vision and flicker, picture resolution, scanning process, Color T V: hue, brightness, saturation, luminance and chrominance, video signal bandwidth, color picture tube, Block diagram of a TV receiver, Digital TV's: fundamentals of LCD TV, LED TV, HDTV, and 3D TV. Smart TV

UNIT – 3

Telecommunication Systems: Telecommunication systems: Line and radio system characteristics, Modulation techniques, switching Systems Principles, Uni-selectors and Two Motion Selectors, Fiber optics working principle, Cellular communications, mobile network generations (1G to LTE).

UNIT – 4

Office Electronics and Home Appliances: Xerography, Calculator, Digital clocks, Microcomputers, Automatic Teller Machines, Bar-code scanner, Washing machines: Electronic control for washing machines, Air conditioner: components, features and specifications, Automotive embedded systems.

TEXTBOOK:

1. "**Consumer Electronics**" by Bali S.P, Pearson Education, Latest Edition
2. "**Audio Video Systems" by** Gupta R.G,TMH, Latest Edition.

REFERENCE BOOKS:

1. "Consumer Electronics Handbook" by Jerry C. Whitaker, 2021, Publisher: CRC Press
2. "Introduction to Consumer Electronics Design' by Martin S. Roden,2020, Publisher: Wiley
3. Consumer Electronics Handbook by Jerry C. Whitaker, 2021, CRC press.

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Course Title	Embedded Systems				Course Type	Open Elective	
Course Code	B22ECO502	Credits	3		Class	V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Lecture	3	3	3			
	Tutorial	-	-	-	Theory	IA	SEE
	Practice	-	-	-			
	-	3	3	3	42	50%	50%

COURSE OVERVIEW:

An Embedded system is a computer *system* with a dedicated function within a larger mechanical or electrical *system*, often with real-time computing constraints. It is *embedded* as part of a complete device often including hardware and mechanical parts. *Embedded systems* control many *devices* in common use today. This course introduces to the basic elements of embedded system such as sensors, interfaces, and firmware, discusses about the various aspects of hardware software co design and also covers the aspects of real time embedded system design.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Give a brief idea about the Embedded system, Classification and Major applications of Embedded Systems
2. Understand the various components of embedded systems, Characteristics and Attributes of Embedded Systems.
3. Study the fundamental Issues in Hardware Software Co-Design.
4. Analyze the Embedded System Examples

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Differentiate Embedded Systems and General Computing Systems	1,2,3,4	2,3
CO2	List the applications of Embedded System	1,2,3,4	2,3
CO3	Identify the various components of Embedded System	1,2,3,4	2,3
CO4	Summarize various design approaches in designing of Embedded system	1,2,3,4	2,3
CO5	List the Design issues and techniques in embedded System	1,2,3,4	2,3
CO6	Analyze the working of various Embedded applications developed for commercial and Industrial Applications	1,2,3,4	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								2		2	2
CO2	2	2	2	2								2		2	2
CO3	2	2	2	2								2		2	2
CO4	2	2	2	2								2		2	2
CO5	2	2	2	2								2		2	2
CO6	2	2	2	2								2		2	2

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

COURSE CONTENT

THEORY:

Contents
UNIT - 1
Introduction to Embedded Systems: Embedded system definition, Embedded System vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, The Innovative Bonding of Lifestyle with Embedded Technology.
UNIT - 2
Typical Embedded Systems, Characteristics and Attributes: Core of the Embedded System, Memory, Sensors and Actuators Communication Interface Embedded Firmware, Other System Components. Characteristics of an embedded system, Quality attributes of embedded systems
UNIT - 3
Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language, Hardware Software Trade-offs.
UNIT - 4
Embedded System Application Development: Design issues and techniques Case Study of Washing Machine- Automotive Application- Smart card System Application, Coffee vending machine.

TEXT BOOKS:

1. Shibu K V "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009, ISBN (13): 978-0-07-014589-4.

REFERENCE BOOK:

1. James K Peckol, "Embedded Systems – A contemporary Design Tool" John Weily, 2008.
2. Arnold S. Berger "Embedded Systems Design: An Introduction to Processes, Tools, and Techniques" ISBN: 1578200733 CMP Books © 2002

MOOCS/SWAYAM/NPTEL

https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/108/102/108102045/

Course Title	Basics of Communication Systems				Course Type	OPEN ELECTIVES	
Course Code	B22ECO601	Credits	3		Class	VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Lecture	3	3	3			
	Tutorial	-	-	-	Theory	IA	SEE
	Practice	-	-	-			
	Total	**3**	**3**	**3**	**42**	**50%**	**50%**

COURSE OVERVIEW:

Communication is an electronic media used for transmit the information or message using computers, e-mail, telephone, video calling, FAX machine, etc. This type of communication can be developed by sharing data like images, graphics, sound, pictures, maps, software, and many things. And that data can be converted into an electrical form suitable for transmit a signal; Analog and Digital. After the transmitted signal is prepared, it is passed to the transmission line of the channel. Due to signal crossing this media, it is faced with many impairments like noise, attenuation, and distortion. The process of transferring the information between two points is called communication. The main elements needed to communicate are the transmitter to send the information, the medium to send the information and the receiver to receive the information on the other end.

COURSE OBJECTIVES:

The objectives of this course are:

1. Give a brief idea about communication system,
2. Understand the radio signal propagation, transmitter, and receiver.
3. Gain the knowledge of fundamental of GSM module and architecture.
4. Study the different types of communication for data transfer.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Summarize various communication system.	1,2,3,4	2,3
CO2	List out components of communication architecture.	1,2,3,4	2,3
CO3	Describe radio wave communication and designing techniques.	1,2,3,4	2,3
CO4	Identify importances of mobile communication.	1,2,3,4	2,3
CO5	Differentiate the wireless and wire communication system.	1,2,3,4	2,3
CO6	Identify communication technologies used for different application.	1,2,3,4	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								2		2	2
CO2	2	2	2	2								2		2	2
CO3	2	2	2	2								2		2	2
CO4	2	2	2	2								2		2	2
CO5	2	2	2	2								2		2	2
CO6	2	2	2	2								2		2	2

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
Introduction to Communication: Elements of communication, block diagram of basic communication model, modulation demodulation, analog communication, AM, FM, digital communication, optical communication, optical fibers.
UNIT – 2
Principle of Radio Communication: Basic principle of radio communication, radio waves and radio technology, satellite communication, block diagram of transmitter and receiver, radio communication in various propagation environments, signal loss.
UNIT – 3
Fundamental of Mobile Communication: GSM architecture, protocols, mobile connection establishment, security, AdHoc network, VANET, MANET, GPRS architecture.
UNIT – 4
Data communication: Basics of data communication, wireless and wire communication, types of wireless communication, bluetooth, zigbee, wifi, lora communication, summarize, Data Rate

TEXT BOOKS:

1. Michael Moher Simon Haykin “An Introduction to Analog & Digital Communications”, Wiley; Second edition (1 January 2012).
2. Rappaport “Wireless Communications”, Pearson ISBN: 9788131731864, 8131731863 (2010).

REFERENCE BOOK:

1. K. Sam Shanmugan “Digital and Analog Communication Systems”, Wiley India Pvt Ltd (21 August 2006)

LINK

1. https://www.youtube.com/watch?v=F3slBe2r8vA&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru

Course Title	Sensors and Instrumentation				Course Type		OE	
Course Code	B22ECO602	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Practice	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

This **course** is an essential **introduction** to the variety of **sensors** and transducers and progress gradually covering all fundamental aspects related sensors and ends with intelligent instrumentation and also the topic virtual instrumentation is dealt in depth sense it is highly relevant in today's world.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To make students familiar with the constructions and working principle of different types of **s**ensors and transducers.
2. To make students aware about the measuring **instruments** and the methods of measurement and the use of different transducers.
3. To provide the knowledge about virtual instruments
4. To build an intelligent system for industry automation.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop the applications using displacement, Temperature position, accelerometer, vibration sensor, flow and level.	1,2,3,4	1,2,3
CO2	Develop the applications using accelerometer, vibration sensor and flow and	1,2,3,4	1,2,3
CO3	Demonstrate the use of virtual instrumentation in automation industries.	1,2,3,4	1,2,3
CO4	Identify and use data acquisition methods.	1,2,3,4	1,2,3
CO5	Comprehend intelligent instrumentation in industrial automation.	1,2,3,4	1,2,3
CO6	Develop the simple models of intelligent instrumentation.	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	3	3	2									1	1	2
CO2	3	3	3	2									1	1	2
CO3	3	3	3	2									1	1	2
CO4	3	3	3	2									1	1	2
CO5	3	3	3	2									1	1	2
CO6	3	3	3	2									1	1	2

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
Sensors & Transducer: Classification & selection of sensors, Measurement of displacement using LVDT & Optical Encoder, Measurement of temperature using Thermistor, Thermocouple & RTD. Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.
UNIT – 2
Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.
UNIT – 3
Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.Demonstration of Data Acquisition using LabView software
UNIT – 4
Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

TEXT BOOKS:

1. DVS Murthy, “Transducers and Instrumentation”, PHI 2nd Edition 2013
2. D Patranabis, “Sensors and Transducers”, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta “ PC interfacing for Data Acquisition & Process Control”, 2nd ED Instrument Society of America, 1994.
4. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.

REFERENCE BOOKS:

1. Arun K. Ghosh “ Introduction to measurements and Instrumentation”, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001
3. Hermann K.P. Neubert, “Instrument Transducers” 2nd Edition 2012, Oxford University Press.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. https://courses.p2pu.org/en/courses/3109/content/6858/f
2. https://scholar.google.co.in/scholar?q=wearable+sensors+journal&hl=en&as_sdt=0&as_vis=1&oi=scholart
3. https://journals.lww.com/jcejournal/citation/1978/07000/medical_instrumentation_application_and_design.17.aspx

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2. https://www.mooc-list.com/tags/sensors
3. https://www.coursera.org/learn/internet-of-things-sensing-actuation
4. https://onlinecourses.nptel.ac.in/noc19_ee41/preview
5. https://mooc.es/course/sensors-and-actuators/