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REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

B. TECH IN ELECTRONICS & COMMUNICATION ENGINEERING

HANDBOOK : 2021-25

Rukmini Educational
Charitable Trust

OUR VISION

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

OUR MISSION

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

BROAD OBJECTIVES

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

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university
2. Be regular and punctual to classes
3. Study regularly and submit assignments on time
4. Be respectful to your Teaches/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop andother valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammUNIT - ion etc.
5. Smoking and keeping any kind of such items.
6. Misusing college & hostel premises/facilities for activities other than studies.
7. Playing loud music in the room which may disturb studies of colleagues / neighbours.
8. Making noise and raising slogans.
9. Keeping electrical appliances, other than authorized ones.
10. Involvement in politics, ethnic, sectarian and other undesirable activities.
11. Proxy in any manner.
12. Use of mobiles in the academic areas.

Note: 1. Rules are revised / reviewed as and when required.
2. Healthy suggestions are welcome for betterment of Institution

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

HANDBOOK

B. Tech. in Electronics and Communication Engineering

2021-25

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

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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. The curriculam caters to and has relevence to local, regional, national, global, developmental need. Maximum number of courses are integrated with cross cutting issues with relevant to professional Ethics, Gender, Human values, Environment, and Sustainability.

Dr. Sudarshan K. M

Director

School of Electronics and Communication Engg

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

REVA University Academic Regulations

B. Tech., (4 years) Degree Programs

(Applicable for the programs offered from 2020-21 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 2020-21 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

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 2019-20

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

3. Duration and Medium of Instructions:

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

3.2 The medium of instruction shall be English.

4. Definitions:

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

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

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

Where:

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

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

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

4.2 Classification of Courses

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

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

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

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

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

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

4.2.5 Open Elective Course (OE):

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

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

4.2.7 Project Work / Dissertation:

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

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

5. Eligibility for Admission:

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

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

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

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

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

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

6.3 The credit hours defined as below:

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

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

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

The following table describes credit pattern

Table -2: Credit Pattern

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

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

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

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

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

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

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

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

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

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

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

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

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

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

8.7 Add- on Proficiency Certification:

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

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

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

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

9 Assessment and Evaluation

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

i. Internal Assessment (IA); and

ii. Semester End Examination (SEE)

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

9.3 The 50 marks of internal assessment shall comprise of:

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

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

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

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

- Question paper of the **1st test should be based on first 40 %of the total syllabus**;
- Question paper of the **2nd test should be based on second 40 %of the total syllabus**;
- An assignment must be designed to cover the last **20% of the Syllabus**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4 week online course – 1 credit

8 week online course / MOOC – 2 credits

12 week online course / MOOC – 3 credits

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

Summary of Internal Assessment and Evaluation Schedule

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

10 Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:
a) Knowledge of relevant processes;
b) Skills and operations involved;
c) Results / products including calculation and reporting.

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

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

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

i	Conducting of semester end practical examination	30 marks

ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

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

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

For > 3 credit courses

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

For 1 & 2 credit courses

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

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

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

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

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

13. Requirements to Pass a Course:

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

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

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

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

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

a. Computation of SGPA and CGPA

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

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

Illustration for Computation of SGPA and CGPA

Illustration No. 1

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

Thus, **SGPA = 159 ÷ 19 = 8.37**

Illustration No. 2

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

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

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

Thus**, SGPA = 199 ÷ 24 = 8.29**

b. Cumulative Grade Point Average (CGPA):

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

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

Illustration:

CGPA after Final Semester

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

8	10	9.25	10 x 9.25 =92.50
Cumulative	**160**		**1288.36**

Thus, **CGPA** = $\frac{19\times6.83+21\times7.29+22\times8.11+22\times7.40+22\times8.29+22\times8.58+22\times9.12+10\times9.25}{\mathbf{160}}$ = 8.05

c. **Conversion of grades into percentage:**

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.05 x 10=80.5

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

14. **Classification of Results**

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

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

Overall percentage=10*CGPA

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

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

Attendance Requirement:

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

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

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

15. Re-Registration and Re-Admission:

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

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

16. Absence during Internal Test:

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

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

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

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

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

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

21. Challenge Valuation:

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

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

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

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

B. Tech in Electronics and Communication Engineering
Scheme of Instructions 2020-24 Batch

I SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0102	Calculus and Differential Equations	FC	3	0	0	3	3
2	B20AS0104	Engineering Chemistry	FC	3	0	0	3	3
3	B20CI0101	Introduction to Python Programming	HC	2	0	1	3	4
4	B20EN0101	Principles of Electrical and Electronics	HC	3	0	1	4	5
5	B20ME0103	Elements of Mechanical and Civil Engineering	HC	3	0	0	3	3
TOTAL				**14**	**0**	**2**	**16**	**18**
Practical /Term Work / Sessional								
6	B20AS0109	Biology for Engineers	FC	1	0	0	1	1
7	B20ME0102	Design Thinking	FC	1	0	1	2	3
TOTAL				**2**	**0**	**1**	**3**	**4**
TOTAL SEMESTER CREDITS					**19**			
TOTAL CUMULATIVE CREDITS					**19**			
TOTAL CONTACT HOURS					**22**			

II SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0203	Integral Transforms	FC	4	0	0	4	4
2	B20AS0202	Engineering Physics	FC	3	0	1	4	5
3	B20CS0101	Introduction to Data Science	HC	2	0	1	3	4
4	B20EN0201	Analog Electronics	HC	3	0	1	4	5
TOTAL				**12**	**0**	**3**	**15**	**18**
Practical /Term Work / Sessional								
5	B20EC0101	IoT and Applications	HC	1	0	1	2	3
6	B20ME0104	Entrepreneurship	HC	1	0	0	1	1
7	B20ME0101	Computer Aided Engineering Drawing	HC	2	0	1	3	4
TOTAL				**4**	**0**	**2**	**6**	**8**
TOTAL SEMESTER CREDITS					**21**			
TOTAL CUMULATIVE CREDITS					**40**			
TOTAL CONTACT HOURS					**26**			

III Semester

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0305	Linear Algebra and Partial Differential Equations	FC	3	0	0	3	3
2	B20EN0301	Linear Integrated Circuits	HC	3	0	1	4	5
3	B20EN0302	Digital Electronics	HC	3	0	1	4	5
4	B20EN0303	Network Theory	HC	3	0	0	3	3
5	B20EN0304	Problem Solving Using C Programming	HC	2	0	1	3	4
TOTAL				**14**	**0**	**3**	**17**	**20**
Practical /Term Work / Sessional								
6	B20EN0305	Course Based Project on Linear Integrated Circuits	HC	0	0	1	1	2
7	B20AS0303	Environmental Science	FC	2	0	0	2	2
8	B20MG0301	Management Science	FC	2	0	0	2	2
9	B20AHM301 OR B20AHM302	Advanced Kannada OR Basics of Kannada	MC	0	0	0	0	1
			TOTAL	**4**	**0**	**1**	**5**	**7**
			TOTAL SEMESTER CREDITS		**22**			
			TOTAL CUMULATIVE CREDITS		**62**			
			TOTAL CONTACT HOURS		**26**			

IV Semester

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0402	Probability and Random Process	FC	3	0	0	3	3
2	B20EN0401	Analog Communication	HC	3	0	1	4	5
3	B20EN0402	Electromagnetics and Transmission lines	HC	3	1	0	4	5
4	B20EN0403	Microcontroller and Applications	HC	3	0	1	4	5
5	B20EN0404	Object Oriented Programming and Data Structures using C++	HC	2	0	1	3	4
TOTAL				**14**	**1**	**3**	**18**	**22**
Practical /Term Work / Sessional								
6	B20EN0405	Course Based project on Microcontroller and Applications	HC	0	0	1	1	2
7	B20AH0301	Communication Skills	FC	2	0	0	2	2
8	**B20LS0301**	Indian Constitution and Professional Ethics	FC	2	0	0	2	2
9	B20AHM401	Universal Human Values	MC	0	0	0	0	1
			TOTAL	**4**	**0**	**1**	**5**	**7**
			TOTAL SEMESTER CREDITS		**23**			
			TOTAL CUMULATIVE CREDITS		**85**			
			TOTAL CONTACT HOURS		**29**			

B. Tech in Electronics and Communication Engineering
Scheme of Instructions 2020-24 Batch
Approved Scheme for 2020-24 Batch in BOS-2022

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0501	Digital Communication	HC	3	0	0	3	3
2	B20EN0502	Signals and Systems	HC	3	0	1	4	5
3	B20EN0503	Verilog for FPGA Development	HC	3	0	0	3	3
4	B20ENS5XX	Professional Elective-1	SC	3	0	0	3	3
5	B20ENS5XX	Professional Elective-2	SC	3	0	0	3	3
6	B20XXO5XX	Open Elective-1	OE	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B20EN0504	Digital Communication Lab	HC	0	0	1	1	2
8	B20EN0505	Verilog for FPGA Development Lab	HC	0	0	1	1	2
9	B20EN0506	Technical Documentation	FC	1	0	0	1	1
10	B20EN0507	Research based project	HC	0	0	1	1	2
TOTAL				**1**	**0**	**3**	**4**	**7**
TOTAL SEMESTER CREDITS				**23**				
TOTAL CUMULATIVE CREDITS				**108**				
TOTAL CONTACT HOURS				**27**				

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0601	Control Engineering	HC	3	0	1	4	5
2	B20EN0602	Digital Signal Processing	HC	3	0	0	3	3
3	B20EN0603	Computer Networks	HC	3	0	0	3	3
4	B20EN0604	Computer Architecture and organization	HC	3	0	0	3	3
5	B20ENS6XX	Professional Elective-3	SC	3	0	0	3	3
6	B20XXO6XX	Open Elective-2	OE	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B20EN0605	Digital Signal Processing lab	HC	0	0	1	1	2
8	B20EN0606	Computer Networks Lab	HC	0	0	1	1	2
9	B20EN0607	Mini project/Internship	HC	0	0	2	2	4
10	B20PA0501	Indian Tradition and Culture	FC	1	0	0	1	2
TOTAL				**1**	**0**	**3**	**5**	**8**
TOTAL SEMESTER CREDITS				**24**				
TOTAL CUMULATIVE CREDITS				**132**				
TOTAL CONTACT HOURS				**28**				

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0701	Microwaves and Antenna	HC	3	0	0	3	3
2	B20EN0702	CMOS VLSI Circuits	HC	3	0	0	3	3
3	B20ENS7XX	Professional Elective-4	SC	3	0	0	3	3
4	B20ENS7XX	Professional Elective-5	SC	3	0	0	3	3
5	B20XXO7XX	Open Elective-3	OE	3	0	0	3	3
TOTAL				**15**	**0**		**15**	**15**
Practical /Term Work / Sessional								
6	B20EN0703	Microwaves and Antenna Lab	HC	0	0	1	1	2
7	B20EN0704	CMOS VLSI Circuits Lab	HC	0	0	1	1	2
8	B20EN0705	Major Project Phase – 1	HC	0	0	1	1	2
TOTAL				**0**	**0**	**3**	**3**	**2**
TOTAL SEMESTER CREDITS					**18**			
TOTAL CUMULATIVE CREDITS					**150**			
TOTAL CONTACT HOURS					**21**			

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20XXO8XX	Open Elective-4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessional								
2	B20EN0801	Major Project Phase – 2	HC	0	0	0	7	14
TOTAL				**0**	**0**	**0**	**7**	**14**
TOTAL SEMESTER CREDITS					**10**			
TOTAL CUMULATIVE CREDITS					**160**			
TOTAL CONTACT HOURS					**17**			

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE							
5TH SEM /OE1		**6TH SEM /OE2**		**7TH SEM /OE3**		**8TH SEM /OE4**	
Course code	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**
B20ECO501	PCB Fabrication	B20ECO601	Basics of Communication Systems	B20ECO70 1	Automotive Electronics	B20ECO801	Consumer Electronics
B20ECO502	Embedded Systems	B20ECO602	Sensors and Instrumentation	B20ECO70 2	Robotic Systems	B20ECO802	Healthcare Electronics

	PROFESSIONAL ELECTIVES						
PE	**Course Code**	**Domain1: Electronics**	**Course Code**	**Domain 2:Communication**	**Course Code**	**Domain3: Computers**	
PE-1 / 5TH SEM	B20ENS511	ARM Processors and Applications	B20ENS512	Optical Fiber Communication	B20ENS513	Theory of Algorithms	
PE-2 / 5TH SEM	B20ENS521	Automotive Electronics	B20ENS522	Information Theory and Coding	B20ENS523	Database Management Systems	
PE-3 / 6TH SEM	B20ENS631	Power Electronics	B20ENS632	Cryptography and Network Security	B20ENS633	JAVA Programming	
PE-4/ 7TH SEM	B20ENS741	Analog and Mixed mode VLSI	B20ENS742	Wireless and Multimedia Communication	B20ENS743	Machine Learning	Operating Systems
PE-5 / 7TH SEM	B20ENS751	MEMS and Nano Technology	B20ENS752	RF Communications and Applications	B20ENS753	Web Programming	Compiler Design

Detailed Syllabus
Semester-1

Course Title	Calculus and Differential Equations				Course Type		FC	
Course Code	B20AS0102	Credits	3		Class		I sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

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

COURSE OBJECTIVE:
The objectives of this course are to:
1. Apply the knowledge of differential calculus in the field of wave theory and communication systems
2. Analyse and apply the knowledge of Partial differentiation in the field of Engineering.
3. Understand the knowledge and multiple integrals to determine area, volume, etc.
4. Apply the knowledge of linear differential equations in modeling.

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, 2,3,4,5,6	1, 3
CO2	Analyse and apply the knowledge of Partial differentiation in the field of Engineering.	1, 2,3,4,5,6	1, 3
CO3	Understand the knowledge and multiple integrals to determine area, volume, etc.	1, 2,3,4,5,6	1, 3
CO4	Apply the knowledge of linear differential equations in modeling.	1, 2,3,4,5,6	1, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyse	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	2	1	2	1							3		3
CO2	3	3	2	2	2	2							3		3
CO3	3	3	3	2	1	3							3		3
CO4	3	3	2	2	1	2							3		3

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

COURSE CONTENT
THEORY

Contents
UNIT - 1
Calculus-I Successive differentiation- nth derivatives (no proof and simple problems only), Leibnitz Theorem (without proof) and problems. Mean value theorem theorems-Rolle's theorem (no proof), Lagrange's mean-value theorems, Cauchy's mean-value theorem problems, and mean value theorem of integral calculus (no proof). Taylor's series and McLaurin's series expansion for function of one variable (only problems).
UNIT - 2
Calculus-II Partial Differentiation: Partial derivatives-Euler's theorem-problems, Total derivative and chain rule. Jacobians-definition and problems (only to find J and illustrative example to verify $JJ^{'}=1$). Taylor's Expansion of function of two variables (only problems- up to 2nd order).Maxima and Minima for a function of two variables (simple problems). Lagrange's multiplier method.
UNIT - 3
Calculus-III Reduction formulae for the integrals of $\sin^n x$, $\cos^n x$,$\sin^m x\cos^n x$ and evaluation of these integrals with standard limits(direct result) - Problems. Multiple Integrals – Double integrals, change of order of integration (simple problems), and triple integrals. Beta and Gamma functions, properties, Relation between beta and gamma functions and simple problems.

UNIT - 4

Differential equations

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS:

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

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASED LEARNING

1.	If $z = log(x^2+y^2)\ find\ \frac{\partial z}{\partial x}\ and\ \frac{\partial z}{\partial y}$
2.	If $x + y + z = logz\ find\ \frac{\partial z}{\partial x}\ and\ \frac{\partial z}{\partial y}$
3.	If $u = x^3 - 3xy^2 + x + e^x cosy + 1$, show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$
4.	If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ show that $xu_x + yu_y = 1$
5.	Verify $u_{xy} = u_{yx}$ for the following functions, i. $u = \sin^{-1}(y/x)$ ii. $u = x^y$ iii. $u = log\left(\frac{x^2+y^2}{x+y}\right)$
6.	If $u = log\sqrt{x^2 + y^2 + z^2}$, show that $(x^2 + y^2 + z^2)\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right) = 1$
7.	State and prove Euler's theorem for Homogeneous functions.
8.	If $u = \frac{x^3+y^3}{\sqrt{x+y}}$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{5}{2}u$
9.	If $u = sin^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, show that $xu_x + yu_y = 2tanu$
10.	Find the Jacobian of u, v, w w.r.t x, y, z given $u = x + y + z,\ v = y + z,\ w = z$
11.	If $x = rsin\theta\ cos\varphi,\ \ y = rsin\theta\ sin\varphi,\ \ z = rcos\theta$ show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2 sin\theta$
12.	If $x = rsin\theta\ cos\varphi,\ \ y = rsin\theta\ sin\varphi,\ \ z = rcos\theta$ show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2 sin\theta$
13.	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy\ dy\ dx$
14.	Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y\ dx\ dy$
15.	Evaluate $\iint y$ dxdy over the region bounded by the 1st quadrant of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
16.	Evaluate $\iint xy\ (x + y)$dxdy taken over the area between $y = x^2 and\ y = x$
17.	Evaluate by change of order of integration $\int_0^1 \int_x^1 \frac{x}{\sqrt{x^2+y^2}}\ dy\ dx$

18.	Evaluate by change of order of integration $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y}\, dx\, dy$
19.	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\, dx\, dy$ by changing to polar coordinates.
20.	Evaluate $\int_{-1}^{1} \int_0^{z} \int_{x-z}^{x+z} (x+y+z)$ dx dy dz
21	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz$ dx dy dz
22	Express $\int_0^1 x^m\ (1-x^n)^p dx$ in terms of β function and evaluate $\int_0^1 x^5\ (1-x^3)^{10} dx$
23	Given that $\int_0^\infty \frac{x^{m-1}}{(1+x)}\, dx = \frac{\pi}{\sin m\pi}$ by data. $\Gamma(m)\Gamma(1-m) = \frac{\pi}{\sin m\pi}$ for $0 < m < 1$
24	Solve $\frac{dy}{dx} = e^{3x-2y} + x^2 e^{-2y}$
25	Solve $e^x tany\, dx + (1 - e^{x)}\, dy = 0$
26	Solve $\frac{dy}{dx} = \frac{y}{x-\sqrt{xy}}$
27	Solve i. $y^2 + x^2 \frac{dy}{dx} = xy \frac{dy}{dx}$ ii. $\frac{dy}{dx} = \frac{y}{x} + sin\left(\frac{y}{x}\right)$
28	Solve $(y^3 - 3x^2 y)dx - (x^3 - 3xy^2 dy = 0)$
29	Solve y $e^{xy} dx + (xe^{xy} + 2y)dy = 0$
30	Solve $\left(x^2 + y^2 + x\right)dx + xydy = 0$
31	Solve i. $\left(x^3 + y^2\right)dx - 2xydy = 0$ ii. $\left(x^2 + y^2 + 2x\right)dx + 2ydy = 0$
32	Solve: $\frac{dy}{dx} + y\cot x = \cos x$
33	Solve $\frac{dy}{dx} + 3x^2 y = x^5 e^{x^3}$
34	Solve $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$
35	Solve $x\frac{dy}{dx} + y = x^3 y^6$
36	Solve: $\frac{dy}{dx} + y\cot x = \cos x$
37	Solve $\frac{d^2y}{dx^2} + 10\frac{dy}{dx} + 25y = 0$
38	Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 3y = 0$
39	Solve $\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} + 3\frac{dy}{dx} - y = 0$
40	Solve $\frac{d^2y}{dx^2} - 4y = cosh2x + 3^x$
41	Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 6e^{3x} + 7e^{-2x} - log2$
42	Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 12y = sin2x + e^{-4x}$
43	Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 12y = 2x + x^2$
44	Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 4y = e^x$cosx
45	Solve $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xcosx$
46	Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = e^{2x} - 4$
47	Solve by the method of variation of parameters $(D^2 + 4)y = tan2x$
48	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = e^x tanx$
49	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + y = secx\ tanx$

50	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$
51	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + a^2y = secax$
52	Solve $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = logx$
53	Solve $(1+2x)^2\frac{d^2y}{dx^2} - 2(1+2x)\frac{dy}{dx} - 12y = 6x + 5$
54	Solve $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + 2y = x\sin(logx)$
55	Solve $(1+x)^2\frac{d^2y}{dx^2} + (1+x)\frac{dy}{dx} + y = 2\sin[log[1+x]]$
56	Solve $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = logx\ \sin(logx)$

Course Title	**Engineering Chemistry**				**Course Type**		**FC**	
Course Code	**B20AS0104**	**Credits**	**3**		**Class**		**I sem**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Theory	3	3	3				
	Practice				Theory	Practical	CIE	SEE
	Tutorial							
	Total	**3**	**3**	**3**	**39**	**0**	50%	50%

COURSE OVERVIEW

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

COURSE OBJECTIVE

The objectives of this course are to:

1. Explain the interaction of light and matter, quantum yield and photosensitization
2. Design construction and applications of energy storage and conversion devices
3. Classify the types of Corrosion, corrosion control and metal finishing techniques
4. Discuss the applications of engineering materials like Polymers composite, sensors and Nano material in various fields.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the phenomenon of light and matter interaction , photopolymerization and photosensitization	1.2, 4,6	1
CO2	Discuss the electrode processes in energy storage and energy conversion devices.	1,2,3,4	3

CO3	Apply the knowledge of corrosion science and metal finishing essential for corrosion control and commercially available materials like PCB and circuits	1,2,3,7	1
CO4	Illustrate the properties of nano materials, composite materials, sensors and their applications in various fields.	1,2, 3,7	2

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	√	√		√		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents

UNIT - 1

Light and Matter Interaction

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

UNIT - 2
Clean Energy Storage and Conversion Devices Introduction to electrochemistry, basic concepts of Batteries and characteristics. Classification: Primary (Dry cell, Li-MnO2) and Secondary (Pb-acid, Li-ion) batteries. Super capacitors: classification, construction and applications in hybrid vehicles. Fuel cells: Alkaline fuel cells, Solid oxide fuel cells and phosphoric acid fuel cell. Photo-conversion devices: Photovoltaic cell, antireflective coating, panels and arrays. Production of single crystal semiconductor by Crystal pulling technique (Czochralski technique), zone refining process of Si. **Problems:** Calculation of energy and power density, capacity of a Battery and capacitance of super capacitors for electric vehicle applications.
UNIT - 3
Corrosion and Metal Finishing Electrochemical theory of corrosion, types of Corrosion- differential metal corrosion, differential aeration corrosion, boiler corrosion, and grain boundary corrosion, Corrosion studies on Al, Fe with pourbiax diagram, Factors affecting rate of corrosion-Primary, secondary. Corrosion control: Galvanizing & tinning, cathodic protection & Anodic Protection. **Metal Finishing:** Theory of electroplating, Factors required to study electroplating Effect of plating variables in electroplating process, Electroplating of gold (acid, neutral and alkaline cyanide bath). Electro less plating of copper and PCB manufacture by Electro less plating of copper.
UNIT - 4
Chemistry of Engineering Materials Polymer composites: Carbon fiber, Kevlar synthesis and applications, Conducting polymers: synthesis, electron transport mechanism and applications in poly acetylene and poly aniline. Liquid crystals: Introduction classification and applications in electronic display devices. Nano materials: Introduction, classification based on dimensionality, quantum confinement. Size dependent properties- surface area, magnetic properties (GMR phenomenon), and thermal properties. Synthesis, Properties and applications of Fullerenes, CNT and Graphene. **Sensors:** Physical and chemical sensors, Biosensors for bio electronic applications.

TEXT BOOKS:

B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43^{nd} edition, 2015.

1. R.V.Gadag & Nithyanandashetty, "Engineering Chemistry" , International Publishing house, Third Edition.2009.
2. S.S. Dara and S. Chand, " A Text Book of Engineering Chemistry", S. Chand Publishing house, New Delhi ,1986.
3. R. Venugopal, Pushpa Iyengar, B.S. Jayaprakash and Shivakumariah, "Engineering chemistry", Subhash Publications, Third Edition,2010.

REFERENCE BOOK

1. Mars G. Fontana," Corrosion Engineering", Tata McGrail , Publishing pvt. Ltd, Third Edition,2005.
2. Charles P. Poole Jr., Frank J. Owens ,"Introduction to Nanotechnology", Wiley India Publishers, First Edition,2003.
3. Krishan K Chawla ,"Composite materials – Science and Engineering" , Springer International Edition, Fourth edition, 2019.

JOURNALS/MAGAZINES

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

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASED LEARNING

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

PROJECT BASED LEARNING

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

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

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

COURSE OVERVIEW

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of fundamentals of python programming to solve real world problems.	1 to 4, 8, 9 , 12	1
CO2	Develop solutions for text processing and other application domains by making use of regular expressions.	1 to 3, 5,9,12	1
CO3	Apply features of object oriented and NumPy package to develop computationally intensive applications to analyze and interpret the data.	1 to 5, 9, 12	2
CO4	Create data science solutions with the help of files, Pandas and Data Visualization.	1,4,5,9,12	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	1	1	2				1	1			1	3		
CO2	3	2	3		2				1			1		3	
CO3	3	1	2	1	2				1			1			3
CO4	3			2	2				1			1	3	3	3

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

COURSE CONTENT

THEORY:

Contents

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

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	a). **"LIST1"** is a list that contains **"N"** different SRN of students read using a user defined function with the help of **input() function**. It is required to add SRN of "M" more students that are to be appended or inserted into "**LIST1**" at the appropriate place. The program must return the index of the SRN entered by user.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on list.
	b).**"TUPLE1"** and **"TUPLE2"** are two tuples that contain "N" values of different data types read using the user defined function "**READ**" with the help of **input() function**. Elements of **"TUPLE1"** and **"TUPLE2"** are to be read one at a time and the "larger" value among them should be placed into **"TUPLE3".** Display all tuples.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on Tuples.
2.	a).**SET1** and **SET2** are two sets that contain unique integers. **SET3** is to be created by taking the union or intersection of **SET1** and **SET2** using the user defined function **Operation**(). Perform either union or intersection by reading choice from user. Do not use built in functions union() and intersection() and also the operators "|" and "&".	Windows/Linux OS, IDE, Jupyter	Create and perform Union and Intersection, Operations on Sets.
	b).The Dictionary "**DICT1**" contains **N** Elements and each element in dictionary has the operator as the **KEY** and operand's as **VALUES**. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.

3.	a).A substring “**Substr**” between index1 and index2 is to be extracted from the given input string “**Str1**”, which is read using input(). Display the substring “**Substr**” using a user defined function if available in string “**Str1”**, otherwise display NULL. b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. i) Convert all the strings to uppercase and display ii) Split the words of a string using space as the separation character and display.	Windows/Linux OS, IDE, Jupyter	String operations.
4.	a).Consider the text file, “**Std.txt**”, with the details of students like SRN, NAME, SEMESTER, SECTION AND AVG_MARKS. Read the file, “**Std.txt**” and display the details of all the students of 4th Semester “ A” Section who have scored more than 75%.	Windows/Linux OS, IDE, Jupyter	File Handling.
	b).Consider the text file “**Emp.txt**”, with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: i) TOTAL_DEDUCTIONS= (LIC+PF) ii) GROSS_SALARY= BASIC_SALARY+ DA iii) NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of “**Emp.txt**” and display the details of each employee		File Handling.
5.	a). A “**CAR**” has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for “**CAR**” to store the above attributes and perform the following operations: i) Get the details of “**CAR**” object from user and store into Array of objects ii) Display the details of “**CAR**” object based on “COMPANY”, “MODEL” and “PRICE”. b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for “**Airlilne**” with the above attributes and perform the following operations: i) Get the details of “Airline” object from user and store into Array of objects ii) List details of all the passengers who travelled From “Bengaluru to London”. iii) List details of all the passengers who travelled From “Chicago to Beijing” on 10th of Feb, 2020.	Windows/Linux OS, IDE, Jupyter	Classes and objects usage.
6.	a). “**Arr_1**” is an integer array of size M x N. Size and content of the array is to be read using input() by using the user defined function READ_DATA(). It is required to display the i) Diagonal elements of ”**Arr_1**” ii) Elements of m^{th} row (row no should be entered by user) iii) Elements of n^{th} column (column no should be entered by user)	Windows/Linux OS, IDE, Jupyter	NumPy arrays usability.

	b).The dictionary "**DICT1**" contains the pass percentage of each semester of B. Tech in CSE, where, " Semester" acts as the key and "Pass Percentage" acts as the value. A Python Pandas dataframe is required to be created using the dictionary "**DICT1**" and display it using a user defined function.		Pandas Series usability.
	Part-B (Mini Project: Library Management System)		
1.	Develop a program to create the **class "USER"** with the attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add_user(), delete_user(), edit_user(), search_user() should be part of the class. Instantiate "User" class with 10 objects. Read the attributes of each "User" object using input() and store them in the file "**User_File.txt**".	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes of user and store them in a file.
2	Develop a program to get the name of the "User" object whose details are to be deleted. Read the "**User_File.txt**" and delete the "User" object if found. Display the contents of "**User_File.txt**" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes and delete the object.
3	Develop a program to get the name of the **"User"** object whose details are to be edited (modified). Edit the details of the user object in the file "**User_File.txt**" and display the contents after modification**.**	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
4	Develop a program to create the **class "BOOK"** with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add_book(), delete_book(), edit_book() and search_book(). Instantiate "Book" class with 10 objects. Read the attributes of each "**BOOK**" object using input () and store them in the file "**Book_File.txt**".	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes of user and store them in a file.
5	Develop a program to get the name of the "**BOOK**" object whose details are to be deleted. Read the "**Book_File.txt**" and delete the "**BOOK**" object whose details match with the data entered. Display the contents of "**Book_File.txt**" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes and delete the object.
6	Develop a program to get the name of the **"BOOK"** object whose details are to be edited (modified). Edit the details of the "**Book**" object in the file "**Book_File.txt**" and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
7	Develop a program to create the class **"TRANSACTION"** with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue_book(), return_book() and search_book(). Instantiate "Transaction" class with 10 objects. Read the attributes of each "Transaction" object using input() and store them in the file "**TransactionFile.txt**". Develop a program to **issue the book** as requested by the user. Update the attributes in "Transaction _File" and display the contents of file.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operations.
8	Develop a program to **return the book**. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in "**TransactionFile.txt**" and display the contents after modification. Compute the fine amount to be paid if return_date is not same as due_date. If both return_date and due_date are same and put zero in fine_amount.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operation.

9	Develop a program to search for a book using its **"author"**. Display the message **"available"** if search is successful otherwise display the message "not available".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
10	Develop a program to get a **list of users** by referring to "**User_File.txt" and "Transaction_File.txt".**	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
11	Develop a program to get **List of Books in stock** by referring to "**Book_File.txt" and "Transaction_File.txt".**	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
12	Develop a program to get **List of Books Issued** by referring to "**User_File", "Book_File" and "Transaction_File".**	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
13	Develop a project by integrating User, Books, Transaction and Reports Modules.	Windows/Linux OS, IDE, Jupyter	Module integration and project development.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES

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

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNING EXERCISES:

a) Explore PYTHON library for IOT programming
b) More exploration on GIThub

c) Data Visualization packages
d) C modules interface

Course Title	Principles of Electrical and Electronics				Course Type		HC Integrated	
Course Code	B20EN0101	Credits	4		Class		I Semester	
Principles of Electrical and Electronics	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	**CIE**	**SEE**
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50 %**	**50 %**

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

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

COURSE OUTCOMES(COs)
On successful completion of this course; the student shall be able to:

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Basics of Electrical Engineering :** Introduction to electrical engineering, AC, Sinusoidal voltage and currents, Magnitude and phase, polar and rectangular representation R-L, R-C and R-L-C series and parallel circuits(both admittance and impedance method), power factor, phasor diagrams(lead and lag circuits), Kirchhoff's Current Law, Kirchhoff's Voltage law, Mesh and Nodal analysis, Source transformation, Star-delta transformation (for DC Circuits only).
UNIT - 2 **Magnetic Circuits, Motors and Transformers:** Definition of magnetic circuit and basic analogy between electric and magnetic circuits, Faradays laws, permittivity, permeability, EMF, MMF equations, Reluctance, Energy and power, 3 phase AC (introduction), Comparison between 1 phase and 3 phase AC. Principle of operation, Construction and EMF equations: DC Generator, DC Motors, Transformers, types of transformer. Numerical examples as applicable.

UNIT - 3
Semiconductor Diodes and Transistors: P-N junction diode, V-I Characteristics, Half-wave rectifier, Full-wave rectifier, Bridge rectifier, Capacitor filter circuit, Zener diode voltage regulators, Clipping and clamping circuit, Numerical examples as applicable. Bipolar junction Transistors BJT configuration: BJT Operation, Common Base, Common Emitter and Common Collector Characteristics, Numerical examples as applicable, SCR, Introduction to FETs.
UNIT - 4
Digital Electronics and Number Systems: Introduction, Switching and Logic Levels, Digital Waveform. Number Systems and its conversions: Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System. Binary addition, Binary subtraction. Boolean Algebra Theorems, De Morgan's theorem. Digital Circuits: Logic gates, Algebraic Simplification, Realization of all logic and Boolean expressions

PRACTICE SESSION:

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

TEXT BOOKS:

1. Kulshreshtha C,"Basic Electrical Engineering" Tata McGraw Hill, 2nd Edition, 2011.

2. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
3. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.

REFERENCE BOOK:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

SWAYAM/NPTEL/MOOCs:

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

<table>
<tr><td>Course Title</td><td colspan="4">ELEMENTS OF MECHANICAL ENGINEERING AND CIVIL ENGINEERING</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20ME0103</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVE:

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the fundamentals of IC engines, refrigeration-air conditioning and power transmission systems.	1,2	3
CO2	Explain the manufacturing processes using lathe, drilling, welding, CNC machines and 3D printing technology	1,2	3
CO3	Explain the basics of Civil Engineering and concepts of idealization.	1,2	1,2
C04	Comprehend the action of forces and compute the numerical problems	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO3	3	3											3	2	
C04	3	3											2	2	

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

COURSE CONTENTS
THEORY

Contents
UNIT – 1 **Introduction to Mechanical Engineering:** Overview of Mechanical Engineering, Importance and applications of Mechanical Engineering in different fields. **Thermal Energy Systems:** Introduction to IC Engines, Classification, parts of IC Engine, working of 4-stroke Petrol engine with PV-diagram. Simple numerical on calculation of IP, BP and Mechanical efficiency, Introduction to refrigeration system, working of vapour compression refrigeration and window spit air conditioning system. Applications of refrigeration systems
UNIT – 2 **Power Transmission System:** Introduction to drives, classification, belt drives (open and crossed-No derivations) and gear drives and types of gear, Numerical on gear drives. **Mechanical Machine Tools:** Introduction- lathe, classification, major parts of engine lathe, operations, Drilling machine, classification working bench drilling machine and operations, CNC Machines-Block diagram and applications. Introduction to 3D Printing technology **Joining processes**-Welding: Working of electric arc welding and soldering, Differences between welding and soldering, Applications and safety tools
UNIT – 3 **Introduction to Civil Engineering:** Scope of Civil Engineering, Types of Infrastructure, Effect of Infrastructure facilities, Role of Civil Engineers in the Infrastructure and Economic Development of Country. **Introduction to Engineering Mechanics:** Basic concepts of idealization, Newton laws of Motion, Elements of force, system of forces, principles of physical Independence, superposition and Transmissibility of forces. Moment of force –Couple, Moment of couple and its characteristics, Equivalent Force – Couple system.
UNIT – 4 **Equilibrium of Forces:** Types of forces acting on the body, free body diagrams, Equations of Equilibrium, Resolution and composition of forces, Lami's theorem. **Coplanar Concurrent Force System:** Parallelogram Law of forces, principle of resolved parts, composition of concurrent forces, Resultant of Concurrent forces, Equilibrium of Concurrent Coplanar Force System- Simple Numerical. **Coplanar Non – concurrent Force System:** Varignon's principle of Moments, Resultant of Non – Concurrent force systems, Equilibrium of Non – concurrent Coplanar force system - Simple Numerical. **Support Reaction and Basics:** Types of loads, supports and beams, Basic concepts of Friction, Centroid and Moment of Inertia.

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

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

4. B C Punmia, “Elements of Civil Engineering”, Laxmi publications

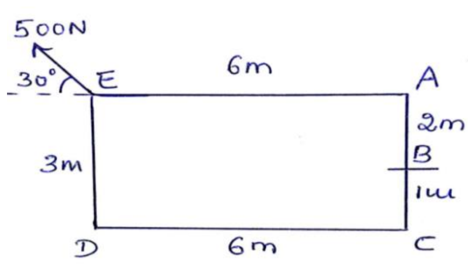
JOURNALS/MAGAZINES

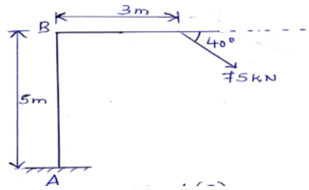
1. International Journal of Machine Tools and Manufacture
2. International Journal of Refrigeration.
3. Civil Engineering and Construction Review-Magazine

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASED LEARNING

Sl. No.	Problem
1	4 Cylinder, four stroke petrol engine of Volkswagen Polo has a piston diameter 300 mm and stroke 500 mm . The mean effective pressure is 8 bar and speed is 350 rpm. The net load on the brake drum is 1080 N The effective diameter of the brake 1.5 m. Find I.P, B.P, and mechanical efficiency
2	A Toyota FORTUNER car having 4 stroke and 4 cylinder running at 450 rpm, has bore diameter 100 mm and stroke length 120mm. The details of the indicator diagram are as follows. Area of indicator diagram = 4 cm^2 Length of the indicator diagram = 6.5 cm, and the spring value of the spring used is 10 bar/cm. Calculate the indicated power.
3	A TATA Zest car having four stroke petrol engine has a piston diameter 300 mm and stroke 500 mm. The mean effective pressure is 5 bar and speed is 250 rpm. The net load on the brake drum is 1000 N The effective diameter of the brake 1.5 m. Find I.P, B.P, and mechanical efficiency
4	KIA Carnival engine has the following details i. Number Cylinder = 8 ii. Cylinder diameter = 25 cm iii. Stroke of the piston = 40 cm iv. Crankshaft speed = 250 rpm v. Brake load = 70 kg vi. Brake drum diameter = 2 m vii. Mean effective pressure = 6 bar Calculate (i) I.P (ii) B.P (iii) Mechanical Efficiency
5	Find the moment of 500N force about points A,B,C and D as shown in fig 
6	Determine the magnitude, X and Y intercepts to the resultant of the force system acting on the laminar.
7	Find the X and Y intercepts of the resultant of the system of coplanar forces acting on the laminar. Each square has a side of 10mm

Sl. No.	Problem
8	Find the moment about A and B as shown in fig 

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

Sl. No.	Suggested Projects
1.	Demo Model for 4-Stroke Petrol Engines
2.	Preparation of metallic Shoe stand using electric ARC welding
3.	Illustrate the road network connection on Indian map
4.	Demo Model of different types of beams

<table>
<tr><td>Course Title</td><td colspan="4">BIOLOGY FOR ENGINEERS</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B20AS0109</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">I sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>13</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

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

COURSE OBJECTIVES

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

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

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	√	√	√			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES

Current Sciences

SWAYAM/NPTEL/MOOCs:

https://onlinecourses.nptel.ac.in/noc19_ge31/preview

Coursera: Biology everywhere

PROBLEM BASED LEARNING

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

<table>
<tr><td>Course Title</td><td colspan="4">DESIGN THINKING</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B20ME0102</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Design Thinking</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>3</td><td>3</td><td>13</td><td>26</td><td>50%</td><td>50 %</td></tr>
</table>

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	1, 2
CO2	Create empathy maps to visualize user attitudes and Develop innovative products or services for a customer base using ideation techniques	1,2,9,10, 12	2
CO3	Build simple prototypes for problems using gathered user requirements.	1,3, 9, 10, 12	1,2
CO4	Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.	1,4,8,9,10,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO3	2		3						3	3		2	2	3	
CO4	2			2				1	3	2		2	2	3	

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

COURSE CONTENTS:

THEORY:

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

PRACTICE SESSION:

Sl. No	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Identifying the problem that can be solved using Design Thinking approach	Observation and survey	Develop identifying human centered problems
2	Build the empathy maps for simple problems like single user	Visualization	Develop ability to understand other's emotions
3	Build the detailed empathy maps for problem identified in the teams formed	Visualization	Develop ability to understand other's emotions
4	Presentation by student teams	PPT	Develop ability to express their views
5	Obtain the insights into user's problems and make PoV statement	Understanding	Develop making problem statements from user perception
6	Presentation by student teams	PPT	Develop ability to express their views
7	Carry out Brain storming between the groups and generate as many as ideas possible	Ideation tools	Develop innovative mind set

8	Prototype for best 3 ideas selected	Sketching, simple model making etc	Develop prototyping techniques
9	Presentation by student teams	PPT	Develop ability to express their plan
10	Test the developed prototype with set of identified users	Google forms , cold calls, social media etc.	Develop understanding of various testing methods
11	Pitching final solution	PPT	Develop ability to express their views

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES/ADDITIONAL SOURCES

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

SWAYAM/NPTEL/MOOCs:

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

Detailed Syllabus

Title	Integral Transforms				Course Type		FC	
Course Code	B20AS0203	Credits	4		Class		II sem	
Course			Contact	Work	Total Number of Classes		Assessment Weightage	
	Theory	4	4	4				
	Practice	-	-	-	Theory	Practical	**CIE**	**SEE**
	Tutorial	-	-	-				
	Total	4	4	4	52	0	50%	50%

COURSE OVERVIEW:

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

COURSE OBJECTIVES

The objectives of this course are to:
1. Apply the knowledge of Laplace transformation from the time domain to the frequency domain

2. familiarization of Fourier series and their applications and be notionally aware of their convergence.

3. Analyze the spectral characteristics of signals using Fourier analysis

4. Apply the knowledge of Z-transform in the areas like signal processing, control engineering etc.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of Laplace transformation from the time domain to the frequency domain, which transforms differential equations into algebraic equations and convolution into multiplication	1,2,3,4,5,6	1,2,3
CO2	Interpret Fourier series and their applications and be notionally aware of their convergence.	1,2,3,4,5,6	1,2,3
CO3	Analyze the spectral characteristics of signals using Fourier analysis.	1,2,3,4,5,6	1,2,3
CO4	Apply the knowledge of Z-transform in the areas like signal processing, control engineering etc.	1,2,3,4,5,6	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	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	3	2	1	2							3	3	2
CO2	3	3	3	2	1	2							3	3	2
CO3	3	3	3	2	1	2							3	3	3
CO4	3	3	3	2	1	2							3	3	2

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. B. V Raman "Higher Engineering Mathematics" by TMH publisher

2. E. Kreyszig "Advanced Engineering Mathematics" Johnwilley &SonsInc 8th Edition

REFERENCE BOOKS:

1. P.V. O'Neil " Advanced Engineering Mathematics" Thomson publisher

2. Potter & Goldberg "Mathematical Methods": PHI. publisher

JOURNALS/MAGAZINES

https://www.researchgate.net/publication/323218108_A_review_on_applications_of_laplace_transformations_in_various_fields

https://www.researchgate.net/journal/1069-5869_Journal_of_Fourier_Analysis_and_Applications

SWAYAM/NPTEL/MOOCs:

https://nptel.ac.in/courses/111/106/111106139/

https://nptel.ac.in/courses/111/106/111106111/

https://nptel.ac.in/courses/111/106/111106111/

PROBLEM BASED LEARNING:

1.	Find the Laplace transform of $f(t) = \begin{cases} t, & 0 < t < 4 \\ 5, & t > 4 \end{cases}$
2.	Find the Laplace transform of $f(t) = \begin{cases} sin2t, & 0 < t < \pi \\ 0, & t > \pi \end{cases}$
3.	Show that $\int_0^\infty t^3 e^{-t} sint\, dt = 0$

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

20.	Obtain the Fourier series for the function $f(x) = x$ in the interval$(-3,3)$.
21	Obtain the Fourier series expansion for the function $f(x) = \begin{cases} 1+2x & in \quad -3 < x < 0 \\ 1-2x & in \quad 0 < x < 3 \end{cases}$
22	Obtain the Fourier series for the function $f(x) = 2x - x^2$ in the interval$(0,3)$.
23	Obtain the sine half range Fourier series of $f(x) = x^2$ in $0 < x < \pi$
24	Find a cosine series for $f(x) = (x-1)^2$, $0 \le x \le 1$.
25	Find the complex Fourier transform of the function $f(x) = \begin{cases} 1, & for \quad \lvert x \rvert \le a \\ 0, & for \quad \lvert x \rvert > a \end{cases}$ Hence evaluate $\int_0^\infty \frac{sin\,x}{x} dx$
26	Find the complex Fourier transform of the function $f(x) = \begin{cases} x, & for \quad \lvert x \rvert \le \alpha \\ 0, & for \quad \lvert x \rvert > \alpha \end{cases}$ where α is a positive constant.
27	Find the inverse Fourier sine transform of $\hat{f}_s(\alpha) = \frac{1}{\alpha} e^{-a\alpha}$, $a > 0$.
28	Solve the integral equation $\int_0^\infty f(\theta)\, cos\, \alpha\theta\, d\theta = \begin{cases} 1-\alpha, & 0 \le \alpha \le 1 \\ 0, & \alpha > 1 \end{cases}$ and hence evaluate $\int_0^\infty \frac{sin^2 t}{t^2} dt$
29	Solve the integral equation $\int_0^\infty f(\theta)\, cos\, \alpha\theta\, d\theta = \begin{cases} 1-\alpha, & 0 \le \alpha \le 1 \\ 0, & \alpha > 1 \end{cases}$ and hence evaluate $\int_0^\infty \frac{sin^2 t}{t^2} dt$
30	Property: Prove that $Z_T(n^k) = -z \frac{d}{dz} Z_T(n^{k-1})$, where k is a positive integer.
31	$Z_T(u_n) = \bar{u}(z)$ then $Z_T(u_{n+k}) = z^k\left[\bar{u}(z) - u_0 - u_1 z^{-1} - u_2 z^{-2} - \cdots - u_{k-1} z^{-(k-1)}\right]$
32	Find the z-transforms of the following. (i) $k^n n$ (ii) $k^n n^2$ (iii) e^{-an} (iv) $e^{-an}\, n$
33	Obtain Z-transform of $cosn\theta$ and $sinn\theta$. Hence deduce Z-transforms of the following. $k^n\, cosn\theta$ (ii) $k^n\, sinn\theta$ (iii) $e^{-an}\, cosn\theta$ (iv) $e^{-an}\, sinn\theta$
34	Find the Z-transform of $(n+1)^2$

35	Find the Z-transform of $2n + sin\left(\frac{n\pi}{4}\right) + 1$
36	Initial value theorem Statement: If $Z_T(u_n) = \bar{u}(z)$ then $\lim\limits_{z\to\infty} \bar{u}(z) = u_0$
37	Initial value theorem Statement: If $Z_T(u_n) = \bar{u}(z)$ then $\lim\limits_{z\to\infty} \bar{u}(z) = u_0$
38	Find the inverse Z-transform of $\frac{z}{(z-1)(z-2)}$
39	Find $Z_T{}^{-1}\left[\frac{5z}{(2-z)(3z-1)}\right]$
40	Compute the inverse Z-transform of $\frac{3z^2+2z}{(5z-1)(5z+2)}$
41	Solve by using Z-transforms: $y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = 0 = y_1$.
42	Solve by using Z-transforms: $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = 0 = y_1$.

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Physics</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B20AS0202</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">I sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>1</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>4</td><td>39</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

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.	1,2,4,5,6,10,12	1,2,3
CO2	Extract various semiconducting parameters like carrier concentration, drift velocity, effective mass, etc.	1,2,3,4,5,6,10,12	1,2,3
CO3	Understand the origin of magnetism and its applications, different kind dielectric materials and the polarization.	1,2,3,4,5,6,10,12	1,2,3
C04	Understand the light matter interaction, carriers generation and recombination, nano-materials and their interesting properties.	1,2,3,4,5,6,10,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

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

COURSE CONTENT
THEORY

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

Text Books

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

PRACTICE SESSION:

Sl. No.	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill /Ability**
1.	Variation of Resistivity of intrinsic Semi-conductor crystal using four probe method	Four probe apparatus, oven, Ge crystal with non-conducting bottom surface	Circuit connections, mathematical calculations

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

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

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

<table>
<tr><td>Course Title</td><td colspan="3">Introduction to Data Science</td><td colspan="2">Course Type</td><td colspan="2">HC Integrated</td></tr>
<tr><td>Course Code</td><td>B20CS0101</td><td>Credits</td><td>3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>26</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the concepts of Data Science in developing the real world applications.	1, 2, 3, 4, 5	1,2,3
CO2	Apply the SQL commands in developing the real-world applications.	1, 2, 3, 4, 5	1,2,3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1, 2, 3, 4, 5	1, 2, 3
CO4	Create the real world AI based solutions using different machine learning algorithms	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			✓	✓	✓	✓

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to Microsoft Excel

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

UNIT – 2

Introduction to Data Science

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

Introduction to SQL

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

UNIT – 3

Data science components

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

UNIT – 4

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

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

Applications of Data Science

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

PRACTICE:

<table>
<tr><th>sl.no</th><th>Title of the Experiment</th><th>Tools and Techniques</th><th>Expected Skill/Ability</th></tr>
<tr><td>1.</td><td>The height (in cm) of a group of fathers and sons are given below, Find the lines of regression and estimate the height of son when the height of father is 164 cm.
<table>
<tr><td>Plot the graph. Hgt of Fathers</td><td>158</td><td>166</td><td>163</td><td>165</td><td>167</td><td>170</td><td>167</td><td>172</td><td>177</td><td>181</td></tr>
<tr><td>Hgt of Sons</td><td>163</td><td>158</td><td>167</td><td>170</td><td>160</td><td>180</td><td>170</td><td>175</td><td>172</td><td>175</td></tr>
</table></td><td>MS Excel</td><td>Create and perform operations on Excel data set by applying Linear regression</td></tr>
<tr><td>2.</td><td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES, perform the following:
i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trendline feature).
iv) Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
v) Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
</table>

<table>
<tr>
<td>3.</td>
<td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.

i) Plot a scatter diagram.
ii) Determine the regression equatine (hint: use MS Excel's Add Trendline feature).
iii) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
iv) Compute the coefficient of determination and the coefficient of correlation</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<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><td>year</td><td>month</td><td>interest rate</td><td>unemployment rate</td><td>stock index price</td></tr>
<tr><td>2020</td><td>10</td><td>2.75</td><td>5.3</td><td>1464</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>5.</td>
<td>Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10,00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for a loan availed of Rs.10,00,000 during 3 years.
<table>
<tr><td>Sl No.</td><td>A</td><td>B</td></tr>
<tr><td>1</td><td>Principal</td><td>Rs.10,00,000</td></tr>
<tr><td>2</td><td>Annual interest rate</td><td>5.20%</td></tr>
<tr><td>3</td><td>Year of the loan</td><td>3</td></tr>
<tr><td>4</td><td>Starting payment number</td><td>1</td></tr>
<tr><td>5</td><td>Ending payment number</td><td>36</td></tr>
<tr><td>6</td><td>total interest paid during period</td><td>?</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Create Excel data and perform EMI estimator</td>
</tr>
<tr>
<td>6.</td>
<td>Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO, should not be NULL.</td>
<td>SQL</td>
<td>Creating Tables</td>
</tr>
</table>

<table>
<tr><td>7.</td><td>Create the customer database of a big Market with CUSTOMER_ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_CODE. Store at least twenty customers details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.</td><td>SQL</td><td>Creating and retrieving Tables</td></tr>
<tr><td>8.</td><td>Apply linear regression to find the weather (temperature) of a city with the amount of rain in centimeters. Create your own database with following details.<table><tr><td>CITY</td><td>Temperature in Centigrade</td><td>Rain in Centimeters</td></tr><tr><td></td><td></td><td></td></tr></table></td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>9.</td><td>Use the linear regression technique to compare the age of humans with the amount of sleep in hours.<table><tr><td>Name</td><td>Age in Years</td><td>Sleep in hours</td></tr></table>Create your own database with above details.</td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>10.</td><td>Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/ recorded in the matches. Assume your own database.</td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>11.</td><td>Design the ER diagram and create schema of the REVA library management system.</td><td>Entity Relationship</td><td>Entity Relationship diagrams</td></tr>
<tr><td>12.</td><td>Design the ER diagram and create schema for Hospital Management system.</td><td>Entity Relationship</td><td>Schema design</td></tr>
</table>

TEXT BOOKS:

1. B.S. Grewal, “Higher Engineering Mathematics”, 43nd edition, Khanna Publishers, 2015.
2. Ramakrishnan and Gehrke , “Database Management systems”, Third 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

<table>
<tr><td>Course Title</td><td colspan="4">Analog Electronics</td><td colspan="2">Course Type</td><td colspan="2">HC Integrated</td></tr>
<tr><td>Course Code</td><td>B20EN0201</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:
Analog Electronics is the base of Electronics & Communication stream. In this course the working of various amplifiers is explained. Students learn how BJT work at low and high frequencies, what happens in FET amplifiers, Power amplifiers, feedback amplifiers, tuned amplifiers and different types of oscillators and their working is analyzed. Introduction to Op-Amps is given in the end of the course.

COURSE OBJECTIVES:
The objectives of this course are to:
1. Understand operation of semiconductor devices.
2. Understand how devices such as semiconductor diodes and Bipolar Junction transistors are modeled and how the models are used in the design and analysis of useful circuits.
3. Apply concepts for the design of Amplifiers
4. Verify the design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies using simulators.

COURSE OUTCOMES (COs):
On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Analyze dc circuits and relate ac models of semiconductor devices with their physical Operation.	1,2,3,5	1,2,3
CO2	Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.	4,5	2,3

CO3	Develop experience in building and trouble-shooting simple electronic analog and digital circuits through Simulator	5,,10,11,12	2,3
CO4	Assess the concepts of both positive and negative feedback in electronic circuits.	1,2,3,5	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

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

COURSE ARTICULATION MATRIX:

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

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

COURSE CONTENTS:

THEORY:

Contents
UNIT – 1
Transistor Biasing: (BJT Version) Operating Point, Fixed Bias, Voltage-Divider Bias Configurations, Emitter-Follower, Bias Stabilization, Problems linked to above topics, Simulation using TINA/PSPICE/Multisim Simulator. **BJT AC Analysis:** The r_e Transistor Model, Modeling of Voltage-Divider Bias and Emitter-Follower Configurations, Two-Port Systems Approach, Cascaded Systems, Darlington Connection, Problems linked to above topics, Simulation using TINA/PSPICE/Multisim Simulator.
UNIT – 2
BJT Frequency Response Logarithms, Decibels, General Frequency Considerations, Normalization Process, Low-Frequency Response-BJT Amplifier with R_L, Millers Effect Capacitance, High Frequency Response-BJT Amplifier, Multistage Frequency Effects. Problems linked to above topics, Simulation using TINA/PSPICE/Multisim Simulator. **Feedback Amplifiers:** Feedback Concepts, Feedback Connection Types, Practical Feedback Circuits- Voltage Series Feedback and Current-Series Feedback . Problems linked to above topics. Simulation using TINA/PSPICE/Multisim Simulator.

UNIT – 3
Oscillator Circuits: Condition for oscillations, Oscillator operation, Phase Shift Oscillator, Colpitts, Hartley and Crystal Oscillators. Problems linked to above topics. Simulation using TINA/PSPICE/Multisim Simulator. **Power Amplifiers:** Series-Fed Class A Amplifier, Transformer-Coupled Class A Amplifier, Class B Amplifier Ciruits-Transformer-coupled Push-Pull Circuits, Complementary-symmetry Circuits, Class C and Class D amplifiers. Problems linked to above topics. Simulation using TINA/PSPICE/Multisim Simulator.
UNIT - 4
Field Effect Transistors: Construction and Characteristics of JFETs, Transfer Characteristics, Important relations, Depletion-Type MOSFET, Enhancement-Type MOSFET. **Introduction to Operational Amplifiers:** Basic Operational Amplifier Circuit, The 741 IC Op-Amp, Voltage Follower, Non-inverting and Inverting Amplifiers. Operational Amplifier Parameters. Problems linked to above topics. Simulation using TINA/PSPICE/Multisim Simulator.

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	ExpectedSkill /Ability
1	Design a Single stage BJT CE Amplifier and obtain frequency response curve and find Bandwidth, Input & Output Impedances.	Measuring instruments, simulation and design equations	Design and circuit debugging. Working in a team
2	Design a Two stage voltage series BJT Amplifier and Obtain frequency response curve, also find Bandwidth, Input & Output Impedances	Measuring instruments, simulation and design equations	Design and circuit debugging. Working in a team
3	Design a CE mode Cascode amplifier and plot frequency response. Also find Gain & Bandwidth.	Measuring instruments, simulation and design equations	Written Communication skills
4	Design a Class - C tuned Amplifier & find its Efficiency.	Measuring instruments, simulation and design equations	Develop ability to express their views
5	Design a BJT Darlington emitter follower and find Gain, Input & Output Impedances.	Measuring instruments, simulation and design equations	Develop making problem statements from user perception
6	Rig-up an R-C Phase Shift oscillator for $f_o \leq 10$ KHz & Crystal oscillator for f_o>1MHz.	Measuring instruments, simulation and design equations	Develop ability to express their views
7	Design a BJT Hartley & Colpitt's Oscillators for frequency ≥100kHz & simulate the circuit in Multisim	Measuring instruments, simulation and design equations	Develop innovative mind set
8	Demonstrate the working of Class-B push pull power amplifier using transistors find its Efficiency & also simulate the same in Multisim.	Measuring instruments, simulation and design equations	Develop prototyping techniques

9	Design an OPAMP Inverting & Non Inverting Amplifier.	Measuring instruments, simulation and design equations	Develop prototyping techniques

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	**IoT and Applications**				**Course Type**		**HC Integrated**	
Course Code	**B20EC0101**	**Credits**	**2**		**Class**		**I/II Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Theory	1	1	1				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**2**	**3**	**3**	**13**	**26**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the architecture of IoT eco-system	1	1,2

CO2	Identify IoT devices, architecture, sensors and Communication protocols	1	1,2
CO3	Demonstrate the interface of sensors to IoT board	1,5, 12	1,2
CO4	Realize various Applications of IoT through case studies	1,5, 12	1,2
CO5	Develop simple IoT projects and modules	1,5,9, 12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1
IoT Basics: Introduction to IoT, How does Internet of Things Works, Features of IoT, Advantages and Disadvantages of IoT, Embedde Devices in IoT, IoT eco-system,IoT Architecture and IoT Devices: Components of IoT architecture, Stages of IoT solution architectur Smart Objects, IoT Devices.

UNIT – 2

IoT boards in Market: Arduino, Arduino UNO, ESP8266 ,Raspberry Pi,IoT Platform: Amazon Web Services (AWS) IoT platform, Microsoft Azure IoT platform, Google Cloud Platform IoT, IBM Watson IoT platform, ThingWork IoT platform Technologies Used in IoT: Bluetooth, Wi-Fi, Li-Fi, RFID ,Cellular ,Z-Wave

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	Introduction to IoT Board a. Arduino UNO b. Arduino Nano c. Node MCU d. Ethernet Shield	Hardware	• Identifications of various parts of Arduino and Node MCU boards • Study of Ethernet shield and connection to the board
2.	Working with Arduino IDE (Integrated Development Environment)	Open source Arduino IDE	• Download specified software • Modify code as per the application
3.	a) Demonstration of Multimeter usage b) Demonstration of Breadboard connection for Voltage, Ground, series and parallel connections c) Exercise to read the value of resistor using Colour code chart	Multimeter Breadboard Resistor packs	• Measurement of voltage at various points in IoT boards • Choose the value of Resistor for an application
4.	Reading photo resistor sensor value connected to Arduino Board	Arduino UNO Arduino IDE LDR , Multimeter, Resistor	• Interface of photo sensor to IoT board for light measurement applications
5.	Reading temperature sensor value connected to Arduino Board	Arduino UNO , Arduino IDE, Temperature sensor, Multimeter	• Interface of Temperature sensor to IoT board for temperature measurement
6.	Reading motion detector sensor value connected to IoT board	Arduino UNO , Arduino IDE, pyro-dielectric sensor, Multimeter	• Interface of Motion detector sensor to IoT board for motion detection detection.

7	Reading distance measurement using Ultrasonic sensor Connected to IoT board	Arduino UNO , Arduino IDE, Ultrasonic sensor, Multimeter	Interface of Motion detector sensor to IoT board for motion detection
8	Interface relay to IoT board	Arduino UNO , Arduino IDE, relay Multimeter	Interface relay to IoT board for Switching applications
9	Connect Wifi-ESP8266 to Arduino UNO board , Send and receive data through smart phone.	Arduino UNO ESP8266, Arduino IDE Smart phone	Connect IoT board to Wifi network
Part-B (Case Study projects-Samples)			

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

PART C (Mini Project)

1	**Arduino Controlled Light intensity**: design and build a simple , effective circuit called Auto Intensity Control of Street Lights using Arduino	ArduinoUNO,DS3231 RTC Module, LDR 16×2 LCD Display ,LED,10KΩ Potentiometer,10KΩ Resistor, Push Button, Connecting Wires, Breadboard	Design and Implementation of IoT project to solve Engineering Problems.
2	**Thermometer**: build an LCD thermometer with an Arduino UNO and a LM35/36 analog temperature sensor.	Arduino Uno, Temperature Sensor, LCD display, Breadboard and Connecting wires	Design and Implementation of IoT project for Engineering applications.
3	Motion activated light lamp: build an automated project that It switches on and off when there's motion.	Arduino Uno, PIR Motion sensor, breadboard, connecting wires, LED generic.	Design and Implementation of IoT project for Engineering applications
4	Touchless motion sensor trash can: build touchless motion sensor trash can	Arduino UNO, Ultra sonic sensor, Micro servo motor, Breadboard, Connecting wires	Design and Implementation of IoT project for Engineering applications

TEXT BOOKS:

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

REFERENCE BOOKS:

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

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNING EXERCISES:

a) Create Arduino project hub

Course Title	**ENTREPRENEURSHIP**				**Course Type**		**HC**	
Course Code	B20ME0104	**Credits**	**1**		**Class**		**I sem**	
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
	Practice	-	-	-				
	Total	1	1	1	13	0	50%	50%

COURSE OVERVIEW

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

COURSE OBJECTIVE

The objectives of this course are to

1. Understand the basic terms, concepts in Entrepreneurship Development
2. Analyze and apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand and explain the key terms, definitions, and concepts used in Entrepreneurship Development	6,7,8,9,10,11, 12	
CO2	Plan a start up by applying the knowledge of sources of finance and the supporting schemes offered by state and central governments and other entrepreneurial development organisations	2,3, 6,7,8,9, 10,11,12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

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	2	1			
CO2		3	1			1	1	1	1	1	3	1			

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

COURSE CONTENT
THEORY:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Baringer and Ireland "Entrepreneurship" 11th Edition, Pearson, 2020.
2. P. Narayana Reddy" Entrepreneurship – Text and Cases" Cengage Learning India, I edition, 2010
3. Paul Burns "Corporate Entrepreneurship: Building The Entrepreneurial Organization"
4. Drucker F Peter,:"Innovation and Entrepreneurship",.Heinemann, London. 1985.

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:

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

SELF-LEARNING EXERCISES:

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

PROBLEM BASED LEARNING

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

<table>
<tr><td>Course Title</td><td colspan="4">Computer Aided Engineering Drawing</td><td colspan="2">Course Type</td><td colspan="2">HC Integrated</td></tr>
<tr><td>Course Code</td><td>B20ME0101</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>2</td><td>2</td><td>2</td></tr>
<tr><td>Tutorial</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>26</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

The objectives of this course are to

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Construct the simple 2D drawings manually and also by using CAD software	1,5,10,12	1
CO2	Draw orthographic projection of point, line, plane surfaces and simple solids	1,3,5,10, 12	1
CO3	Draw sectional views of a prisms, pyramids, cone and cylinder	1,3,5,10, 12	1

CO4	Develop the lateral surfaces of the solids	1,2, 3,5,10, 12	1,2,3
CO5	Create isometric view of the solids	1,3,5,10, 12	1

BLOOM'S LEVELOF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

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

PRACTICE:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASEDLEARNING

Sl.	Problems
1	A point 30 mm above XY line is the front view of two points A and B. The top view of A is 40 mm behind VP and the top view of B is 45 mm in front of VP. Draw the projections of the points and state the Quadrants in which the points are situated.

2	A point 'A' is 30 mm in front of VP & 40 mm above HP. Another point B is 20 mm behind VP & 35 mm below HP. The horizontal distance between the points measured parallel to XY line is 60 mm. Draw the three projections of the points. Join their front and top views.
3	A point P is on HP and 35 mm in front of VP. Another point Q is on VP and below HP. The line joining their front views makes an angle of 300 to XY line, while the line joining their top views makes an angle of 450 with XY line. Find the distance of the point Q from HP.
4	A point is 35 mm below HP, 20 mm behind VP and 25 mm behind / in front / from RPP. Draw its projections and name the side view.
5	A line AB 80 mm long is inclined to HP at 30 degree and inclined to VP at 45degree. Draw front and top views of line and determine their lengths. Also, measure the perpendicular distance of end B from both HP & VP.
6	A line AB has its end A 20 mm above the HP and 30 mm in front of VP. The other end B is 60 mm above HP and 45 mm in front of VP. The distance between end projectors is 70 mm. draw its true length and apparent inclinations.
7	The top view pq of a straight line is 70 mm and makes an angle of 60 degree with XY line. The end Q is 10 mm in front of VP and 30 mm above HP. The difference between the distances of P and Q above HP is 45 mm. draw the projections. Determine its true length and true inclinations with HP and VP.
8	The top view of a line 75 mm long measures 50 mm. The end P is 30 mm in front of VP and 15 mm above HP. The end Q is 15 mm in front of VP and above HP. Draw the projections of the line and find its true inclinations with HP and VP.
9	The distance between the end projectors through the end points of a line AB is 60 mm. the end A is 10 mm above HP and 15 mm in front of VP. The end B is 35 mm in front of VP. The line AB appears 70 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.
10	The point B of a line AB is on the horizontal plane, the top view of the line makes an angle of 30 degree with XY line, being 80 mm. the point A is on the vertical plane and 50 mm above the horizontal plane. Draw the top and front views of the line and obtain the true length of the line. Also find the inclinations of the line with two planes.
11	The end A of a line AB is in HP and 25 mm in front of VP. The end B is 10 mm in front of VP and 50 mm above HP. The distance between the end projectors when measured parallel to the line of intersection of HP and VP is 80 mm, Draw the projection of the line AB and determine its true length and true inclination with HP and VP.
12	Find the true length and true inclination of a line AB with HP having one of its ends 20 mm in front of VP and 30 mm above the HP. The line is inclined at 40 degree to VP and left side view of the line is 60 mm long and inclined at 60degree to the x1y1 line. Draw all the three views of the line.
13	An equilateral triangular lamina of 25mm side lies with one of its edges on HP such that the surface of the lamina is inclined to HP at 60degree. The edge on which it rests is inclined to VP at 60degree. Draw its projections.
14	A 30 degree-60degree setsquare of 60mm longest side is kept such that the longest side is in HP, making an angle of 30 degree with VP. The set square itself is inclined at 450 to HP. Draw the projections of the setsquare.
15	A square lamina ABCD of 40mm side rests on corner C such that the diagonal AC appears to be at 45 degree to VP. The two sides BC and CD containing the corner C make equal inclinations with HP. The surface of the lamina makes 30 degree with HP. Draw its top and front views.
16	A mirror 30 mm x 40 mm is inclined to the wall such that its front view is a square of 30 mm side. The Longer sides of the mirror appear perpendicular to both HP and VP. Find the inclination of the mirror with the wall.

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

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

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

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

Approved Second year scheme and syllabus for B.Tech ECE 2021-25 batch

III Semester

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0305	Linear Algebra and Partial Differential Equations	FC	3	0	0	3	3
2	B20EN0301	Linear Integrated Circuits	HC	3	0	0	3	3
3	B20EN0302	Digital Electronics	HC	3	0	0	3	3
4	B20EN0303	Network Theory	HC	3	0	0	3	3
5	B20EN0304	Problem Solving Using C Programming	HC	1	1	0	2	2
TOTAL				**13**	**1**	**0**	**14**	**14**
Practical /Term Work / Sessional								
6	B20EN0306	Linear Integrated Circuits Lab	HC	0	0	1	1	2
7	B20EN0307	Digital Electronics Lab	HC	0	0	1	1	2
8	B20EN0308	Problem Solving Using C Programming lab	HC	0	0	1	1	2
9	B20EN0305	Course Based Project on Linear Integrated Circuits	HC	0	0	1	1	2
10	B20AS0303	Environmental Science	FC	2	0	0	2	2
11	B20MG0301	Management Science	FC	2	0	0	2	2
12	B20AHM301 OR B20AHM302	Advanced Kannada OR Basics of Kannada	MC	0	0	0	0	1
			TOTAL	**4**	**0**	**4**	**8**	**13**
			TOTAL SEMESTER CREDITS		**22**			
			TOTAL CUMULATIVE CREDITS		**62**			
			TOTAL CONTACT HOURS		**27**			

IV Semester

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0402	Probability and Random Process	FC	3	0	0	3	3
2	B20EN0401	Analog Communication	HC	3	0	0	3	3
3	B20EN0402	Electromagnetics and Transmission lines	HC	3	1	0	4	5
4	B20EN0403	Microcontroller and Applications	HC	3	0	0	3	3
5	B20EN0404	Object Oriented Programming and Data Structures using C++	HC	1	1	0	2	2
TOTAL				**13**	**2**	**0**	**15**	**16**
Practical /Term Work / Sessional								
6	B20EN0406	Analog Communication lab	HC	0	0	1	1	2
7	B20EN0407	Microcontroller and Applications lab	HC	0	0	1	1	2

8	B20EN0408	Object Oriented Programming and Data Structures using C++ lab	HC	0	0	1	1	2
9	B20EN0405	Course Based project on Microcontroller and Applications	HC	0	0	1	1	2
10	B20AH0301	Communication Skills	FC	2	0	0	2	2
11	**B20LS0301**	Indian Constitution and Professional Ethics	FC	2	0	0	2	2
12	B20AHM401	Universal Human Values	MC	0	0	0	0	1
			TOTAL	**4**	**0**	**4**	**8**	**13**
			TOTAL SEMESTER CREDITS			**23**		
			TOTAL CUMULATIVE CREDITS			**85**		
			TOTAL CONTACT HOURS			**29**		

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0501	Digital Communication	HC	3	0	0	3	3
2	B20EN0502	Signals and Systems	HC	3	0	1	4	5
3	B20EN0503	Verilog for FPGA Development	HC	3	0	0	3	3
4	B20ENS5XX	Professional Elective-1	SC	3	0	0	3	3
5	B20ENS5XX	Professional Elective-2	SC	3	0	0	3	3
6	B20XXO5XX	Open Elective-1	OE	3	0	0	3	3
		TOTAL		**18**	**0**	**1**	**19**	**20**
		Practical /Term Work / Sessional						
7	B20EN0504	Digital Communication Lab	FC	0	0	1	1	2
8	B20EN0505	Verilog for FPGA Development Lab	FC	0	0	1	1	2
9	B20EN0506	Technical Documentation	FC	1	0	0	1	1
10	B20EN0507	Research based project	HC	0	0	1	1	2
		TOTAL		**1**	**0**	**4**	**5**	**9**
		TOTAL SEMESTER CREDITS				**23**		
		TOTAL CUMULATIVE CREDITS				**108**		
		TOTAL CONTACT HOURS				**29**		

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0601	Control Engineering	HC	3	0	1	4	5
2	B20EN0602	Digital Signal Processing	HC	3	0	0	3	3
3	B20EN0603	Computer Networks	HC	3	0	0	3	3

4	B20EN0604	Computer Organization and Operating System	HC	3	0	0	3	3
5	B20ENS6XX	Professional Elective-3	SC	3	0	0	3	3
6	B20XXO6XX	Open Elective-2	OE	3	0	0	3	3
TOTAL				**17**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B20EN0605	Digital Signal Processing lab	HC	0	0	1	1	2
8	B20EN0606	Computer Networks Lab	HC	0	0	1	1	2
9	B20EN0607	Mini project/Internship	HC	0	0	2	2	4
10	B20PA0501	Indian Tradition and Culture	FC	1	0	0	1	2
TOTAL				**1**	**0**	**3**	**5**	**10**
TOTAL SEMESTER CREDITS					**24**			
TOTAL CUMULATIVE CREDITS					**132**			
TOTAL CONTACT HOURS					**30**			

II SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0701	Microwaves and Antenna	HC	3	0	0	3	3
2	B20EN0702	CMOS VLSI Circuits	HC	3	0	0	3	3
3	B20ENS7XX	Professional Elective-4	SC	3	0	0	3	3
4	B20ENS7XX	Professional Elective-5	SC	3	0	0	3	3
5	B20XXO7XX	Open Elective-3	OE	3	0	0	3	3
TOTAL				**15**	**0**		**15**	**15**
Practical /Term Work / Sessional								
6	B20EN0703	Microwaves and Antenna Lab	HC	0	0	1	1	2
7	B20EN0704	CMOS VLSI Circuits Lab	HC	0	0	1	1	2
8	B20EN0705	Major Project Phase – 1	HC	0	0	1	1	2
TOTAL				**0**	**0**	**3**	**3**	**2**
TOTAL SEMESTER CREDITS					**18**			
TOTAL CUMULATIVE CREDITS					**150**			
TOTAL CONTACT HOURS					**21**			

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20XXO8XX	Open Elective-4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessional								
2	B20EN0801	Major Project Phase – 2	HC	0	0	0	7	14

TOTAL	0	0	0	7	14
TOTAL SEMESTER CREDITS	10				
TOTAL CUMULATIVE CREDITS	160				
TOTAL CONTACT HOURS	17				

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE							
5TH SEM /OE1		**6TH SEM /OE2**		**7TH SEM /OE3**		**8TH SEM /OE4**	
Course code	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**
B20ECO501	PCB Fabrication	B20ECO601	Basics of Communication Systems	B20ECO701	Automotive Electronics	B20ECO801	Consumer Electronics
B20ECO502	Embedded Systems	B20ECO602	Sensors and Instrumentation	B20ECO702	Robotic Systems	B20ECO802	Healthcare Electronics

	PROFESSIONAL ELECTIVES						
PE	**Course Code**	**Domain1: Electronics**	**Course Code**	**Domain 2:Communication**	**Course Code**	**Domain3: Computers**	
PE-1 / 5TH SEM	B20ENS511	ARM Processors and Applications	B20ENS512	Optical Fiber Communication	B20ENS513	Theory of Algorithms	
PE-2 / 5TH SEM	B20ENS521	Automotive Electronics	B20ENS522	Information Theory and Coding	B20ENS523	Database Management Systems	
PE-3 / 6TH SEM	B20ENS631	Power Electronics	B20ENS632	Cryptography and Network Security	B20ENS633	JAVA Programming	
PE-4/ 7TH SEM	B20ENS741	Analog and Mixed mode VLSI	B20ENS742	Wireless and Multimedia Communication	B20ENS743	Machine Learning	Operating Systems
PE-5 / 7TH SEM	B20ENS751	MEMS and Nano Technology	B20ENS752	RF Communications and Applications	B20ENS753	Web Programming	Compiler Design

Detailed Syllabus
Semester-III

Course Title	Linear Algebra and Partial Differential Equations				Course Type		HC	
Course Code	B20AS0305	**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 arbitrary variable Equations solvable by direct integration , Solution of Lagrange's linear PDE. Method of variable separable-D heat equation, 1-D wav equation. Non-linear equations of the first order. Charpits method.

Text books:

1.B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.

2.Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

11. https://www.journals.elsevier.com/linear-algebra-and-its-applications/most-downloaded-articles
12. https://www.researchgate.net/publication/304178667_A_Study_on_the_Linear_Algebra_Matrix_in_Mathematics
13. https://www.sciencedirect.com/journal/linear-algebra-and-its-applications/vol/1/issue/1
14. http://vmls-book.stanford.edu/vmls.pdf
15. https://www.researchgate.net/publication/317685719_A_Study_of_General_First-order_Partial_Differential_Equations_Using_Homotopy_Perturbation_Method
16. https://www.journals.elsevier.com/partial-differential-equations-in-applied-mathematics/

SWAYAM/NPTEL/MOOCs:

5. https://www.youtube.com/watch?v=LJ-LoJhbBA4&list=PLbMVogVj5nJQ2vsW_hmyvVfO4GYWaaPp7
6. https://www.youtube.com/watch?v=9h_Q-R6sXbM&list=PL7oBzLzHZ1wXQvQ938Wg1-soq09GywgOw

7. https://www.youtube.com/watch?v=Kk5SEzASkZU&list=PL9m2Lkh6odgKbfY03TFRhwjOqW79UdzK8
8. https://www.youtube.com/watch?v=W3HXK1Xe4nc&list=PLbPn3CUduj5TPQtrwfI70F1SW4LvPf90d
9. https://www.youtube.com/watch?v=Nonfmx0-LQQ

Course Title	Linear Integrated Circuits				**Course Type**		**HC**	
Course Code	B20EN301	**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	-	-	-				

	Practical	-	-	-	Theory	Practical	IA	SEE
	-							
	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 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.	1,2,3,4,5,9,10	1,2,3
CO2	Identify the linear, non-linear applications of Op-Amp and active filters.	1,2,3,4,5,9,10	1,2,3
C03	Analyze the operational amplifier applications as Wave form generators.	1,2,3,4,5,9,10	1,2,3
CO4	Categorize Op-Amp based comparators, waveform generators, VCO and PLL operation and its application.	1,2,3,4,5,9,10	1,2,3
CO5	Design various applications of special function Op-Amp ICs such as 555 timer, Voltage Regulator IC.	1,2,3,4,5,9,10	1,2,3
CO6	List and compare the performance of various types of ADC and DAC using Op-Amp	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								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, Zin mod compensation. 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**

Course Title	**Digital Electronics**				**Course Type**		**HC**	
Course Code	**B20EN0302**	**Credits**	**3**		**Class**		**III Semester**	
Digital Electronics	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	**IA**	**SEE**
	Practical	0	0	0				
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50 %**	**50 %**

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 OBJECTIVES:

The objectives of this course are:

7. Illustrate Boolean laws and systematic techniques for minimization of expressions.
8. Demonstrate the methods for simplifying Boolean expressions.
9. Familiarize the commonly used terms like min-term, max-term, canonical expression, SOP,POS etc.
10. Introduce the Basic concepts of combinational and sequential logic.
11. Present real-world examples for making the learners attuned to Logic concepts.
12. Highlight the formal procedures for the analysis and design of combinational circuits and sequential circuits.
13. 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	Define a Boolean term, expression, SOP, POS, Min-term etc.	1,2,3,4,5,9, 10	1,3
CO2	Construct the K-map from a Boolean expression and to find the minimal SOP/POS forms	1,2,3,4,5,9, 10	1,3
CO3	Design arithmetic and combinational logic circuits using gates, encoders, decoders, multiplexers and de-multiplexers	1,2,3,4,5,9, 10	1,3
CO4	Design specified synchronous or asynchronous sequential logic circuits using appropriate flip flops.	1,2,3,4,5,9, 10	1,3
CO5	Design sequential circuit with Moore and Mealy configurations.	1,2,3,4,5,9, 10	1,3
CO6	Design the applications of Combinational & Sequential Circuits.	1,2,3,4,5,9, 10	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO4	3	2	3	1	3				1	1			2		3
CO5	3	2	3	1	3				1	1			2		3
CO6	3	2	3	1	3				1	1			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, Generation of switching equations from truth tables, Karnaugh maps-3,4,5 variables, Incompletely specified functions (Don't care terms) Simplifying Max term equations, Quine-McClusky techniques – 3 & 4 variables.
UNIT – 2 **Design of Combinational Logic Circuits:** 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, Boolean function implementation using Multiplerxers and decoders, Comparators(1 and 2 bit)
UNIT - 3 **Introduction to Sequential Logic:** Basic Bistable elements, Latches, Flip-Flops-SR, D, JK & T The master-slave flip- flops: SR flip-flops, JK flip-flops, Shift Registers- SISO, SIPO, PISO, PIPO, binary ripple counters and synchronous binary counters, Design of a synchronous mod-n counter using clocked JK, D, T and SR flip-flops.
UNIT - 4 **Sequential Circuit Design and Logic Families:** Introduction to Mealy and Moore Model circuits. State machine notation, Synchronous sequential circuit analysis and construction of state table and diagram, Design of a Sequence Detector, Guidelines for construction of state graphs, Serial Adder with Accumulator, Design of Binary Multiplier. Introduction to Logic families: RTL, DTL, TTL,ECL,CMOS,Bi-CMOS,GaAs logic families

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:

2. Charles H Roth Jr., Larry L. Kinney "Fundamentals of Logic Design" Cengage Learning, 7th Edition.
3. 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

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
5. https://nptel.ac.in/courses/108/102/108102112/

Course Title	**Network Theory**				**Course Type**		**HC**	
Course Code	**B20EN0303**	**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	-	-	-				
	Practice	0	0	0	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**3**	**3**	**0**	**42**	**0**	**50 %**	**50 %**

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. It also explains about the concepts of network graph theory to simplify and analyze the complex network. The course also includes the concepts of synthesizing a network from its immittance functions.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Analyse the concepts of super mesh, super node and network theorems.
2. Illustrate the mathematical and graphical analysis of electrical circuits.
3. Analyse 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 by the application of super-mesh, super-node and various network theorems.	1,2,3,4	1,2,3

CO2	Determine branch voltages and node currents by drawing tie set and cut set schedule of an electrical circuit.	1,2,3,4	1,2,3
CO3	Model a two port network in terms of Z, Y, h & T parameters.	1,2,3,4	1,2,3
C04	Design the resonant circuits for given frequency and compute the performance parameters	1,2,3,4	1,2,3
CO5	Apply Laplace transform technique to analyze the transient behavior of series and parallel 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 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 **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
Network Topology: Terminologies of network graph theory: Tree, Co-tree, Incidence matrix, Tie-set schedule (numericals on network equilibrium equations), Cut-set (only definition, schedule & matrix. Network equilibrium equations excluded). Numerical examples on dc n/w's only. **Two Port Networks:** Definition of Z, Y, h & T parameters, Inter-relationships between parameters. Numerical examples.
UNIT – 3
Transient Analysis using LT: Initial & Final conditions of network elements, application of Laplace transform technique for transient response of RL, RC, RLC circuits (given initial conditions) for various input functions, Numerical. **Resonance Circuits:** R-L-C Series & R||L||C Parallel resonance (resonant frequency, cut-off frequencies, bandwidth, dynamic impedance, quality factor-derivations included for series resonance and parallel resonance), Numericals.
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", 6^{th} Edition, Tata McGraw-Hill Publication, 2011.
2. R R Singh, "Network Analysis and Synthesis", 2^{nd} 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", 8^{th} 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:

10. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec01.mp4
11. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec02.mp4
12. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec04.mp4
13. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod01lec06.mp4
14. https://nptel.ac.in/content/storage2/108/105/108105159/MP4/mod06lec45.mp4

Course Title	**Problem Solving Using C Programming**				**Course Type**	**HC**
Course Code	**B20EN0304**	**Credits**	**2**		**Class**	**III Semester**
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage
	Lecture	1	1	1		
	Tutorial	1	2	2		
	Practical	-	-	-		

	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**2**	**3**	**2**	**14+28**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop an algorithm/flowchart to solve the computational problems	1,2,3,4,5,10	1,2,3
CO2	Solve data processing applications using appropriate data types, operators, and flow control statements .	1,2,3,4,5,10	1,2,3
CO3	Write C programs using derived data types like arrays and strings to operate on block of data.	1,2,3,4,5,10	1,2,3
CO4	Solve complex problems using procedure-oriented (modular) programming approach	1,2,3,4,5,10	1,2,3
CO5	Design and develop computer programs using the concept of pointers, structures, and unions	1,2,3,4,5,10	1,2,3
C06	Demonstrate the creation of file and file operations in C-language	1,2,3,4,5,10	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO6	✓	✓	✓			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

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

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, Pentice Hall Software Series, 2005.

2. Herbert Schildt, "C: The Complete Reference", 4th edition, Tata McGraw Hill, 2000.
3. Nanjesh Bennur, Dr. C. K. Subbaraya, "Programming in C", 2nd Edition, Excellent Publishing House, 2015.

REFERENCE BOOK:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

SWAYAM/NPTEL/MOOCs:

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

<table>
<tr><td>Course Title</td><td colspan="4">Linear Integrated Circuits Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN306</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="6"></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></td><td></td><td></td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">IA</td><td rowspan="3">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</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 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 OBJECTIVES:

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)

On successful completion of this course; the student shall 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
C03	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
THEORY:

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Study the characteristics of negative feedback amplifiers	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
2	Design and Test Instrumentation amplifier	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
3	Design and testing of second order low pass filter and high pass filter	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
4	Design of second order band pass.	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
5	Design and testing of Schmitt Trigger circuit for the given values of UTP and LTP	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
6	Design and testing of Astable multi-vibrator circuits using IC 555 for given frequency and duty cycle	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
7	Design and testing of PLL	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
8	Design and testing of a rectangular and triangular wave generator	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
9	Design and testing of integrator and differentiator circuit	CRO, Function Generator, and design equations	Design and circuit debugging. Working in a team
10	Design and testing of a voltage regulator circuit using op-Amp	CRO, Function Generator, and design equations	Design 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 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="4">Digital Electronics Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>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="6">Digital Electronics</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">IA</td><td rowspan="3">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</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:

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

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	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

(All the above experiments have to be supported by suitable simulation tool)

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>Course Title</td><td colspan="4">Problem Solving Using C Programming Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>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="6"></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>
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<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">IA</td><td rowspan="3">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</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:

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

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop algorithms/flowcharts to solve computational problems.	1,2,3,5	1,2,3
CO2	Solve data processing applications using appropriate data types, operators and control flow statements.	1,2,3,5,10	1,2,3
CO3	Write C programs using derived data types like arrays and strings to operate on block of data.	1,2,3,5,10	1,2,3
CO4	Solve complex problems using procedure-oriented (modular) programming approach	1,2,3,5,10	1,2,3
CO5	Design and develop computer programs using the concept of pointers, structures, unions and records.	1,2,3,5,10	1,2,3
C06	Demonstrate the creation of file and file operations in C-language	1,2,3,5,10	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Write a Program to calculate and display the volume of a CUBE by reading its height, width and depth from keyboard.	Algorithm, Flowchart, C compiler.	Reading values from input device, calculating and writing results on output device.
2	Write a program to take input of name, rollno and marks obtained by a student in 4 subjects of 100 marks each and display the name, rollno with percentage score secured. NOTE: Also write same program for three students.	Algorithm, Flowchart, C compiler.	Reading values from input device, calculating and writing results on output device.
3	a. Write a program to print whether a given number is even or odd. b. Write a program to print even numbers from 1 to 10.	Algorithm, Flowchart, C compiler.	Writing program skills with conditional statements.
4	a. Write a Program to Check Whether a Number is Prime or not. b. Write a program to find the factorial of a number.	Algorithm, Flowchart, C compiler.	Writing program skills with conditional & looping statements.
5	a. Write a program to find whether a character is consonant or vowel using switch statement. b. Write a program to print the sum of numbers from 1 to 10 using for loop.	Algorithm, Flowchart, C compiler.	Writing program skills with conditional & looping statement.
6	a. Write a program to create an integer array of size 5, read values from input device and print the values of the array.	Algorithm, Flowchart, C compiler.	Writing program skills with array creation and operations on it.

	b. Write a Program to Search an element in array.		
7	a. Write a program to calculate factorial of a number using recursion. b. Write a program to add, subtract, multiply and divide two integers using user-defined type function with return type. c. Write a program to swap two integers using call by value and call by reference methods of passing arguments to a function.	Algorithm, Flowchart, C compiler.	Writing program skills with function declaration and definition.
8	a. Write a C program to create, declare and initialize structure. b. Write a program to declare, initialize an UNION.	Algorithm, Flowchart, C compiler.	Writing program skills with structure and union.
9	a. Write a program to find biggest among three numbers using pointer. b. Write a program to swap value of two variables using pointer. c. Write a program to swap to array using pointers.	Algorithm, Flowchart, C compiler.	Writing program skills with pointers.
10	a. Write a program to create a file called 'record' and store information about a person, in-terms of his name, age, and salary. b. Write a program to illustrate how a file stored on the disk is read.	Algorithm, Flowchart, C compiler.	Writing program skills with file handling.

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, Pentice Hall Software

Series, 2005.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata McGraw Hill, 2000.
3. Nanjesh Bennur, Dr. C. K. Subbaraya, “Programming in C”, 2nd Edition, Excellent Publishing House, 2015.

REFERENCE BOOK:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

SWAYAM/NPTEL/MOOCs:

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

<table>
<tr><td>Course Title</td><td colspan="4">Course Based Project on Linear Integrated Circuits</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0305</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="6"></td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</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 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.

<table>
<tr><td>Course Title</td><td colspan="4">Environmental Science</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B20AS0303</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="6"></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>2</td><td>0</td><td>0</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">IA</td><td rowspan="3">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>0</td><td>0</td><td>28</td><td>-</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

COURSE OBJECTIVES:

The objectives of this course are:

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

1.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand, analyze and execute favorable environmental conditions and the role of individual, government and NGO in environmental protection	6,7,8,9	1
CO2	List the causes, effects & remedial measures and find ways to overcome them by suggesting the pollution-controlled products.	6,7,8,9	1

CO3	Classify different wastes, sources of waste and their effect on population	6,7,8,9	1
CO4	Demonstrate various water conservation methods and suggest appropriate technique for conservation of water	6,7,8,9	1
CO5	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.	6,7,8,9	1
C06	Critically analyse the ecological imbalances and provide recommendations to protect the environment.	6,7,8,9	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents

UNIT – 1

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

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

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

UNIT – 2

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

Environmental degradation: Introduction, Global warming and greenhouse effect,
Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.
Waste management: Municipal solid waste, Biomedical waste and Electronic waste (E-Waste).

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

UNIT – 3

Energy & Natural resources:

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

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

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

UNIT – 4

Ecology, ecosystem & field work:

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

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

Field work:

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

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

TEXT BOOKS:

REFERENCE BOOK:

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

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

<table>
<tr><td>Course Title</td><td colspan="4">Management Science</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B20MG0301</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="6"></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>2</td><td>0</td><td>0</td></tr>
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<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
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<tr><td>Total</td><td>2</td><td>0</td><td>0</td><td>28</td><td>-</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO6									1	2	3		1		

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1 **Introduction to Management and Organization:** Concepts of Management and organization- nature, importance and Functions of Management. Systems Approach to Management - Taylor's Scientific Management Theory- Taylor's Principles of Management, Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory - Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management. Designing Organizational Structures: Basic concepts related to Organization Depart mentation and Decentralization.
UNIT – 2 **Operations and Marketing Management**: Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study --Basic procedure involved in Method Study and Work Measurement - Business Process Reengineering(BPR) Statistical Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis. Purchase Procedure, Stores Management and Store Records - JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix. And Marketing Strategies based on Product Life Cycle. Channels of distribution.
UNIT – 3 **Human Resources Management (HRM):** Concepts of HRM. HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR.. Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development. Placement, Wage and Salary Administration, Promotion. Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating -Capability Maturity Model (CMM) Levels - Performance Management System.
UNIT - 4 **Strategic Management and Contemporary strategic Issues:** Mission, Goals, Objectives, Policy, Strategy. Programmes, Elements of Corporate Planning Process, Environmental Scanning. Value Chain Analysis, SWOT Analysis. Steps in Strategy Formulation and implementation, Generic. Strategy alternatives. Bench Marking and Balanced Score and as Contemporary Business Strategies.

TEXT BOOKS:

REFERENCE BOOK:

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

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

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

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

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

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

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

SWAYAM/NPTEL/MOOCs:

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡಿಗರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಪರಿವಿಡಿ

ಘಟಕ – 1 : **ಕವಿತೆಗಳು**

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

ಘಟಕ – 2 : **ಕಥೆಗಳು**

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

ಘಟಕ – 3 : **ವಿಜ್ಞಾನ ಲೇಖನಗಳು**

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

ಘಟಕ – 4 : ಪರಿಸರ ಲೇಖನಗಳು

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

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

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

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡೇತರರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಭಾಷಾ ಕೌಶಲ್ಯಗಳು

ಘಟಕ – 1

1. ಆಲಿಸುವುದು

- ಆಲಿಸುವ ಕೌಶಲ್ಯ
- ಆಲಿಸುವಿಕೆಯಲ್ಲಿನ ದೋಷಗಳು
- ಉತ್ತಮ ಆಲಿಸುವಿಕೆ

ಘಟಕ – 2

2. ಮಾತನಾಡುವುದು

- ಸಂಭಾಷಣೆ
- ವ್ಯವಹಾರಿಕ ಸಂಭಾಷಣೆ
- ದೋಷಗಳು ಮತ್ತು ಪರಿಹಾರಗಳು

ಘಟಕ – 3

3. ಓದುವುದು

- ಓದು ಕಲಿಸುವಾಗ ಗಮನಿಸಬೇಕಾದ ಅಂಶಗಳು
- ಧ್ವನ್ಯಾಂಗಗಳ ಪರಿಚಯ
- ಓದಿನ ವಿಧಗಳು

ಘಟಕ – 4

4. ಬರೆಯುವುದು

- ವರ್ಣಮಾಲೆಯ ಸ್ವರೂಪ
- ಕಾಗುಣಿತ ಸ್ವರೂಪ
- ಕನ್ನಡ ಸಂಖ್ಯೆಗಳು

❖ ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ ಕನ್ನಡೇತರರಿಗೆ **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ

❖ ಬಿ ಎಂ ಎಸ್ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಕನ್ನಡೇತರರಿಗೆ **'ಕನ್ನಡ ಮನಸ್ಸು'** ಪಠ್ಯ ಪುಸ್ತಕ

❖ ಕರ್ನಾಟಕ ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ವಿಭಾಗ ಇವರು **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ ತಂದಿದ್ದಾರೆ.

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

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0402	Probability and Random Process	HC	3	0	0	3	3
2	B20EN0401	Analog Communication	HC	3	0	0	3	3
3	B20EN0402	Electromagnetics and Transmission lines	HC	3	1	0	4	5
4	B20EN0403	Microcontroller and Applications	HC	3	0	0	3	3
5	B20EN0404	Object Oriented Programming and Data Structures using C++	HC	1	1	0	2	2
TOTAL				13	2	0	15	16

Practical /Term Work / Sessional								
	B20EN0406	Analog Communication	HC	0	0	1	1	2
	B20EN0407	Microcontroller and Applications	HC	0	0	1	1	2
	B20EN0408	Object Oriented Programming and Data Structures using C++	HC	0	0	1	1	2
	B20EN0405	Course Based project on Microcontroller and Applications	HC	0	0	1	1	2
7	B20AH0301	Communication Skills	FC	2	0	0	2	2
8	B20LS0301	Indian Constitution and Professional Ethics	FC	2	0	0	2	2
9	20AHM401	Universal Human Values	MC	0	0	0	0	1
TOTAL				4	0	4	8	13
TOTAL SEMESTER CREDITS					**23**			
TOTAL CUMULATIVE CREDITS					**85**			
TOTAL CONTACT HOURS					**29**			

Course Title	**Probability and Random Process**				**Course Type**		**Hard Core**	
Course Code	B20AS0402	**Credits**	**3**		**Class**		**IV Semester**	
Probability and Random Process	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	**Analog Communication**				**Course Type**		**HC**	
Course Code	**B20EN0401**	**Credits**	3		**Class**		**IV Semester**	
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Tutorial	-	-	-				
	Practice	0	0	0				
	-				Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**		**50%**	**50%**

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:

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(COs)

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:** Modulation , need for modulation, Classifications, AM, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring 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. Super heterodyne receivers. Related numerical
UNIT - 3 **Angle Modulation and Demodulation:** 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, zero crossing detectors, Phase Locked Loop, Non-linear Model of Phase Locked Loop, Linear Model of Phase Locked Loop.
UNIT - 4 **Introduction to Noise and Noise in Continuous Wave Modulation Systems:** Introduction, Autocorrelation and power spectral density, Mean, co-variance, 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

<table>
<tr><td>Course Title</td><td colspan="3">Electromagnetics and Transmission lines</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0402</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="7"></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>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>1</td><td>2</td><td>2</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+ Tutorial</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>4</td><td>5</td><td>5</td><td>42+28</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

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 at radio frequency

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the relation between E and V in Electrostatic field	1,2,3,4,12	1,2,3
CO2	Solve the problems on ampere circuit law applicable to Magnetic field	1,2,3,4,12	1,2,3
CO3	Determine the relationship between time varying Electric and Magnetic field and Electromotive force in Maxwell’s equation	1,2,3,4,12	1,2,3
CO4	Correlate Electromagnetic Wave equation in different media	1,2,3,4,12	1,2,3

CO5	Analyze the Electrical equivalent of Transmission line	1,2,3,4,12	1,2,3
CO6	Compare the characteristics of transmission line for various load conditions	1,2,3,4,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3								2	3	2	1
CO2	3	3	3	3								2	3	2	1
CO3	3	3	3	3								2	3	2	1
CO4	3	3	3	3								2	3	2	1
CO5	3	3	3	3								2	3	2	1
CO6	3	3	3	3								2	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, Maxwell's Equations for Electrostatic Fields, Energy Density, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations; Capacitance - Parallel plate, 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, Forces due to Magnetic Fields, Ampere's Force Law, 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 Different Final 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 and Good Dielectrics, Illustrative Problems. Reflection and Refraction of Plane Waves - Normal for both perfect Conductor and perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem , 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 Single Stub Matching, Illustrative Problems.

TEXT BOOKS:

4. Matthew N. O. Sadiku, "Elements of Electromagnetics" 4th., Oxford niv.Press
5. William H. Hay Jr. and John A. Buck, "Engineering Electromagnetics" 7thEd., 2006, TMH.
6. 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:

17. https://aemjournal.org/index.php/AEM/scope
18. https://www.tandfonline.com/toc/uemg20/current
19. IEEE Transactions on electromagnetic Compatibility
20. 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	Microcontrollers and Applications	Course Type	HC

Course Code	B20EN0403	Credits	3		Class		IV Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**		**50 %**	**50 %**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

1. Introduce Microcontroller 8051 Architecture.
2. Give an insight into instruction set of microcontroller 8051.
3. Introduce assembly and C programming for 8051.
4. Provide insight into timer, serial communication and interrupts modules of 8051.
5. Interface a microcontroller with peripheral devices.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the Architecture of 8051 microcontroller	1,2,4	1,3
CO2	Describe Instruction Set of 8051	1,2,4	1,3
CO3	Write Assembly and C Programs for 8051	1,2,4,5	1,2,3
CO4	Design Timer applications	1,2,12	1,2,3
CO5	Implement serial communication applications	1,2,12	1,2,3
CO6	Interface various peripherals.	1,2,12	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									3		2
CO2	3	3		2									3		2
CO3	3	3		2	2								3	2	2
CO4	3	3										2	3	2	2
CO5	3	3										2	3	2	2
CO6	3	3										2	3	2	2

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

COURSE CONTENT

THEORY:

Contents
UNIT – 1 **8051 Architecture, Addressing Modes and Instruction Set:** Introduction to Microprocessors and Microcontrollers, The 8051 Architecture, Memory organization, Addressing Modes, Data transfer Instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instruction. Assembler Directives, Stack, Assembly language programs
UNIT – 2 **Timers/Counters, Serial Communication and Interrupts:** Basics of interrupts, 8051 interrupt structure. Timers and Counters, Timer delay calculations, Serial Communication, connections to RS-232, UART. Programming in Assembly and C Language
UNIT – 3 **Interfacing and Applications :** 8051 Memory Interfacing, Interfacing 8051 to LCD, parallel and serial ADC, DAC, Stepper motor and DC Motor,MAX232, Interfacing Programming in C Language.
UNIT – 4 **Advanced microcontrollers:** Architecture and memory organization: PIC16F877A, MSP430, ARM Cortex-3, AtMega32

TEXT BOOKS:

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. Sandhu, Harprit singh. “Making PIC microcontroller instruments and controllers / Harprit Singh Sandhu.” McGraw-Hill (2009).
4. https://e2echina.ti.com/group/c8df485b47/m/msp430/11060/download
5. https://www.arm.com/zh/files/word/Yiu_Ch1.pdf

6. http://ce.sharif.edu/~pourmohammadi/AVR%20Microcontroller%20and%20Embedded%20Systems/AVR%20Microcontroller%20and%20Embedded%20Systems.pdf

<table>
<tr><td>Course Title</td><td colspan="4">Object Oriented Programming and Data Structures using C++</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0404</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"></td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="3">Total Number of Classes Per Semester</td><td colspan="2" rowspan="3">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>1</td><td>2</td><td>2</td></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>2</td><td>3</td><td>3</td><td>14+28</td><td></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:

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	1,2,3,5	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. Apply the concept of run time polymorphism	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 and linked list.	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	3	2		2								2	2	1
CO2	3	3	2		3								3	2	1
CO3	3	3	2		3								3	3	2
CO4	3	3	3		3								3	3	2
CO5	3	3	3		2								3	2	3
CO6	3	3	3		2								3	2	3

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

COURSE CONTENT
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

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

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;

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. Concept of Files.

TEXT BOOKS:

1. Stanley B. Lippmann, Josee Lajore: “C++ Primer”, 4th Edition, Pearson Education, 2005
2. Langsam, Augenstein, Tenenbaum, "Data Structures Using C and C+", 2nd edition, Pearson Education India, 2015.

REFERENCE BOOK:

1. Herbert Schildt , “The Complete Reference C++”, Fourth Edition, McGraw-Hill, 2003.
2. Bjarne Stroustrup, “ The C++ Programming Language”, 4th Edition, Pearson Education, 2003
3. . Seymour Lipschutz, “Data Structure with C”, TMH.
4. G. A. V. Pai, “Data Structures and Algorithms”, TMH, 2008

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

SWAYAM/NPTEL/MOOCs:

- SWAYAM/NPTEL: “Programming in C++ and Data Structures”;
  link: https://onlinecourses.nptel.ac.in/noc21_cs02/preview
  link: https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/
- MOOC: Programming in C++ and Data Structures.
  link: https://www.coursera.org/specializations/hands-on-cpp
  link: https://www.coursera.org/learn/cs-fundamentals-1

Course Title	Analog Communication Lab				Course Type	HC
Course Code	B20EN0406	Credits	1		Class	IV Semester
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment in

	Theory	-	-	-	Per Semester		Weightage	
	Tutorial	-	-	-				
	Practice	1	2	2	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 to correlate the concepts studied in theory and the results obtained from experiments.

COURSE OBJECTIVES:

The objectives of this course are:

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(COs)

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	Design 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	Demonstrate Pre-Emphasis and De-Emphasis of a given signal.	1,2,3,4,5,9,10	1,2,3
CO6	Demonstrate AM and FM techniques using LabVIEW software	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 and Techniques**	**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 Modulation and Demodulation.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
3	AM-Double Sideband Suppressed Carrier (DSBSC) Generation and Detection.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
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 Modulated wave for modulation index (β >1) using IC 8038 and Demodulate the signal using IC 565.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
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

Text Books:

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

REFERENCE BOOK:

3. B. P. Lathi, "Modern digital and analog Communication systems", Oxford University press, 3rd Edition, 2005.
4. 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	**Microcontrollers and Applications Lab**				**Course Type**	**HC(Integrated)**
Course Code	**B20EN0407**	**Credits**	**1**		**Class**	**IV Semester**
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment in

	Lecture	-	-	-	Per Semester		Weightage	
	Tutorial	-	-	-				
	Practice	1	2	2				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**1**	**2**	**2**		**28**	**50 %**	**50 %**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

1. Introduce Microcontroller 8051 Architecture.
2. Give an insight into instruction set of microcontroller 8051.
3. Introduce assembly and C programming for 8051.
4. Provide insight into timer, serial communication and interrupts modules of 8051.
5. Interface a microcontroller with peripheral devices.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the Architecture of 8051 microcontroller	1,2,4	1,3
CO2	Describe Instruction Set of 8051	1,2,4	1,3
CO3	Write Assembly and C Programs for 8051	1,2,4,5	1,2,3
CO4	Design Timer applications	1,2,12	1,2,3
CO5	Implement serial communication applications	1,2,12	1,2,3
CO6	Interface various peripherals.	1,2,12	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									3		2
CO2	3	3		2									3		2
CO3	3	3		2	2								3	2	2
CO4	3	3										2	3	2	2
CO5	3	3										2	3	2	2
CO6	3	3										2	3	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	Data Transfer Instructions: Block Data Transfer without overlap, Sorting	Keil uVision3	Writing programs for a given task
2	Arithmetic Instructions: 32-bit multi-precision Addition, Subtraction, square and cube of 8-bit number and 8-bit Division.	Keil uVision3	Writing programs for a given task
3	Logical Instructions: ASCII to packed BCD and Vice versa, Implementation of Boolean expressions (Bit Manipulation).	Keil uVision3	Writing programs for a given task
4	Timers: Wave form generation with varying Duty Cycle using Interrupt and Polling Techniques.	Keil uVision3	Writing programs for a given task
5	Serial Communication: Serial data transmission with Polling and Interrupt technique (Regular and Look up table).	Keil uVision3	Writing programs for a given task
6	Interfacing DAC to generate various waveforms with output voltage varying between -12V to 12V with	Keil uVision3	Writing programs for a given task

	Amplitude and Frequency control.		
7	DC Motor speed control using external interrupt.	Keil uVision3	Writing programs for a given task
8	Stepper motor interfacing by controlling the steps and direction.	Keil uVision3	Writing programs for a given task
9	Display the ASCII value of Key pressed on LCD.	Keil uVision3	Writing programs for a given task

TEXT BOOKS:

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. Sandhu, Harprit singh. "Making PIC microcontroller instruments and controllers / Harprit Singh Sandhu." McGraw-Hill (2009).
4. https://e2echina.ti.com/group/c8df485b47/m/msp430/11060/download
5. https://www.arm.com/zh/files/word/Yiu_Ch1.pdf
6. http://ce.sharif.edu/~pourmohammadi/AVR%20Microcontroller%20and%20Embedded%20Systems/AVR%20Microcontroller%20and%20Embedded%20Systems.pdf

Course Title	**Object Oriented Programming and Data Structures using C++ Lab**				**Course Type**		**HC**	
Course Code	**B20EN0408**	**Credits**	**1**		**Class**		**IV Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-				
	Practice	1	2	2	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**1**	**2**	**2**		**26**	**50 %**	**50 %**

COURSE OVERVIEW:

The purpose of this course is to provide the solid foundations in the concepts of data structures algorithms and OOP using C++ programming language. The concepts of Data Structures and C++ Programming Language are very important to developing Application Software, System Software, Operating Systems, and Network Simulators as it employs Object-Oriented programming (OOP) aspect. This course has important features of OOP like Encapsulation, Data Abstraction, Polymorphism and Inheritance which are not present in C Programming Language. Survey of fundamental linear 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:

1. Provide insights into the role of programming languages like C and C++ in design and development.
2. Provide a concise 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	Illustrate the use of C++ Procedural Programming.	1,2,3,5,9,10	1,2,3
CO2	Apply the concept of classes and objects in writing object-based programs	1,2,3,5,9,10	1,2,3
CO3	Apply the concept of inheritance and polymorphism in writing object-oriented programs.	1,2,3,5,9,10	1,2,3
CO4	Identify and classify various types of data structures	1,2,3,,5,9,10	1,2,3
CO5	Implement data structures like an array, stack, queue, linked list and File Handling using C++ programs.	1,2,3,5,9,10	1,2,3
CO6	Evaluate the knowledge gained on Procedural and Object-Oriented programming concepts of C++ using the appropriate IDE.		

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	a. Write a C++ program to generate all the prime numbers between 1 to 20. b. Write a C++ program to find both the largest and smallest number in an array of size 10. c. Write a Program to illustrate New and Delete Keywords for dynamic memory allocation.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with conditional & looping statements.
2	Write a C++ Program to display Names, Roll No., and grades of 3 students who have appeared in the examination. Declare the class of name, Roll No. and grade. Create an array of class objects. Read and display the contents of the array.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with declaring & defining 'Class, Data Members, & Member Functions'.
3	Given that an EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary and print data members.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with member function all.
4	Write a C++ Program to illustrate default constructor, parameterized constructor and copy constructors.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with constructors.
5	a. Write C++ program to illustrate single Inheritance. b. Write C++ program to illustrate single Inheritance.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with class inheritance.
5	a. Write C++ program to implement compile-time polymorphism. b. a. Write C++ program to implement run-time polymorphism.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with polymorphism.

6	Write C++ program to implement Stack and perform push, pop, & display operation on it.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with Stack.
7	Write C++ program to implement Queue and perform enqueue, dequeue, & display operation on it.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with Queue.
8	Write C++ program to implement Singly Linked List and perform operation 'adding new node at the beginning of Linked List' & display node values.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with Linked List.
9	Write C++ program to implement Singly Linked List and perform operation 'adding new node at the end of Linked List' & display node values.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with Linked List.
10	a. Write C++ program to implement Singly Linked List and perform operation 'deleting a last node from the Linked List' & display node values. b. Write C++ program to implement Singly Linked List and perform operation 'deleting a first node from the Linked List' & display node values.	Algorithm, Flowchart, & C++ compiler.	Writing program skills with Linked List.

TEXT BOOKS:

1. Stanley B. Lippmann, Josee Lajore: "C++ Primer", 4th Edition, Pearson Education, 2005
2. Langsam, Augenstein, Tenenbaum, "Data Structures Using C and C+", 2nd edition, Pearson Education India, 2015.

REFERENCE BOOK:

1. Herbert Schildt , "The Complete Reference C++", Fourth Edition, McGraw-Hill, 2003.
2. Bjarne Stroustrup, " The C++ Programming Language", 4th Edition, Pearson Education, 2003
3. Seymour Lipschutz, "Data Structure with C", TMH.
4. G. A. V. Pai, "Data Structures and Algorithms", TMH, 2008

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

SWAYAM/NPTEL/MOOCs:

- SWAYAM/NPTEL: “Programming in C++ and Data Structures”;
  link: https://onlinecourses.nptel.ac.in/noc21_cs02/preview
  link: https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/
- MOOC: Programming in C++ and Data Structures.
  link: https://www.coursera.org/specializations/hands-on-cpp

link: https://www.coursera.org/learn/cs-fundamentals-1

<table>
<tr><td>Course Title</td><td colspan="4">Course based project on Microcontrollers and Applications</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0405</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="6"></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>Theory</td><td>0</td><td>0</td><td>0</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 Based Project/Project Based Learning has been considered a good approach in improving education in Engineering, because, this approach facilitates learning difficult subjects, encourages active learning, and allows developing both the Engineering skills and transversal skills by using a 'learning environment that simulates a real professional challenge'.

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

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

BLOOM’S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

Execution:

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

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

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

4. The activities for each week will be assigned.

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

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

Assessment and Evaluation:

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

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

Course Title	Communication Skills			Course Type	FC
Course Code	B20AH0301	Credits	2	Class	IV Semester

	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**2**	**2**	**2**	**28**		**50 %**	**50 %**

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES(COs)
On successful completion of this course; the student shall be able to:

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

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		1	1		
CO2										3		1	1		
CO3										3		1	1		
CO4										3		1	1		

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

COURSE CONTENT
THEORY:

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

TEXT BOOKS:

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

REFERENCE BOOK:

1. Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.
2. Rizvi, M. Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill, 2005.
3. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 20ll.
4. Sen et al. Communication and Language Skills. Cambridge University Press, 20l5.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:
SWAYAM/NPTEL/MOOCs:

TEXT BOOKS:

REFERENCE BOOK:
JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:
SWAYAM/NPTEL/MOOCs:

Course Title	Indian Constitution and Professional Ethics				Course Type		FC	
Course Code	B20LS0301	**Credits**	**2**		**Class**		**IV Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-				
	Practice	-	-	-	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**2**	**2**	**2**	**28**		**50 %**	**50 %**

COURSE OVERVIEW:

COURSE OBJECTIVES:

The objectives of this course are:

i. To provide conceptual knowledge of Indian culture and traditions

ii. To introduce students to the science and technological advancements related to Indian culture

iii. To help students understand the Indian spiritual aspects of Indian culture

iv. To help learners understand the factors which unite the diverse cultures of India

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.	6,8,9	1
CO2	Describe various ancient theories in treatment of any disease.	6,8,9	1
CO3	Appreciate the science and technological advancements in ancient India.	6,8,9	1
CO4	Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.	6,8,9	1

CO5	Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food	6,8,9	1
CO6	Understand India as a land united by cultural diversity.	6,8,9	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

Contents

UNIT - 1 Indian Tradition

i. 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
ii. Religion – Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity
iii. Art – Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, puppetry
iv. Architecture – Engineering and Architecture in Ancient India; Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India
v. Literature- Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

Unit 2: Contribution of ancient India to Science and Maths

i. Development of Science in Ancient India- Astronomy, Mathematics, Medicine, Metallurgy.

ii. Scientists of Ancient India:

a. Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya
b. Science- Kanad, Varahamihira, Nagarjuna
c. Medical Sciences (Ayurveda and Yoga)- Susruta, Charaka, Yoga and Patanjali

iii. Science and Scientists in Medieval India- Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.

iv. Scientists in Modern India- Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir Bhabha, Dr.

Unit 3: Indian Spiritual Aspects

I. Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

ii. Hata Yoga and Pranayama- Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga; Bhakti Yoga – yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

iii. Buddhist, Jaina Spiritualities- Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - Ashtanga Marga

Unit IV: Unity in Diversity

i. Commensality and the Significance of Food – Eating Together as Family and as a Society, Food at Rituals; annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World
ii. Celebrating Diverse Festivals – Festival Types: Religious and Seasonal, Religious - Holi, Diwali, Ganesh Chaturthi, Janmashtami, Mahavir Jayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals) - Baisakhi, Pongal, Sankranti
iii. Attire - Indus Valley Civilization, Vedic period, Modern India

TEXT BOOKS:

1. Sundararajan K.R., Hindu Spirituality - Vedas through Vedanta, Cross Road Publications, New York, 1997.

2. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992

3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998

4. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.

5. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

REFERENCE BOOK:
JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:
SWAYAM/NPTEL/MOOCs:

Course Title	**Universal Human Values**				**Course Type**		**MC**	
Course Code	B20AHM401	**Credits**	**0**		**Class**		**IV Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	1	1				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	1	1	13 Theory	- Practical	- **IA**	- **SEE**
	Total	**2**	**2**	**2**	**28**		**50 %**	**50 %**

COURSE OVERVIEW:

COURSE OBJECTIVES:

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

The objectives of this course are:

COURSE OUTCOMES(COs)

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

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession	6,9,10	1
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc	6,9,10	1

CO3	Understand the role of a human being in ensuring harmony in society and nature.	6,9,10	1
CO4	Demonstrate the role of human being in the abetment of pollution	6,9,10	1
CO5	Describe appropriate technologies for the safety and security of the society as responsible human being	6,9,10	1
CO6	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	6,9,10	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

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

TEXT BOOKS:

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

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

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

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

REFERENCE BOOK:

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

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

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

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:
SWAYAM/NPTEL/MOOCs:

Approved Scheme for 2020-24 Batch in BOS-2022

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0501	Digital Communication	HC	3	0	0	3	3
2	B20EN0502	Signals and Systems	HC	3	0	1	4	5
3	B20EN0503	Verilog for FPGA Development	HC	3	0	0	3	3
4	B20ENS5XX	Professional Elective-1	SC	3	0	0	3	3
5	B20ENS5XX	Professional Elective-2	SC	3	0	0	3	3
6	B20XXO5XX	Open Elective-1	OE	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B20EN0504	Digital Communication Lab	HC	0	0	1	1	2
8	B20EN0505	Verilog for FPGA Development Lab	HC	0	0	1	1	2
9	B20EN0506	Technical Documentation	FC	1	0	0	1	1
10	B20EN0507	Research based project	HC	0	0	1	1	2
TOTAL				**1**	**0**	**3**	**4**	**7**
TOTAL SEMESTER CREDITS					**23**			
TOTAL CUMULATIVE CREDITS					**108**			
TOTAL CONTACT HOURS					**27**			

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0601	Control Engineering	HC	3	0	1	4	5
2	B20EN0602	Digital Signal Processing	HC	3	0	0	3	3
3	B20EN0603	Computer Networks	HC	3	0	0	3	3
4	B20EN0604	Computer Architecture and organization	HC	3	0	0	3	3
5	B20ENS6XX	Professional Elective-3	SC	3	0	0	3	3
6	B20XXO6XX	Open Elective-2	OE	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B20EN0605	Digital Signal Processing lab	HC	0	0	1	1	2
8	B20EN0606	Computer Networks Lab	HC	0	0	1	1	2

9	B20EN0607	Mini project/Internship	HC	0	0	2	2	4
10	B20PA0501	Indian Tradition and Culture	FC	1	0	0	1	2
TOTAL				**1**	**0**	**3**	**5**	**8**
TOTAL SEMESTER CREDITS					**24**			
TOTAL CUMULATIVE CREDITS					**132**			
TOTAL CONTACT HOURS					**28**			

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0701	Microwaves and Antenna	HC	3	0	0	3	3
2	B20EN0702	CMOS VLSI Circuits	HC	3	0	0	3	3
3	B20ENS7XX	Professional Elective-4	SC	3	0	0	3	3
4	B20ENS7XX	Professional Elective-5	SC	3	0	0	3	3
5	B20XXO7XX	Open Elective-3	OE	3	0	0	3	3
TOTAL				**15**	**0**		**15**	**15**
Practical /Term Work / Sessional								
6	B20EN0703	Microwaves and Antenna Lab	HC	0	0	1	1	2
7	B20EN0704	CMOS VLSI Circuits Lab	HC	0	0	1	1	2
8	B20EN0705	Major Project Phase – 1	HC	0	0	1	1	2
TOTAL				**0**	**0**	**3**	**3**	**2**
TOTAL SEMESTER CREDITS					**18**			
TOTAL CUMULATIVE CREDITS					**150**			
TOTAL CONTACT HOURS					**21**			

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20XXO8XX	Open Elective-4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessional								
2	B20EN0801	Major Project Phase – 2	HC	0	0	0	7	14
TOTAL				**0**	**0**	**0**	**7**	**14**
TOTAL SEMESTER CREDITS					**10**			
TOTAL CUMULATIVE CREDITS					**160**			
TOTAL CONTACT HOURS					**17**			

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE							
5TH SEM /OE1		**6TH SEM /OE2**		**7TH SEM /OE3**		**8TH SEM /OE4**	
Course code	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**
B20ECO501	PCB Fabrication	B20ECO601	Basics of Communication Systems	B20ECO70 1	Automotive Electronics	B20ECO801	Consumer Electronics
B20ECO502	Embedded Systems	B20ECO602	Sensors and Instrumentation	B20ECO70 2	Robotic Systems	B20ECO802	Healthcare Electronics

	PROFESSIONAL ELECTIVES						
PE	**Course Code**	**Domain1: Electronics**	**Course Code**	**Domain 2:Communication**	**Course Code**	**Domain3: Computers**	
PE-1 / 5TH SEM	B20ENS511	ARM Processors and Applications	B20ENS512	Optical Fiber Communication	B20ENS513	Theory of Algorithms	
PE-2 / 5TH SEM	B20ENS521	Automotive Electronics	B20ENS522	Information Theory and Coding	B20ENS523	Database Management Systems	
PE-3 / 6TH SEM	B20ENS631	Power Electronics	B20ENS632	Cryptography and Network Security	B20ENS633	JAVA Programming	
PE-4/ 7TH SEM	B20ENS741	Analog and Mixed mode VLSI	B20ENS742	Wireless and Multimedia Communication	B20ENS743	Machine Learning	Operating Systems
PE-5 / 7TH SEM	B20ENS751	MEMS and Nano Technology	B20ENS752	RF Communications and Applications	B20ENS753	Web Programming	Compiler Design

Detailed Syllabus

V Semester

Course Title	**Digital Communication**				**Course Type**		**HC**	
Course Code	B20EN0501	**Credits**	3		**Class**		**V Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**		**50 %**	**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	Intrepret 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-jsTlpA
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

Course Title	**Signals and Systems**				**Course Type**		**HC Integrated**	
Course Code	**B20EN0502**	**Credits**	**4**		**Class**		**V Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment inWeightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	1	2	2				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	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 OBJECTIVES:

The objectives of this course are :

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.	1,2,3,4,5,9,10	1,2
CO2	Apply Convolution operation on an LTI System to calculate the output.	1,2,3,4,5,9,10	1,2
CO3	Represent the continuous and Discrete time periodic signals in frequency domain and calculate the Fourier Coefficients	1,2,3,4,5,9,10	1,2,3
CO4	Represent the continuous and Discrete time Aperiodic signals in frequency domain and interpret the Frequency Spectrum	1,2,3,4,5,9,10	1,2,3
CO5	Analyze the stability of Discrete time system by applying Z-transform.	1,2,3,4,5,9,10	1,2,3
CO6	Represent the discrete time system in Z-domain and determine the behavior of Causal LTI system using properties of Z-Transform.	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	1	1	2				2	2			2	3	
CO2	3	3	2	1	2				2	2			2	3	
CO3	3	2	1	1	2				2	2			2	3	
CO4	3	3	1	1	2				2	2			2	3	
CO5	3	3	2	1	2				2	2			2	3	
CO6	3	2	1	1	2				2	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, Basic operations on signals, Classification of signals, Properties of systems, Numerical on each topic.
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, Fourier Representation of Periodic Signals: **Analysis using** CTFS and DTFS of basic signals. Numerical on each topic.
UNIT - 3 **Fourier Transform and its applications** FT representation of CT signals – Definition of FT, FT of standard CT signals, Properties and their significance, Inverse FT, Solving differential equations using FT. FT representation of DT signals-Definition of DTFT, DTFT of standard DT signals, Properties and their significance. Numerical on each topic.
UNIT - 4 **Z-Transforms and its applications** Z -Transforms: Definition, Properties of Z transform, ROC, Inversion of Z – transforms, transform analysis of LTI Systems. Z-Transforms and its application to solve difference equations. Numerical on each topic.

PRACTICE SESSION:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1.	a) Generation and Plotting of Sine Waves b) Generation and Plotting of Elementary Signals	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.	To Compute the Linear	Simulation of Mathematical Model	Program synthesis, Debugging,

	Convolution of The Given Input Sequence x(n) & The Impulse Response of The System h(n). (Causal Sequences)	in Octave or MATLAB scripting.	Simulation and Verification
6.	To Compute the Linear Convolution of The Given Input Sequence x(n) & The Impulse Response of The System h(n). (Non-Causal Sequences)	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.	a) Fourier synthesis of square wave in MATLAB b) Fourier synthesis of a triangular wave in MATLAB	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
10.	Demonstration of Sampling Theorem.	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
11.	To Compute the Linear Convolution of The Given Input Sequence x(n) & The Impulse Response of The System h(n) using TMS320C6713 Kit.	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
12.	Solve Any Given Difference Equation of An LTI System Without Initial Conditions Using TMS320C6713 Kit.	Simulation of Mathematical Model in CCS Studio. Dumping and Verification of Simulated code in TMS320C6713 Kit.	Program synthesis, Debugging, Simulation and Verification
13.	Demonstration 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.

REFERENCE BOOK:

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.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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/

Course Title	**Verilog for FPGA Development**				**Course Type**		**HC**	
Course Code	**B20EN0503**	**Credits**	**3**		**Class**		**V Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**-**	**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. Understand behavioural 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	1,2,3	1,2,3
CO3	Develop Verilog programs for digital circuits using gate, dataflow, behavioral and switch 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	1,2,3	1,2,3

CO6	Demonstrate the FPGA design flow by implementing digital circuits	1,2,3	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										1	2	1
CO2	3	3	3										3	2	1
CO3	3	3	2										3	3	2
CO4	3	3	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, why Verilog HDL?, trends in HDLs. **Hierarchical Modeling Concepts:** Top-down and bottom-up design methodology, differences between modules and moduleinstances, parts of a simulation, design block, stimulus block.
UNIT - 2 **Basic Concepts:** Lexical conventions, data types, system tasks, compiler directives. **Modules and Ports**: Module definition, port declaration, connecting ports, hierarchical name referencing.
UNIT - 3 **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 - 4

Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, generatestatement, event control, conditional statements

Logic Synthesis with Verilog: Verilog HDL Synthesis, Synthesis design flow,Verification of Gate-Level Netlist.

Field Programmable Gate Arrays: Field Programmable Gate Arrays, The Role of FPGAs in the ASIC Market, FPGA Technologies, XlLINX Virtex FPGAs, Verilog-Based Design Flows for FPGAs, Synthesis with FPGAs

TEXT BOOKS:

1. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, Pearson Education.
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.

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

Professional Elective 1

Course Title	**ARM Processors and Applications**				**Course Type**		**SC**	
Course Code	B20ENS511	**Credits**	3		**Class**		**V Semester**	
	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	Analyze and Compare various Processor and Controller Architectures with ARM Cortex-M3.	1,2,3	1,2
CO2	Apply the knowledge of programming in assembly language and C language.	4,5	1,2,3
CO3	Demonstrate programming proficiency using the various exceptions and interrupts	1,2,3,4,5	1,2,3
CO4	Illustrate the concept of memory mapping and bit banding for Cortex series microcontrollers	1,2,3,5	1,2,3
CO5	Program ARM Cortex-M3 MCUs by identifying the software development tools.	1,2,3,4,5	1,2,3
CO6	Program ARM Cortex-M3 MCUs for Serial Communication 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 **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.
UNIT - 2 **Instruction Sets-** Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming.
UNIT - 3 **Exceptions and Interrupts-** Exceptions types, fault exceptions, basic interrupt configuration, example procedures in setting up an interrupt, interrupt/exception sequences, tail-chaining interrupts, late arrivals, interrupt latency.
UNIT - 4 **Cortex M3 Programming-** Overview of NxP's LPC1768, understanding different functional blocks and their Applications in LPC 1768, pin connect block, GPIO programming, System Control, Clock Control and Power Control, Timers/counters, WDT, RTC, ADC, I2C, SPI, UART, serial communication.

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/

Course Title	Optical Fiber Communication				Course Type		SC	
Course Code	B20ENS512	Credits	3		Class		V Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment inWeightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	0	0	0	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

Optical Fiber communication covers very relevant topics that make them aware of importance of fundamentals of Light and latest developments in Coherent Optical communication and necessary to communication engineers to address future needs of high data rate communications. The course will give you the knowledge in order to understand both the fundamentals and the rapid development, that you as professional engineer can use the fiber optics efficiently. Further the course focus on characteristics of optical fibers, laser diodes, optical detectors, and receivers from physical and transmission system point of view. Finally, the course will conclude with outlook for future research in extending the capabilities of these networks to higher bandwidths and secured communications.

COURSE OBJECTIVES:

The objectives of this course are to:

1Comprehend the knowledge of mathematically propagation of optical signals over optical Fiber cables.

2.Conceptualize the degradation of signals during propagation of optical signals over optical fiber.

3.Explain the characteristics of optical sources and detectors.

4.Analyze various techniques for coherent transmission and system performance factors in optical Communication system.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the optical fiber communication link, structure, propagation, fiber configurations, and modes of transmission in fiber.	1,2,3,4	1,2,3
CO2	Estimate the signal degradation factors/losses associated with optical fibers	1,2,3,4	1,2,3
CO3	Apprise the properties of various optical components in optical communication systems	1,2,3,4	1,2,3
CO4	Analyze the characteristics of optical sources and photo detectors	1,2,3,4	1,2,3
CO5	Design short haul and long haul analog/digital optical fiber communication system	1,2,3,4	1,2,3

CO6	Analyze the performance of optical receiver based on receiver sensitivity/channel selectively	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	3	3	1	1									3	2	1
CO3	3	3	1	1									3	3	1
CO4	3	3		1									3	3	1
CO5	3	3		1									3	3	1
CO6	3	3		1									3	3	1

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1 **Overview to Optical Fiber Communication:** Electromagnetic spectrum, Optical spectral Bands, General system Advantages and Applications of fiber optic transmission systems, Basic Optical laws and Definitions, Ray theory transmission , TIR, Numerical Aperture, Acceptance angle, Parameters of fiber optic cable: Acceptance angle, Numerical aperture, Skew rays, Mode, Index Profile, V number. Single mode fibers - Cutoff wavelength, Mode Field Diameter, Fiber Birefringence, Average optical power, Fiber Materials, Manufacturing process of fiber optic cable.

UNIT – 2
Signal Distortion in Optical Fibers: Attenuation, Fiber attenuation measurement, Demonstration of Measurement of attenuation loss and bending loss for various lengths of fiber optic cable, Scattering Losses – Rayleigh, Mie, Brillouin and Raman Scattering, Fiber Bend Loss, Dispersion - Concepts of Modal Dispersion, Material Dispersion, Waveguide Dispersion, Polarization Mode Dispersion; Optical Time Domain reflectometer (Principle, concept & applications)
UNIT - 3
Optical Transmitter and Receiver Optical sources: Light emitting diode: LED structures, LED characteristics, Practical parameters - Quantum efficiency, LED Power, Laser Diodes - Modes & threshold conditions, Principle operation of Semiconductor Laser, Configuration of Fabry-Perot resonator for laser diode, Practical parameters - Quantum efficiency, Resonant frequency; **Optical detectors/ Photo detectors:** Optical detection principles, Characteristics of optical detector, Physical Principle of PIN and APD, Practical parameters - Quantum efficiency, Detector responsitivity, Cutoff wavelength, Response time **Optical sensors:** Basic concept, Intrinsic fiber sensors, Extrinsic fiber sensors Optical Amplifier - EDFA Amplification Mechanism, EDFA Architecture,
UNIT – 4
OFC System and system design considerations: Optical Receiver: Fundamental Receiver Operation, Practical parameters - Receiver sensitivity, Quantum Limit, Eye diagrams, Concepts of Coherent detection. Analog Links – Overview of Analog Links, CNR(concept), Multichannel Transmission Techniques(concept), Link Parameters Definitions – Gain, Noise Figure, SFDR; Digital Links – Simplex Point to point link, Link Power Budget and Rise Time Budget with examples, Power Penalties, Modal noise, Mode-Partition Noise, Reflection Noise, Chirping

TEXT BOOKS:

1. Gerd Keiser “Optical Fiber Communications”, TMH, 4th Edition, 2008.
2. John M. Senior, “Optical Fiber Communications”, Pearson Education, 3rd Edition, 2009

REFERENCE BOOK:

1.D.K. Mynbaev, S.C. Gupta and Lowell L. Schemer, “Fiber Optic Communications”, Pearson Education, 2005.
2.G. P. Agarawal, “Fiber Optics Communication Systems”, John Wiley New York, 1997.
3.Joseph C Palais ,“Fiber Optic Communication”, 4th Edition, Pearson Education.

SWAYAM/NPTEL/MOOCs:

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

Course Title	**Theory of Algorithms**				**Course Type**		**SC**	
Course Code	B20ENS513	**Credits**	3		**Class**		**V Semester**	
	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:

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 problems.	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:

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

Professional Elective 2

<table>
<tr><td>Course Title</td><td colspan="4">Automotive Electronics</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS521</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"></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 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	Explain power train and drive train components in automotive systems	1,2	1,2,3
CO2	Discuss the role of electronics in engine control systems	2,3	1,2
CO3	Analyze the Exhaust After-Treatment systems in automotive systems	1,2,3	1,2
CO4	Illustrate the concepts of in-vehicle networking	2,3,7	2
CO5	Describe automotive safety systems & infotainment systems.	2,3,4,7	3
CO6	Recognize the On-board diagnostics, Off-board diagnostics.	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											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 **Automotive Industry and Modern Automotive Systems:** Vehicle classifications and specifications, need for electronics in automobiles, Automotive Fundamentals Overview – Four Stroke Cycle, Electronic Ignition systems, Spark plug, Spark pulse generation, Ignition Timing. Transmission Control - Automotive transmissions, Drive Train, Brakes, Steering System - Steering Control, Starting System- Battery, Air/Fuel Systems, Fuel Handling, Air Intake System.
UNIT - 2 **Introduction to automotive sensors and Actuators:** Air/ Fuel Management Sensors – Oxygen (O2/EGO) Sensors, Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Sensors for occupant safety. Actuators – Solenoid actuator , Fuel Metering Actuator, Fuel Injector, Ignition Actuator , Sensor and actuator interfacing techniques.

UNIT - 3
Exhaust After-Treatment Systems and Communication Protocols: Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR) and it's control, Exhaust Gas Recirculation Actuator, Evaporative Emission Systems, Electronic Fuel Control System, Electronic Ignition control, Idle speed control. Automotive Communication Protocols: SPI, I^2C, USB, CAN, LIN, FLEXRAY, MOST protocols.
UNIT - 4
Electronics for Passenger Safety and Convenience: Electronics for Passenger Safety and Convenience – SIR, Air bag and seat belt pretension systems, Tire pressure monitoring systems, TCS , ESP, Collision Avoidance Radar warning Systems, Radio navigation, Advance Driver Information System. Integrated Body – Climate Control Systems, Electronic HVAC Systems, Lighting, Entertainment Systems, Alternative Fuel Engines, Lighting, wipers, Power windows, Remote keyless entry systems. Automotive Diagnostics – On-board diagnostics, Off-board diagnostics.Introduction to autonomous vehicles.

TEXT BOOKS:

7. Denton, "Automotive Electrical and Electronic Systems, Burlington", MA 01803, Elsevier Butterworth-Heinemann, 2004.
8. William B. Ribbens, "Understanding Automotive Electronics, 8^{th} Edition, Newnes, 2017.

REFERENCE BOOK:

1. Ronald K. Jurgen, "Automotive Electronics Handbook", 2^{nd} Edition, McGraw-Hill, 2007.
2. Robert Bosch GmbH, "Bosch Automotive Electrics & Electronics: Systems and Components, Networking and Hybrid Drive", Robert Bosch GmbH, 3^{rd} Edition, 1999.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:
https://nptel.ac.in/courses/108/102/108102121/

Course Title	**Information Theory and Coding**				**Course Type**		**SC**	
Course Code	**B20ENS522**	**Credits**	**3**		**Class**		**V Semester**	
	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**	**0**	**50 %**	**50 %**

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 correction.	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	**Database Management Systems (DBMS)**			**Course Type**	**SC**
Course Code	B20ENS523	**Credits**	**3**	**Class**	**V Semester**

	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	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 applications.	1,2,3	1,2,3
CO2	Make use of the concepts of relational algebra to solve quaries over database.	1,2,3	1,2
CO3	Construct the database for given real world application and solve quaries over it using SQL commands.	1,2,3	1,2
CO4	Develop an optimized database using design gidelines 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 quaries..	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	1
CO2	2	1	1										3	1	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. **SQL[10 Hrs]**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, 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 Elective -1

Course Title	**PCB Fabrication**				**Course Type**		**Open Elective**	
Course Code	**B20ENO501**	**Credits**	3		**Class**		**V Semester**	
PCB Fabrication	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:

This course discusses the basic design rules of PCB Designing and also the types of error. Also describes the modern tools for designing the PCB and Fabrication Process. The main objective of learning the PCB development process is to launch onto the production line and in the market.

Course Objectives:

The Course Objectives are

1. To understand the basic design rules for PCB Designing.
2. To acquainted with the production techniques of PCB Designing.
3. To introduce the modern tools for designing of PCB.
4. To understand the fabrication process of Single layer and Double layer PCB.

Course Outcomes:

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the basic rules of PCB designing.	1,2,3,9,11,12	1,2
CO2	List the design rules in designing PCB	1,2,3,9,11,12	1,2
CO3	Explain the EMI/EMC requirement of PCB	1,2,3,7,9,11,12	1,2
CO4	Apply advance techniques, skills and modern tools for designing of PCBs	1,2,3,5,9,11,12	1,2
CO5	Enumerate the PCB Etchning process	1,2,3,5,9,11,12	1,2,3, ,
CO6	Demonstrate the Fabrication of designed PCB.	1,2,3,5,7,9, 11,12	1,2

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	PO 10	PO11	PO12	PSO1	PSO2	PS O3
CO1	1	2	1						1		2	2	3	1	

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

Course Content:

Contents
UNIT – 1 **Introduction to Printed circuit board**: Fundamental of electronic components, different packages of components, SMD and PTH components, understanding selection criteria for components based on power specifications, size constraints, connection orientation requirement, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork. **Design rules for PCB**: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.DRC errors like Pad to Pad error, Cm-P,Cm-B,Cm-Cm,T-P,T-T,T-V etc.
UNIT-2 **Introduction printed circuit board production techniques:** Photo printing, film master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations. **PCB design for EMI/EMC:** Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques.
UNIT - 3 **Introduction to Electronic design automation(EDA) tools for PCB designing:** Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, creating report of design, creating manufacturing data (GERBER) for design.
UNIT - 4 **Fabricate single-side PCB for simple network**: Fabricate single-sided PCB, mount the components and assemble in a cabinet for any one of the electronic circuits. Components library creation, net list generation, DRC check by using PCB Design EDA tool. **Design and Fabricate Double-side PCB:** Understanding need of double side PCB board, inter layer signal passing through vias and bias, plated holes. Double layer board fabrication using tonner transfer method.

Text Books:

1. Printed circuit board design, fabrication assembly and testing by R. S. Khandpur, Tata McGraw Hill 2006

Reference Books:

1. Printed circuit Board Design and technology, Walter C. Bosshart
2. Printed Circuits Handbook, Sixth Edition, by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016
3. Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition 2009
4. Introduction to System-on-Package, Rao R Tummala &Madhavan Swami Nathan, McGraw Hill, 2008.
5. EMC and Printed circuit board, Design theory and layout, Mark I Montrose IEEE compatibility society
6. Flexible Printed circuit board Design and manufacturing, By Robert torzwell
7. Web-based Current literature.

Additional Resources:

1. https://www.youtube.com/watch?v=gMxVK3h5K1g
2. https://www.youtube.com/watch?v=4mewixM67Uc&list=PLSLZd4oi2O9rOSAuj0GvXGAa4D9ezeEVM
3. https://www.youtube.com/watch?v=IuG2vuwdMXc

Course Title	**Embedded Systems**				**Course Type**	**Open Elective**	
Course Code	B20ENO502	**Credits**	**3**		**Class**	**V Semester**	
Embedded Systems	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

https://nptel.ac.in/courses/108/102/108102045/

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Course Title	**Digital Communication Lab**				**Course Type**		**HC**	
Course Code	B20EN0504	**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	Practical	**IA**	**SEE**
	Total	**1**	**2**	**2**	**-**	**28**	**50 %**	**50 %**

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 conditions	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 DivisionMultiplexing 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

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	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 and circuit debugging. Working in a team

		design equations	
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,Multimeter, CRO) and design equations	Design and circuit debugging. 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 BOOK:

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

Course Title	**Verilog for FPGA Development Lab**				**Course Type**	**HC**
Course Code	**B20EN0505**	**Credits**	**1**		**Class**	**V Semester**
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment in

	Lecture	-	-	-	Per Semester		Weightage	
	Tutorial	-	-	-				
	Practice	1	2	2	Theory	Practical	**IA**	**SEE**
	-							
	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 in programming 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, DC motor 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	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
9	Display messages on the 7-segment display	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
10	Control speed and direction of DC motor	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.

<table>
<tr><td>Course Title</td><td colspan="3">Technical Documentation</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B20EN0506</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>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>1</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>14</td><td>-</td><td>50%</td><td>50 %</td></tr>
</table>

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.	8,9,10,12	**1**
CO2	Learn to avoid communication problems that distract the readers, causing confusions, distrust, or misunderstanding.	8,9,10,12	**1**
CO3	Learn to the practice of various verbal reasoning and grammar practice.	8,9,10,12	**1**
CO4	To search engineering information, both in traditional ways and online.	8,9,10,12	1
CO5	Write research/design reports with special emphasis on content and style.	8,9,10,12	1
CO6	learn strategies for preparing and delivering presentations, single or in team	8,9,10,12	1

BLOOM’S LEVEL OF THE COURSE OUTCOMES:

<table>
<tr><td rowspan="2">CO#</td><td colspan="6">Bloom’s Level</td></tr>
<tr><td>Remember (L1)</td><td>Understand (L2)</td><td>Apply (L3)</td><td>Analyze (L4)</td><td>Evaluate (L5)</td><td>Create (L6)</td></tr>
<tr><td>CO1</td><td>√</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td>√</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

CO3		√					
CO4		√					
CO5			√				
CO6			√				

COURSE ARTICULATION MATRIX:

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

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

Course Title	Research based project				Course Type		FC	
Course Code	B20EN0507	**Credits**	1		**Class**		**VI Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	0	1	1				
	Tutorial	0	-	-	Theory	Practical	**CIE**	**SEE**
	Practical	1	-	-				
	Total	**1**	**1**	**1**		**28**	**50%**	**50 %**

COURSE OVERVIEW

Research-based project course targets to promote and develop student competencies related to research practice and to benefit students through activities linked to research. This course denotes the application of learning and teaching strategies that link research with teaching. One of the main advantages would be to awaken student's interest in knowledge and the main problems that society faces in order that students may broaden their perspectives and focus their study areas.

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	Observe students research in the real world	1,4,6,7,8,9,10,11,12	1,2,3
CO2	Present research methods and approaches	1,4,6,7,8,9,10,11,12	1,2,3
CO3	Show experimental procedures and real exercises of computational issues in scientific disciplines.	1,4,6,7,8,9,10,11,12	1,2,3
CO4	Perform searches from the bibliography of a research paper, analyzing figures, diagrams, tables and simulators presented in the paper	1,4,6,7,8,9,10,11,12	1,2,3 ,
CO5	Describe a peer review of a research process	1,4,67,8,9,10,11,12	1,2,3
CO6	Relate the current result with the literature	1,4,6,7,8,9,10,11,12	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

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

Detailed Syllabus

VI Semester

Course Title	**Control Engineering**				**Course Type**		**HC Integrated**	
Course Code	**B20EN0601**	**Credits**	**4**		**Class**		**V I Semester**	
Control Engineering	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	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 critera ,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 observabilty 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/

<table>
<tr><td>Course Title</td><td colspan="4">Digital Signal Processing</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0602</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="6">Digital signal processing</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>
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<tr><td>Practice</td><td>-</td><td>-</td><td>-</td></tr>
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<tr><td></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:

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, efficient computation of th 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 Windows (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.

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. 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

<table>
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<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td colspan="2"></td><td colspan="2"></td></tr>
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<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 main objective of this course is to provide a foundational view of communication networks: the principles upon which the Internet and other computer networks are built; how those principles translate into deployed protocols and hands-on experience on solving challenging problems with network protocols. Computer communication networks course will include topics such as link-layer technology, switching, routing protocols, the Internet Protocol, reliability, flow control, congestion control, and their embodiment in TCP and UDP, Quality of Service and application layer protocols such as HTTP, etc. The course will involve a significant amount of network simulator tool to design the basic network topologies and protocols.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the basics of data communication and networking.
2. Classify multiple access methods and identify different LANs.
3. Illustrate functions of network layer and Demonstrate different routing protocols
4. Discuss transport layer and application layer protocols

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the fundamental concepts of basic networking, Protocols, Standards and Layered models	1,2,3	1,2,3
CO2	Compare OSI Model & TCP/IP Suite	1,2,3	1,2,3
CO3	Differentiate multiple access methods and LANs	1,2,3	1,2,3
CO4	Demonstrate the concepts of network layer and build sub-nets and routing mechanism.	1,2,3,5	1,2,3
CO5	Evaluate different transport layer protocols	1,2,3,5	1,2,3
CO6	Evaluate different application layer protocols	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	1										1	2	1
CO2	3	2	1										1	2	1
CO3	3	2	1		3								3	2	1
CO4	3	2	1		3								3	2	1
CO5	3	2	1		3								3	2	1
CO6	3	2	1		3								3	2	1

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Introduction to Data Communication and Networking:** Layered tasks, OSI Model, TCP/IP Suite, and Comparison of OSI Model & TCP/IP Suite. Addressing of TCP/IP Model. Framing, Flow and Error Control, Protocols: Noiseless channels and noisy channels, HDLC
UNIT - 2 **Multiple Access &LANs:** Random access, Controlled access, Channelization. Wired LAN, Ethernet, IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11
UNIT - 3 **Network Layer:** Logical addressing, Ipv4 addresses, Ipv6 addresses, Internetworking, Ipv4 Header Format and Ipv6 Header Format, Transition from Ipv4 to Ipv6. Distance vector routing, link state routing.
UNIT - 4 **Transport layer & Application Layer:** Process to Process Delivery, UDP, TCP, SCTP, Domain Name System, Resolution

Text Books:

1. B Forouzan “Data Communication and Networking”, 4th Ed, TMH 2006.

Reference Books:

1. James F. Kurose, Keith W. Ross “Computer Networks”, Pearson Education, 2nd Edition, 2003.
2. Wayne Tomasi”Introduction to Data communication and Networking” Pearson Education 2007.
3. S. Keshav, “An Engineering Approach to Computer Networking”, Pearson Education.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch01.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch02.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch11.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch12.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch13.ppt
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http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch23.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch25.ppt

SWAYAM/NPTEL/MOOCs:

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<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">I A</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:

Computer architecture and organization typically deals with the basic principles of computer organization, operation and architecture. It provides an overview of computer hardware and software and how the basic functional units are interconnected to form a complete computer system. The basics of I/O data transfer synchronization, interrupts and Direct Memory Access methods are presented. Bus protocols and standards are also presented with PCI, SCSI, and USB standards being used as representative commercial examples.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Make the students to understand the fundamental concepts of computer system architecture.
2. Provide an understanding of memories in computer, basic structure, I/O organization.
3. Provide an understanding of the concepts of interrupts, direct memory access and standard I/O interfaces.
4. Illustrate the organization of different types of semiconductor and other secondary storage memories.
5. Illustrate the simple processor organization based on hardwired control and micro programmed control.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe basic structure of computer system and memories.	1,2,3	1,2,3
CO2	Interpret the different types of addressing modes	1,2,3	1,2,3
CO3	Describe the Input/output organization and interrupt handling mechanisms.	1,2,3	1,2
CO4	Analyze the organization of different types of semiconductor and other secondary storage memories.	1,2,3	1,2,3
CO5	Differentiate the types of memories in a computer	1,2,3	1,2,3,
CO6	Distinguish between simple processor organization based on hardwired control and micro programmed control.	1,2,3	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

THEORY:

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: Numbers, arithmetic operations and characters, 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 Accesses, Buses, Interface Circuits, Standard I/O interfaces.
UNIT – 3 **The Memory System:** Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Synchronous DRAMs, Read Only Memories, Cache Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks.
UNIT – 4 **Basic Processing Unit:** Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control.

TEXT BOOKS:

9. Carl Hamacher, Z Varnesic and S Zaky, “Computer Organization”, Fifth Edition, McGraw Hill 2002.

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:

Memory Organization and Assembly Language Programming - ScienceDirect
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

Professional Elective-3

Course Title	**POWER ELECRONICS**				**Course Type**		SC	
Course Code	B20ENS631	**Credits**	3		**Class**		**VI Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial							
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**--**	**50%**	**50%**

COURSE OVERVIEW:
This course provides the basics of power devices, semiconductor devices control characteristics and its application is discussed. It also covers analysis of power converters for R, RL, RLE load conditions. The different types of modulation technique for control and conversion of power is also discussed.

COURSE OBJECTIVES:
The objectives of this course are:
1. Explain various power Semiconductor devices and applications.
2. Prepare the students to analyze different power converter circuits.
3. Provide understanding of modulation techniques used in power electronics.

COURSE OUTCOMES(COs)
On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Choose suitable power semiconductor device for a given application.	1,2,3,4	1,2,3
CO2	Design Controlled rectifier circuit for given specifications		
CO3	Analyze AC to DC and DC-DC, DC-AC and AC-AC converters for different load conditions.	1,2,3,4	1,2,3
CO4	List the advantages of Multi level Inverters	1,2,3,4	1,2,3
CO5	Analyze the different types of modulation techniques used to control and convert the power.	1,2,3,4	1,2,3
CO6	Analyze Bidirectional controllers and Single phase controllers for Inductive loads	1,2,3,4	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	1	1									3	3	3
CO2	3	3	3	3									3	3	3
CO3	3	3	2	1									3	3	2
CO4	3	3	1	2									2	2	2
CO5	3	3	1	2									2	2	2
CO6	3	3	1	2									2	2	2

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

COURSE CONTENT
THEORY:

Contents
Unit-1 **Power semiconductor devices:** Survey of power Semiconductor devices, Power diode, SCR, GTO, LASCR, RCT, SITH, BJT, MOSFET, IGBT etc., Switching losses, applications . **Controlled Rectifiers (Converters):** Single Phase, Half wave / full wave, half controlled /fully controlled converters with R and RL loads, Dual converters.
UNIT - 2 **DC- DC Converters :** Introduction, Principle of step down operation, step down converter with RL load, Principle of step up operation, step up converter with R-load, performance parameters, converter classification.
UNIT - 3 **Inverters:** Introduction, Single Bridge inverters with R load, Voltage control, modulation techniques, SPWM, Boost inverter. Current source inverters. **Multi-level inverters:** Introduction, multilevel concept, diode clamped multilevel inverter.
UNIT - 4 **AC voltage controllers :** Introduction, principle of on- Off control, single phase bidirectional controllers with R-load, single phase controllers with inductive loads.

Text Books:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Third Edition, 2004
2. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition, 1994

Reference Books:

1. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995.
2. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1996.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

https://www.youtube.com/watch?v=KTzQgAFTbCY
https://www.youtube.com/watch?v=Fl_oU71L-e4
https://www.youtube.com/watch?v=wHvF-yGOVos
https://www.youtube.com/watch?v=TKrtGkgsMA0
https://www.youtube.com/watch?v=ZbvWe9xBu3Q&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO
https://www.youtube.com/watch?v=djbJm-xWo2w
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https://www.youtube.com/watch?v=vvLwZ36fVa4

<table>
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<tr><td>Course Code</td><td>B20ENS632</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="6"></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:

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

<table>
<tr><td>Course Title</td><td colspan="4">JAVA Programming</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS633</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="6">JAVA Programming</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 inWeightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
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<tr><td>Practice</td><td>-</td><td>-</td><td>-</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:

Java is an object-oriented language that enables learners to create real-world applications. Java technology based software works just about everywhere from the smallest devices to super computers! Java technology components are not impacted by the kind of computer, phone, smart device or operating systems they are running on. The architecture-neutral nature of Java technology is important in a networked world where one cannot predict the kind of devices that partners, suppliers and employees use to connect to their organizations. The Java Programming in course is the first step for developing such applications. This course provides an introduction to object-oriented concepts and its implementation in Java technology programs. In addition, it covers syntax and semantics of the Java programming language.

COURSE OBJECTIVES:

The objectives of this course are:

1. Illustrate the creation of classes and objects in Java
2. Demonstrate concept reusing of code using inheritance and interfaces
3. Use proper program handling mechanism to write robust programs
4. Familiarize advance java concepts like Threads, Streams, IO, JDBC

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop simple programs using Java language concepts such as variables, conditional, methods and construct	1,2,3,5	1,3
CO2	Apply the concept of Classes and objects in developing program	1,2,3,5	1,3
CO3	Apply program structure like interface to develop programs	1,2,3,5	1,3
CO4	Build application using the concept of packages, exception handling and file handling	1,2,3,5	1,3
CO5	Discuss the concepts like threads, JDBC, Servlets,	1,2,3,5	1,3
CO6	Implement the Concept of **Threads, Streams, IO, JDBC in programs**	1,2,3,5	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT - 1 **Java Revolution:** Revolutionary programming language; **Object -Oriented Fundamentals:** Object oriented programming, how java is better than C++; **Java Language Introduction:** Hello World, Step by step, Variables; Types; Operators; Flow Control, Java User input, Input types. **Class:** Object references, Instance variables, the new operator, The Dot operator, Method declaration, Method calling, this, Constructors,
UNIT - 2 **Inheritance:** Inheritance: Super, Method overloading, Method overloading, Method Overriding, Dynamic method dispatch; final, finalize, static, Abstract class and method. **Interfaces:** The interface statement, The implement statement, Variables in interfaces. **String Handling:** String constructors, Special String Syntax, Character Extraction, Comparison, String copy modification;(Handson)
UNIT – 3 **Package:** The package statement, Compiling classes in packages, the import statement, Access protection; **Exception Handling:** Fundamentals, Exception types, try and catch, Multiple catch clauses, Nested try statements. **Input/output:** Files, Input Stream, Output Stream, File streams.(Handson)

UNIT – 4

Threads: Single threaded event loop, The java thread model, Thread, Runnable, Thread priorities, Thread Synchronization;

Introduction to Advance Java: JDBC – Introduction, Architecture, Steps to create JDBC application, Java Servlets – Introduction, life-cycle, JAVA Data Structures Maps, Linked List, Concurrent Data Structures

Introduction to JAVA Memory Management (Handson)

TEXTBOOKS:

1. Patrick Naughton, “The Java Handbook”, Tata McGraw-Hill, 2006
2. Herbert Schildt, Java™: The Complete Reference, McGraw-Hill, Tenth Edition, 2018.

REFERENCE BOOK:

1. Bruce Eckel, “Thinking in Java”, III Edition, Pearson 2004.
2. Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015
3. Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011
4. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. Ed Burnette; Eclipse IDE Pocket Guide : Using the Full-Featured IDE, O'Reilly Media, Inc, USA
2. Oracle Java Documentation https://docs.oracle.com/javase/tutorial/
3. https://www.edureka.co/blog/advanced-java-tutorial

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs03/preview
2. https://www.coursera.org/specializations/core-java
3. https://www.coursera.org/learn/java-programming

Open Elective -2

Course Title	**Communication Systems**				**Course Type**	**OPEN ELECTIVES**	
Course Code	B20ENO601	**Credits**	**3**		**Class**	**VI Semester**	
Embedded Systems	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:

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:

5. Give a brief idea about communication system,
6. Understand the radio signal propagation, transmitter, and receiver.
7. Gain the knowledge of fundamental of GSM module and architecture.
8. 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 importance's 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, modulatio 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 communicatio 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 networ 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	B20ENO602	Credits	3		Class		VI Semester	
	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
	Practical	-	-	-				
	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 level	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:

4. https://courses.p2pu.org/en/courses/3109/content/6858/f
5. https://scholar.google.co.in/scholar?q=wearable+sensors+journal&hl=en&as_sdt=0&as_vis=1&oi=scholart
6. 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/

Course Title	Digital Signal Processing Lab				Course Type		HC	
Course Code	B20EN0605	**Credits**	1		**Class**		**VI 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				
	-	-	-	-				
		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 domain	1,2,3,4,5,9,10	1,2,3
CO4	Design and analyze IIR and FIR	1,2,3,4,5,9,10	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	1,2,3,4,5,9,10	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	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)		**SLO:5,14,18**
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 approximation behavior 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:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. 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

<table>
<tr><td>Course Title</td><td colspan="4">Computer Networks Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0606</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">Computer Communication Networks (I)</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>-</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:

COURSE OBJECTIVES:

The objectives of this course are to:

1. Identify the necessary software and hardware to constitute a designed computer network
2. Implement a simple LAN Network
3. Describe, Analyze and evaluate a number of datalink, network, and transport layer protocols
4. Describe routing protocols

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COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Write and debug the code for various error detection, Congestion Control Techniques	1,2,3,5, 9,10	1,2,3
CO2	Write and test the code using different security techniques to secure the messages,	1,2,3,5, 9,10	1,2,3,
CO3	Write the program and Evaluate different network layer and transport layer protocols	1,2,3,5, 9,10	1,2,3
CO4	Write the code for different wired and wireless network scenarios and test the performance using simulators	1,2,3,5, 9,10	1,2,3
CO5	Evaluate various design parameters such as latency, error rate, throughput, and their influence on node/link utilization and performance	1,2,3,5, 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		3				2	2			1	2	3
CO2	2	2	2		3				2	2			1	2	3
CO3	2	2	2		3				2	2			1	2	3
CO4	2	2	2		3				2	2			1	2	3
CO5	2	2	2		3				2	2			1	2	3
CO6	2	2	2		3				2	2			1	2	3

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Write a program for bit stuffing & de-stuffing using HDLC.	C/C++ Software	Identify bit stuffing and destuffing
2	Write a program for character stuffing & de-stuffing using HDLC.	C/C++ Software	Identify byte stuffing and destuffing
3	Perform the Encryption and Decryption of a given message using substitution method.	C/C++ Software	Analyze the Encryption and Decryption of a given message using substitution method.
4	Choose the two prime numbers, p=17 and q=11.Write a program for public key encryption system using RSA algorithm to encrypt and decrypt the message.	C/C++ Software	Understand the key concept of public key encryption system using RSA algorithm to encrypt and decrypt the message.
5	Write a program to implement the congestion control b using the leaky bucket algorithm. Examine node transmitting/receiving packets to/from other nodes. Using a random function; vary the packet size.	C/C++ Software	Analyze the leaky bucket algorithm for congestion control
6	Write a program for distance vector algorithm to find the shortest path for transmission.	C/C++ Software	Analyze to find the shortest path using the distance vector algorithm
7	Create a three node network topology and connect the duplex links between them. Tcl script to observe the packet flow for the given network in network animator (NAM)	NS2 Simulator Software	Understand the concept of duplex link in a given three node topology, and analyze the packet flow.
8	Simulate a four node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3, n1-n3. Apply relevant applications over TCP agents by changing the parameters and hence determine the number of packets transmitted.	NS2 Simulator Software	Analyze the concept of TCP agent for a given four node network and determine the number of packets transmitted
9	Simulate a four node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply UDP agent between n0-n3, n1-n3. Apply relevant applications over UDP agents by changing the parameters and hence determine the number of packets transmitted.	NS2 Simulator Software	Analyze the concept of UDP agent for a given four node network and determine the number of packets transmitted
10	Simulate a three nodes point-to point network and connect the duplex links between them. Set the queue size, vary the transmission speeds (bandwidth)and find the number of packets dropped.	NS2 Simulator Software	Evaluate the concept of duplex link in a given three node topology, and analyze queue size, the transmission speeds (bandwidth)and the number of packets dropped.

11	Simulate an Ethernet LAN using N-nodes (6-10) with UDP/TCP connection. Apply relevant applications over UDP/TCP agents by changing the parameters and hence determine the number of packets transmitted.	NS2 Simulator Software	Analyze packet transmission in 802.3 Ethernet using UDP/TCP
12	Simulate a wireless network for n nodes. For a wireless network consisting of three mobile nodes (n0-n2), Nodes are configured with the specific parameters of a wireless node. Initial location of the node is fixed. Nodes are given mobility with fixed speed and fixed destination location. TCP agent is attached to node0 and TCP sink agent is attached to node1. Both the agents are connected and FTP application is attached to TCP agent. Write a Tcl script and make an ad-hoc simulation to analyze the output in the trace file. Use the routing protocol as Adhoc on demand distance vector (AODV).	NS2 Simulator Software	Design and analyze AODV protocol for wireless networks.

Text Books:

1. B Forouzan "Data Communication and Networking", 4th Ed, TMH 2006.

Reference Books:

1. James F. Kurose, Keith W. Ross "Computer Networks", Pearson Education, 2nd Edition, 2003.
2. Wayne Tomasi"Introduction to Data communication and Networking" Pearson Education 2007.

S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education

Course Title	**Mini Project/ Internship**				**Course Type**		**FC**	
Course Code	B20EN0607	**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 Traditions and Culture			Course Type	FC		
Course Code	B20PA0501	Credits	1	Class	VI 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 OBJECTIVES:
The objectives of this course are to:

1.Provide conceptual knowledge of Indian culture and traditions
2.Introduce students to the science and technological advancements related to Indian culture
3.Help students understand the Indian spiritual aspects of Indian culture
4.Help learners understand the factors which unite the diverse cultures of India

COURSE OUTCOMES (COs)
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	1
CO2	Describe various ancient theories in treatment of any disease.	6	1
CO3	Appreciate the science and technological advancements in ancient India.	6	1
CO4	Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.	6	1
CO5	Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food	6	1
CO6	Understand India as a land united by cultural diversity.	6	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	✓	✓				
CO5	✓	✓				

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
Unit 1: Indian Tradition
vi. 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 19^{th} Century vii. Religion – Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity viii. Art – Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, puppetry ix. Architecture – Engineering and Architecture in Ancient India; Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India x. Literature- Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

Unit 2: Contribution of ancient India to Science and Maths

i. Development of Science in Ancient India- Astronomy, Mathematics, Medicine, Metallurgy.

ii. Scientists of Ancient India:

d. Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya
e. Science- Kanad, Varahamihira, Nagarjuna
f. Medical Sciences (Ayurveda and Yoga)- Susruta, Charaka, Yoga and Patanjali

iii. Science and Scientists in Medieval India- Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.

iv. Scientists in Modern India- Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir Bhabha, Dr, Vikram Ambalal Sarabhai, ,Dr. APJ Abdul Kalam

Unit 3: Indian Spiritual Aspects

I. Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

ii. Hata Yoga and Pranayama- Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga; Bhakti Yoga – yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

iii. Buddhist, Jaina Spiritualities- Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - Ashtanga Marga

Unit IV: Unity in Diversity

iv. Commensality and the Significance of Food – Eating Together as Family and as a Society, Food at Rituals; annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World
v. Celebrating Diverse Festivals – Festival Types: Religious and Seasonal, Religious - Holi, Diwali, Ganesh Chaturthi, Janmashtami, Mahavir Jayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals) - Baisakhi, Pongal, Sankranti
vi. Attire - Indus Valley Civilization, Vedic period, Modern India

Text Books

1. Sundararajan K.R., "Hindu Spirituality - Vedas through Vedanta, Cross Road Publications", New York, 1997.

2. Griffiths Bede, "Yoga and the Jesus Prayer Tradition, Asian Trading Corporation", Bangalore, 1992

3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998

4. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.

5. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

School of Electronics & Communication Engineering

10th Combined Board of Studies for UG and PG courses in Electronics & Communication Engineering
Academic Year: 2022-23

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BoS Chairperson
School of ECE

Proposed syllabus for VII and VIII semester 2022-24 Batch (BOS 2023)

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0701	Microwaves and Antenna	HC	3	0	0	3	3
2	B20EN0702	CMOS VLSI Circuits	HC	3	0	0	3	3
3	B20ENS7XX	Professional Elective-4	SC	3	0	0	3	3
4	B20ENS7XX	Professional Elective-5	SC	3	0	0	3	3
5	B20XXO7XX	Open Elective-3	OE	3	0	0	3	3
TOTAL				**15**	**0**		**15**	**15**
Practical /Term Work / Sessional								
6	B20EN0703	Microwaves and Antenna Lab	HC	0	0	1	1	2
7	B20EN0704	CMOS VLSI Circuits Lab	HC	0	0	1	1	2
8	B20EN0705	Major Project Phase – 1	HC	0	0	1	1	2
TOTAL				**0**	**0**	**3**	**3**	**2**
TOTAL SEMESTER CREDITS					**18**			
TOTAL CUMULATIVE CREDITS					**150**			
TOTAL CONTACT HOURS					**21**			

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20XXO8XX	Open Elective-4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessional								
2	B20EN0801	Major Project Phase – 2	HC	0	0	0	7	14
TOTAL				**0**	**0**	**0**	**7**	**14**
TOTAL SEMESTER CREDITS					**10**			
TOTAL CUMULATIVE CREDITS					**160**			
TOTAL CONTACT HOURS					**17**			

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE							
5TH SEM /OE1		**6TH SEM /OE2**		**7TH SEM /OE3**		**8TH SEM /OE4**	
Course code	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**
B20ECO501	PCB Fabrication	B20ECO601	Basics of Communication Systems	B20ECO701	Automotive Electronics	B20ECO801	Consumer Electronics
B20ECO502	Embedded Systems	B20ECO602	Sensors and Instrumentation	B20ECO702	Robotic Systems	B20ECO802	Healthcare Electronics

	PROFESSIONAL ELECTIVES							
PE	Course Code	Domain1: Electronics	Course Code	Domain 2:Communication	Course Code	Domain3: Computers		
PE-1 / 5TH SEM	B20ENS511	ARM Processors and Applications	B20ENS512	Optical Fiber Communication	B20ENS513	Theory of Algorithms		
PE-2 / 5TH SEM	B20ENS521	Automotive Electronics	B20ENS522	Information Theory and Coding	B20ENS523	Database Management Systems		
PE-3 / 6TH SEM	B20ENS631	Power Electronics	B20ENS632	Cryptography and Network Security	B20ENS633	JAVA Programming		
PE-4/ 7TH SEM	B20ENS741	Analog and Mixed mode VLSI	B20ENS742	Wireless and Multimedia Communication	B20ENS743	Machine Learning	B20ENS744	Operating Systems
PE-5 / 7TH SEM	B20ENS751	MEMS and Nano Technology	B20ENS752	RF Communications and Applications	B20ENS753	Web Programming	B20ENS754	Compiler Design

Proposed Syllabus for VII and VIII Semester

Detailed Syllabus

Course Title	Microwaves and Antennas				**Course Type**		**HC**	
Course Code	B20EN0701	**Credits**	**3**		**Class**		**VII Semester**	
Microwave and Antennas	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**	**36**	**26**	**50%**	**50%**

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	1,2,3,4,9,10, 12	1,2,3
CO2	Identify Microwave passive and active devices for several applications.	1,2,3,4,9,10,	1,2,3
CO3	Design Microwave amplifiers and Filters	1,2,3,4,9,10,	1,2,3
CO4	Describe the process of microwave measurements	1,2,3,4,9,10,	1,2,3
CO5	Analyze the various performance parameters related to antenna in wireless communication applications	1,2,3,4,9,10, 12	1,2,3
CO6	Analyze The Micro strip patch antenna , Smart Antenna and feeding mechanism	1,2,3,4,9,10, 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	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, features of TEM , Rectangular Waveguide Construction, TE and TM Modes, Losses associated with Microwave Transmission**.** **Microwave Passive Components and Active Devices:** Scattering Parameters**,** directional Coupler, Power Divider, Magic Tee, resonator, GUNN diode, IMPATT, Schottky diode, PIN diode, Parametric amplifier
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 analyzer and Measurement of Scattering parameters
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	CMOS VLSI Circuits				**Course Type**		**HC**	
Course Code	B20EN0702	**Credits**	**3**		**Class**		**VII 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**
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**		**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:
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	1,2,3,5,10	1,2
CO2	Demonstrate the working of CMOS Inverter circuits on the basis of their operation and working	1,2,3,5,10	1,2
CO3	Correlate the electrical properties of various MOS and BICMOS circuits and build the circuits.	1,2,4,5,10	1,2
CO4	Sketch the physical design/layouts in CMOS and nMOS technology	2,3,4,5,10	1,2
CO5	Design of memories with efficient architectures to calculate and improve access times, power consumption	2,3,4,5,10	1,2
CO6	Apply verification and Testing principles to verify the characteristics of Digital Circuits	1,4,5,10	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	1	2	3	3	3				2	3			1	2	
CO2	1	2	3	3	3				2	3			1	2	
CO3	2	1		3					2	3			1	2	

CO4		2	3	1	2				2	3			1	2	
CO5		2	3	1	2				2	3			1	2	
CO6	1			2	3				2	3			2	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, 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/

<table>
<tr><td>Course Title</td><td colspan="4">Microwaves and Antenna Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0703</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5"></td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

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	1,2
CO2	Find the different performance parameters of microwave directional coupler	1,2,3,4,5	1,2
CO3	Measure the generated frequency and wave length of Klystron tube, GUNN diode	1,2,3,4,5	1,2
CO4	Demonstrate Inverse square law	1,2,3,4,5	1,2
CO5	Measure VSWR, Reflection Coefficient of Given antenna.	1,2,3,4,5	1,2
CO6	Measure of Co Polarization and Cross Polarization level of an antenna	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	2	2	3	3					2	2			1	2	
CO2	2	2	3	3					2	2			1	2	
CO3	2	2	3	3					2	2			1	2	
CO4	2	2	3	3					2	2			1	2	
CO5	2	2	3	3					2	2			1	2	
CO6	2	2	3	3					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:

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	CMOS VLSI Circuits lab				**Course Type**		**HC**	
Course Code	**B20EN0704**	**Credits**	01		**Class**		**VII Semester**	
	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:

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 perform	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	
CO2	1	2	3	3	3								1	2	
CO3	2	1	3	3	3								1	2	
CO4	3	2	3	3	3								1	2	
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.
4		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	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.

	verification with gate level simulation		
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:

5. Neil H. E. Weste, David Money Harris, “CMOS VLSI Design- a circuits and systems perspective”, 2thEdition, Addison-Wesley, 2010.
6. Sung- Mo Kang and Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, Tata McGraw-Hill, 3rd Edition, 2007.
7. Douglas A Pucknell, Kamran Eshraghian “Basic VLSI DESIGN” , EEE 3rd Edition
8. Sedra/Smith “Microelectronic circuits”, Oxford,, 5th Edition,2007.

REFERENCE BOOK:

2. 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:

5. https://nptel.ac.in/courses/117/101/117101058/
6. https://nptel.ac.in/courses/117/101/117101058/
7. https://nptel.ac.in/courses/108/106/108106158/
8. https://nptel.ac.in/courses/117/103/117103125/

Professional Electives-4

Course Title	**Analog & Mixed Mode VLSI**				**Course Type**		**Integrated**	
Course Code	**B20ENS741**	**Credits**	**3**		**Class**		**VII Semester**	
Analog & Mixed Mode VLSI	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Theory	0	0	0				
	practical	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**0**	**50 %**	**50 %**

COURSE OVERVIEW:

This course focuses on transistor-level design of mixed-signal CMOS integrated circuits. After reviewing the fundamentals of MOSFET operation, the course will cover the design of analog building blocks such as amplifiers, current-mirrors, comparators, multipliers, and level shifters. Different concepts and parameters used in designing ADC's and DAC's will be well understood along with their available architectures. Analog layout techniques and issues in designing mixed signal operations will be explored.

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the concepts of analog amplifiers and non-linear MOS circuits.
2. Recognize analog and digital signals and convert them from one form to another using the basic principles.
3. Characterize the set of parameters to design the data converter for a given specification
4. Describe the different types of architectures of ADCs and DACs
5. Summarize the rules and issues in designing the layout of a given analog or digital circuit.
6. Draw the layout for a simple analog, digital or mixed signal circuit

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	State the concepts of analog amplifiers and non-linear MOS circuits.	1,2,3,5,10,12	1,2,3
CO2	Distinguish between analog and digital signals and convert them from one form to another by applying the basic principles	1,2,3,5,10,12	1,2,3
CO3	Estimate the set of parameters to design the data converter for a given specification	1,2,3,5,10,12	1,2,3
CO4	Apply a specific type of ADC or DAC architecture to suit the problem statement	1,2,3,5,10,12	1,2,3
CO5	Analyze the rules and techniques to develop the layout of a given simple analog or digital circuit.	1,2,3,5,10,12	1,2,3
CO6	Sketch the layout for a simple analog, digital or mixed signal circuit.	1,2,3,5,10,12	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	1	1
CO2	3	2	2									2	2	1	1
CO3	3	2	2									2	2	1	1
CO4	3	2	2	2								2	2	1	1
CO5	3	2	2	2								2	2	1	1
CO6	3	2	2									2	2	1	1

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Analog MOS circuit:** Analog model of a MOS transistor, Current mirror- Concept and Different Types, Single stage Amplifier - Common source and Common Drain, Differential amplifier, Single stage Operational amplifier. **Non-Linear Analog Circuits**: Basic CMOS Comparator Design, Analog Multiplier-Multiplying Quad, Basic Level Shifter.
UNIT – 2 **Data Converter Fundamentals**: Analog versus Digital, Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications, Mixed-Signal Layout Issues.
UNIT – 3 **Data Converter Architectures**: DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC. ADC Architectures: Flash, 2-Step Flash ADC, Pipeline, ADC, Integrating ADC, Successive Approximation ADC.
UNIT – 4 **Analog layout design for mixed signal:** Analog layout techniques, Passive component layout - capacitor, resistor and inductor, Floor planning- analog and digital components, power supply and ground pin issues, matching, shielding, interconnection issues.

TEXT BOOKS:

1. R. Jacob Baker, Harry W Li, David E Boyce, ”Design, Layout, Simulation, CMOS Circuit” ,PHI Education, 3rd Edition 2005.
2. R. Jacob Baker, “CMOS- Mixed Signal Circuit Design, (Vol II of CMOS: Circuit Design, Layout and Simulation)”, John Wiley India Pvt. Ltd, 2008. 2nd Edition

REFERENCE BOOK:

1. B Razavi, “Design of Analog CMOS Integrated Circuits”, First Edition, McGrawHill, 2001.
2. Phillip. E. Allen and D R Holberg, “CMOS Analog Circuit Design”, 2nd Edition, Oxford University Press, 2002.
3. Gray, Meyer, Lewis and Hurst “Analysis and design of Analog Integrated Circuits”, 4thEdition Willey International, 2002

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

1. http://www.ee.ucl.ac.uk/~ademosth/E757/Topic7a.pdf
2. https://www.elprocus.com/digital-to-analog-converter-dac-applications/
3. https://training.ti.com/precision-dacs-architectures?cu=1136484
4. https://www.analog.com/en/analog-dialogue/articles/the-right-adc-architecture.html
5. https://www.taylorfrancis.com/chapters/nonlinear-analog-components-tertulien-ndjountche/10.1201/b10943-6
6. https://link.springer.com/chapter/10.1007/978-3-642-83677-0_2
7. https://resources.pcb.cadence.com/blog/2019-types-of-analog-signals-and-unique-layout-considerations#:~:text=%20Here%20are%20some%20best%20practices%20for%20analog,digital%20grounds%20for%20PCB%20testing%20later...%20More%20
8. http://smdpc2sd.gov.in/downloads/IGF/IGF%201/Introduction%20to%20Analog%20Layout%20Design.pdf

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/117/106/108106105/
2. https://nptel.ac.in/courses/117/101/117101105/
3. https://nptel.ac.in/courses/117/106/117106034/

Course Title	**Wireless and Multimedia Communication**				**Course Type**		**SC**	
Course Code	**B20ENS742**	**Credits**	3		**Class**		**VII Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Theory	-	-	-				
	practical	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**56**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

This course introduces students to wireless and multimedia communication and concentrates on building a firm foundation for understanding the concepts of Cellular communication, Wireless Network Architecture. The representation of data is critical in the study of multimedia, and we look at the most important data representations for use in multimedia applications. Specifically, graphics and image data, video data, and audio data are examined in detail. Next, multimedia data compression turns out to be a very important enabling technology that makes modern multimedia systems possible. Therefore, it introduces with lossless and lossy compression methods, supplying the fundamental concepts necessary to fully understand these methods. For the latter category, lossy compression, arguably JPEG still-image compression standards, including JPEG2000, are the most important. But, since a picture is worth 1,000 words, and so video is worth more than a million words per minute, we examine the ideas behind the MPEG standards MPEG-1, MPEG-2, MPEG-4, MPEG-

7, and beyond into new video coding standards H.264 and H.265. Multimedia Communications and Networking considers the great demands multimedia communication and content sharing places on networks and systems.

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the evolution and various generations of wireless networks
2. Understand the needful concepts behind the wireless architecture and operation
3. To analyze the impact of multimedia communication techniques on day to day human life.
4. To evaluate various representations of graphics, image & video for multimedia communication

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Categorize wireless telecommunication systems and networks	1,2,3,4,12	1,2,3
CO2	Review wireless network architecture and operation	1,2,3,4,12	1,2,3
CO3	Compare the various industry standard processing and storage techniques for digital audio and video	1,2,3,4,12	1,2,3
CO4	Analyze various industry standard compression techniques for effective bandwidth utilization of the media and also storage capacity.	1,2,3,4,12	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	2				2						1	3	3	3
CO2	2	2	2	3		2						1	2	3	3
CO3	3	2	2	3		2						1	2	3	3
CO4	2	2	3	3		2						1	3	2	2

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

COURSE CONTENT

THEORY:

Contents
UNIT-1 **Wireless Telecommunication Systems and Networks** : Introduction, History and Evolution, Different generations of wireless cellular networks 1G, 2G, 3Gand 4G networks, Common Cellular System and network components, views of cellular networks, 3G cellular systems components, Cellular component identification, Call establishment.
UNIT - 2 **Wireless Network Architecture and Operation:** Introduction, Cellular concept and fundamentals, Capacity expansion techniques, Cellular backbone networks, Mobility management, Radio resources and power management, GSM system overview, GSM and TDMA techniques, GSM network and system architecture, GSM channel concepts, GSM identifiers.
UNIT - 3 **Graphics, Image & Video Representation and Digital Audio & Compression Algorithms:** Graphics/Image data types, popular file formats, Color science – Light and spectra, Spectral sensitivity of the eye, Image formation, Gamma correction, Colour matching function, CIE chromaticity diagram, Colour models in video, Fundamental concepts in video: Types of video signal.
UNIT-4 **Digital Audio & Compression Algorithms** : Digitization of sound, MIDI, Quantization & transmission of audio, Lossless compression: Basics of information theory, RLC, VLC – Shannon Fano, Huffman. **JPEG & MPEG:**JPEG Standard, Video compression based on motion compensation, Search for motion vectors, H.261, H.263, MPEG-1, MPEG-2, MPEG-4, MPEG-7, MPEG-21

Text Books:

5. Ze-Nian Li, Mark S. Drew, "Fundamentals of Multimedia", Pearson Education, 2008.
6. Fred Halsall, "Multimedia Communications", Pearson education, 2001.
7. Gary J Mullett, "Introduction to wireless Telecommunications Systems and Networks",Thomson/Cengage Learning, 2006.

REFERENCE BOOK:

1. Ralf Steinmetz, KlaraNahrstedt, "Multimedia – Computing, Communications & Applications", Pearson Education, 2004
2. William C. Y. Lee, "Mobile Cellular Telecommunication", MGH, 2nd, 2009.
3. D P Agrawal, "Wireless communication" Thomson learning, 2nd Edition 2007.
4. David TSE, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge 2005.

1. **JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:**
2. https://www.youtube.com/watch?v=ulOTz5Rv9CM
3. https://www.youtube.com/watch?v=GfCCADMhQ8c
4. https://www.youtube.com/watch?v=rC16fhvXZOo
5. https://www.youtube.com/watch?v=HrGGKBdUAW4
6. https://youtu.be/7BZvAKYhf3U
7. https://youtu.be/qzQ6EvsqsGs
8. https://youtu.be/kf_p60xSQSs
9. https://youtu.be/gfaC6NxP72g
10. https://youtu.be/LJg7aH7c6Bc

11. https://youtu.be/x0-qoXOCOow
12. https://youtu.be/3dET-EoIMM8
13. [Predictive Coding - Lossless Compression | Coursera]()

<table>
<tr><td>Course Title</td><td colspan="4">Machine Learning</td><td colspan="2">Course Type</td><td colspan="2">PE(SC)</td></tr>
<tr><td>Course Code:</td><td>B20ENS743</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5"></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>Theory</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>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:

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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	Operating Systems				Course Type		PE	
Course Code	B20ENS744	Credits	3		Class		VII Semester	
	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**	39	0	**50%**	**50%**

COURSE OVERVIEW:

In this course, students will explore the critical issues involved in the design and implementation of operating systems. An operating system serves as an interface between user programs and the underlying computer hardware, facilitating efficient resource sharing and providing essential services such as file management, process control, and access to peripherals. Students will gain a historical perspective on the evolution of operating systems and delve into the major components of modern OS. The course will focus on the trade-offs between functionality and performance during OS design and implementation. Emphasis will be placed on three key subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping), and file systems, as well as on the Linux process model.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Introduce the history, basics and structure of Operating System
2. Describe process concepts and scheduling techniques
3. Familiarize with physical and virtual memory management techniques
4. Examine the Linux process model and illustrate how Linux schedules processes and provides interprocess communication.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the history, basics structure of operating systems and their services.	1,2,3	1,2
CO2	Analyse different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.	1,2,3	1,2,3
CO3	Understand about Processes, Threads and Deadlocks.	1,2,3	1,2
CO4	Compare and contrast various memory management techniques like paging, segmentation and demand paging etc.	1,2,3	1,2
CO5	Understand various algorithms for page replacement activity in memory management	1,2,3	1,2,3
CO6	Understand how the file system in Linux-based operating system is structured	1,2,3	1,2

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 ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

Contents
Unit – I: Operating System Principles: Evolution of Operating Systems, Structural overview, Operating System operations, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure, Virtual machines.
Unit – II: Process Management: Overview, Process state, PCB, threads, process scheduling, Operations on processes, Inter process communication-shared memory systems and Message passing Systems. Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, Scheduling algorithms.
Unit – III: Memory Management: Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Basic page replacement, FIFO Page Replacement, Optimal Page Replacement, LRU Page Replacement.
Unit – IV: Case Study: The Linux Operating System: Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication.

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006
2. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition 2011.

REFERENCE BOOKS:

1. D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill,2002.
2. Charles Crowley; Operating System: A Design-oriented Approach; Irwin Publishing, 2002.
3. Gary J. Nutt; Operating Systems: A Modern Perspective; Addison-Wesley, 2011.
4. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
5. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
6. Maurice J. Bach ; The Design of the UNIX Operating System; Pearson Education; Prentice Hall of India, 2004.

JOURNALS/MAGAZINES:

1. ACM Transactions on Computer Systems
2. IEEE Transactions on Computers
3. Operating Systems Review
4. Journal of Systems and Software
5. ACM Queue
6. Linux Journal

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106102132
2. https://www.youtube.com/watch?v=3Qfx4geYN9I
3. https://nptel.ac.in/courses/106106144,,
4. https://nptel.ac.in/courses/117106113
5. https://youtu.be/akU1Ji8Vzdk

Professional Elective-5

Course Title	**MEMS and Nano Technology**				**Course Type**		**SC**	
Course Code	**B20ENS751**	**Credits**	**3**		**Class**		**VII Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Theory	0	0	0				
	practical	-	-	-				
	Total	3	3	3	42	0	50%	50%

COURSE OVERVIEW:
Micro-Electro-Mechanical Systems (MEMS) is a multidisciplinary area that includes a design and fabrication of sensors and actuators which are capable of micron-size mechanical movements. Lectures cover a wide range of topics in design and fabrication of MEMS.

COURSE OBJECTIVES:

The objectives of this course are:

1. To introduce the basic concepts of MEMS and advantages of miniaturization.

2. To describe the various MEMS materials, devices, and applications.
3. To analyze the fundamentals of micromachining and micro fabrication techniques.
4. To understand the various micromachining techniques used to fabricate MEMS devices
5. To introduce various sensors and actuators.
6. To introduce the students to nanoelectronics, nanodevices, spintronics and molecular electronics.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Appreciate the underlying working principles of MEMS devices	1,2,4,7,9,12	1,3
CO2	Demonstrate the application of scaling laws in the design of microsystems.		
CO3	Describe the various steps involved in MEMS fabrication.	1,2,3,4,57,9,	1,3
CO4	Understand the various micromachining techniques used to fabricate MEMS devices.		
CO5	Know various application areas for MEMS device.	1,2,3,4,5,6,9,	1,3
CO6	Describe the principles behind Nanoscience engineering and Nanoelectronics.		

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							2	4	1		**3**
CO2	1	2	1	2	4						2		1		3
CO3	3	2	1								2	4	1		**3**
CO4	3	2	1	2	3							4	1		**3**
CO5	3	2	1	2	3								1		**3**
CO6	1	2		1							2		1		**3**

COURSE CONTENT

Contents
UNIT - 1
Introduction to MEMS History of Microsystem Technology with overview on commercial products, Scaling laws, Why Miniaturization? Microsystems versus MEMS, Why Microfabrication? MEMS and Microsystems, Typical MEMS and Microsystem Products, Evaluation of Microfabrication, Microsystem and Microelectronics, The Multidisciplinary Nature of Microsystem Design and Manufacture, Microsystem Miniaturization, Smart Materials, Structures and Systems, Integrated Microsystems, Applications of Smart Materials and Microsystems. Materials for MEMS: Silicon compatible material System-Silicon, Czochralski Crystal Growing, Silicon oxide and Nitride, Thin metal Films, Polymers, Other material and substrates.
UNIT - 2
Microsystems Fabrication Process Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography. Photolithography, Ion-implantation, diffusion, oxidation, CVD – Physical Vapor Deposition – Etching and materials used for MEMS, Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process.
UNIT – 3
Micro Sensors, Actuators, Systems and Smart Materials: silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conduct metric gas sensor, silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic comb-drive and magnetic micro relay, portable clinical analyzer, active noise control in a helicopter cabin **VLSI Process Integration:** Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, CMOS IC Technology, MOS Memory IC Technology, Bipolar IC Technology, IC Fabrication.
UNIT - 4
Introduction to NANO Electronic Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moore‘s law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometerlength scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems

TEXT BOOKS:

1. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, “Micro and Smart Systems”, Wiley India, 2010.
2. Chang Liu, “Foundation of MEMS” Pearson Education International, 2006.
3. Tai Ran Hsu, “MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering, Wiley, 2008.
4. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, —Nanoscale Science and Technology‖, John Wiley, 2007.

REFERENCE BOOKS:

1. S. M. Sze, “VLSI Technology”, McGraw-Hill, Second Edition.
2. Nadim Maluf, Kirt Williams “An Introduction to Microelectromechanical Systems Engineering” Second addition.
3. Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, —Hand Book of Nanoscience Engineering and Technology‖, CRC press, 2003.
4. Charles P Poole, Jr, Frank J Owens, —Introduction to Nanotechnology‖, John Wiley, Copyright 2006, Reprint 2011.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

21. https://www.sciencedirect.com/science/article/abs/pii/S092150930100956X
22. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=581729http://bonnie.ece.gatech.edu/book/TUTORIAL/tutorial.html
23. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1627742https://www.springer.com/journal/34
24. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4554610https://ieeexplore.ieee.org/document/1143815
25. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=735330.
26. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1258171
27. https://www.mdpi.com/2072-666X/11/4/434/htm

SWAYAM/NPTEL/MOOCs:

4. https://archive.nptel.ac.in/courses/117/105/117105082/
5. https://nptel.ac.in/courses/117/105/117105082/
6. https://nptel.ac.in/courses/108/108/108108113/
7. https://www.coursera.org/learn/sensor-manufacturing-process-control#syllabus

<table>
<tr><td>Course Title</td><td colspan="4">Web Programming</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS753</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">7 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 in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Theory</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>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 students to basic web design using HTML,CSS,JavaScript and PHP. Throughout the course students are introduced to planning and designing effective web pages. Implementing web pages by writing HTML and CSS code, enhancing web pages with the use of page layout techniques, text formatting, tables, images, and multimedia; and producing a functional, multi-page website. Validating the user data using Client side scripting language JavaScript and PHP is used to process the forms. Upon successful completion of this course, students will have a good foundation in web design and data validation using HTML,CSS, JavaScript and PHP and students will be prepared to study more advanced web design topics.

COURSE OBJECTIVES:

The objectives of this course are to:

COURSE OBJECTIVES: The objectives of this course are:

1. Illustrate the Semantic Structure of HTML and CSS.
2. Compose forms and tables using HTML and CSS.
3. Design Client-Side programs using JavaScript.
4. To impart skills required to develop web applications and services

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply XHTML and CSS syntax and semantics to build web pages.	1,2,3,4,5	1,2,3
CO2	Apply appropriate user experience and interactive design concepts to custom websites.	1,2,3,4,5	1,2,3
CO3	Design and build applications using Android and or iOS UI Paradigms	1,2,3,4,5	1,2,3
CO4	Apply Reactive and Functional programming concepts	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	2	2								2	1	3
CO2	3	2	1	2	2								3	1	2
CO3	3	1	2	3	2								3	2	1

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

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Fundaments of Computers and Internet** Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling
UNIT - 2 **Cascading Style Sheets:** Introduction, Levels of Style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, The Box Model, HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout
UNIT - 3 **The Basics of JavaScript:** JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server‟s Responsibilities, Quick Tour of PHP, Program Control, Functions
UNIT - 4 Introduction, PHP Basics, General Syntactic characteristics, Control statements, Arrays, Functions, Pattern Matching, Files, Cookies, Session Tracking, Database Access with PHP and MySQL. PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting, PHP Error and Exception Handling

PRACTICE SESSION:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	Create a XHTML form which includes Name, Address and Comment, Hyperlinks, Images Lists.	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML
2	Validate the user input using JavaScript. (Ex: Validating the student SRN).	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML
3	Create a XHTML form with SRN, Name, and Address fields and it also includes tables and Forms. On	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML

	submitting the form, it should store the values in MySQL table.		
4	PHP code to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page.	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML
5	PHP code to store page views count in SESSION and to show the count on web page	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML

TEXT BOOKS:

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India. (ISBN:978-9332575271)
2. Robert W. Sebesta, "Programming the World Wide Web", 7th Edition. Addison-Wesley, 2012.
3. Robin Nixon, **"**Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML**5",** 4th Edition, O'Reilly Publications, 2015

REFERENCE BOOK:

1. Navneet Mehra, Bunny Mehra, **"**Website Development Using HTML and CSS - A Practical Step-By-Step Guide to Develop E-Commerce Store**"**, Unicorn Books (2012)

2. Jon Duckett, "HTML and CSS: Design and Build Websites**",** Wiley; 1 edition, ISBN-13: 978-1118008188

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

28. https://www.tutorialspoint.com/internet_technologies/websites_development.htm
29. https://www.tutorialspoint.com/internet_technologies/css.htm
30. https://www.w3schools.com/xml/
31. https://ieeexplore.ieee.org/document/8400266
32. https://2019.programming-conference.org/track/proweb-2019-papers
33. https://ieeexplore.ieee.org/document/4221621

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/ 05/106 05084/
2. https://nptel.ac.in/courses/106/105/106105084/
3. https://nptel.ac.in/courses/106/105/106105084/
4. https://nptel.ac.in/courses/106/105/106105084/
5. https://nptel.ac.in/courses/106/105/106105084/
6. https://nptel.ac.in/courses/106/105/106105084/

Open Electives

Course Title	**Automotive Electronics**				**Course Type**		**OE**	
Course Code	B20EC O701	**Credits**	**3**		**Class**		**VII Semester**	
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**39**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

The course covers 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:

5. Understand the functions of electronic systems in modern automobiles, modern electronics technology to improve the performance, safety, comfort and related issues
6. Study the principles of automotive sensors and interfacing techniques, design, model and simulate interfacing systems with sensors
7. Know the principles and functionalities of various Automotive Communication Protocols (ACPs) and Exhaust after treatment systems.
8. 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	Explain power train and drive train components in automotive systems	1,2,5	1,2,3
CO2	Discuss the role of electronics in engine control systems	2,3,5	1,2
CO3	Analyze the Exhaust After-Treatment systems in automobiles.	1,2,3	1,2
CO4	Illustrate the concepts of in-vehicle networking	7,9,10	2
CO5	Describe automotive safety systems & infotainment systems.	4,7,8	3
CO6	Recognize the On-board diagnostics, Off-board diagnostics.	4,7,8	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			2								1	2	
CO2		2	3		3								1	2	
CO3	1	2	3										1	2	
CO4							1		2	3				2	
CO5				3			2	1							1
CO6				3			2	1							1

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Automotive Industry and Modern Automotive Systems:** Vehicle classifications and specifications, need for electronics in automobiles, Automotive Fundamentals Overview – Four Stroke Cycle, Electronic Ignition systems, Spark plug, Spark pulse generation, Ignition Timing. Transmission Control - Automotive transmissions, Drive Train, Drum and Disk Brakes, Steering System - Steering Control, Starting System- Battery, Air/Fuel Systems, Fuel Handling.
UNIT - 2 **Introduction to automotive sensors and Actuators:** Air/ Fuel Management Sensors – Oxygen (O2/EGO) Sensors, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor **Actuators** – Solenoid actuator, Fuel Metering Actuator, Fuel Injector, Ignition Actuator, Exhaust Gas Recirculation Actuator, Sensor and actuator interfacing techniques.
UNIT - 3 **Exhaust After-Treatment Systems and Communication Protocols:** Exhaust After-Treatment Systems – Catalytic Converter, Exhaust Gas Recirculation (EGR) and it's control, Electronic Fuel Control System, Electronic Ignition control, Idle speed control **Automotive Communication Protocols:** Features for Selection of protocols, SPI, I^2C, USB, CAN, LIN, MOST protocols.
UNIT - 4 **Electronics for Passenger Safety and Convenience:** Electronics for Passenger Safety and Convenience – Air bag and seat belt pretension systems, Anti-lock Braking System, Tire pressure monitoring systems, Traction Control System, Collision Avoidance Radar warning Systems, Advance Driver Information System, Adaptive Lighting system, Alternative Fuel Engines, Automatic wipers, Power windows, Remote keyless entry systems. **Automotive Diagnostics** – On-board diagnostics, Off-board diagnostics.

TEXT BOOKS:

1. Denton, "Automotive Electrical and Electronic Systems, Burlington", MA 01803, Elsevier Butterworth-Heinemann, 2004.
2. William B. Ribbens, "Understanding Automotive Electronics, 5th Edition, Newnes, 2006.

REFERENCE BOOK:

1. Ronald K. Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 2007.
2. Robert Bosch GmbH, "Bosch Automotive Electrics & Electronics: Systems and Components, Networking and Hybrid Drive", Robert Bosch GmbH, 3rd Edition, 1999.

<table>
<tr><td>Course Title</td><td colspan="4">Robotic Systems</td><td colspan="2">Course Type</td><td colspan="2">OE</td></tr>
<tr><td>Course Code</td><td>B20ECO702</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">VII 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>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:

Robotic systems are machines designed to carry out tasks autonomously or semi-autonomously, typically in environments that are hazardous, inaccessible, or impractical for human beings. They are often equipped with sensors, actuators, and control systems that allow them to sense their environment, make decisions, and carryout actions to achieve their objectives. Robotic systems can take many different forms, including industrial robots used in manufacturing, autonomous vehicles used for transportation, drones used for surveillance or delivery, and even humanoid robots used for research, entertainment, or personal assistance. They can be programmed to perform a wide range of tasks, such as assembling products, exploring hazardous environments, monitoring crops, or performing surgery.

COURSE OBJECTIVES:

The objectives of this course are to:

5. Describe Sensors used in Robotic systems
6. Learn various actuators and Kinematics used in Robotic systems
7. Learn Robot Programming concepts
8. Insight to Future of Autonomous Robots

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe Sensors used in Robotic systems	1,2,3,4,5,9,10	1,2,3
CO2	Learn various actuators and Kinematics used in Robotic systems	1,2,3,4,5,9,10	1,2,3
CO3	Learn Robot Programming concepts	1,2,3,4,5,9,10	1,2,3
CO4	Insight to Future of Autonomous Robots	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	1	2	1				2	2			2	1	1
CO2	3	2	1	2	1				2	2			2	1	1
CO3	3	2	1	2	1				2	2			2	1	1
CO4	3	2	1	2	1				2	2			2	1	1

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

COURSE CONTENTS:
THEORY:

Contents
UNIT – 1
Introduction of Robotics: Applications, Robot Anatomy– Common robot configurations Work VolumeRobot drive systems, Control systems Sensors: Position sensors potentiometers, Encoders, LVDT, Touch and tactile sensor, Proximity sensors Machine Vision systems : Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation
UNIT – 2
Actuators and Kinematics Comparison of hydraulic, electric, pneumatic actuators, Hydraulic actuators, Electric motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics. Rotation and Translation of robotics, Euler angle representation for xyz frames. Homogeneous Transformations.
UNIT – 3
Robot Programming: Methods of Robot programming, A robot program as a path in space, methods of defining positions in space, motion interpolation, wait, signal and delay commands, branching, Robotic languages, constants variables and other data objects, motion command send effectors and sensor commands, program control and subroutines
UNIT - 4

Autonomous Robots: Current trends in Robotics, Human Robot cooperation and Interactions, Multi Robot systems, Micro and Nanorobots, Self organization, self repair, Autonomous Evolution and Self Replication, Potential Dangers of Robotics.

TEXT BOOKS:

1. Mikell P Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Oderey, " Industrial Robotics", Technology, programming and Apllications, Mc Graw Hill, USA 1986
2. George A Bekey," Autonomous Robots", MIT Press, Cambride, Massachusetts London, England, 2005

REFERENCE BOOKS

1. Fu K. S., Gonzelez R. C., Lee C. S. G.,"Robotics: Control, Sensing, Vision, Intelligence" , McGraw Hill Book Co., International edition, 2008.
2. YoremKoren, "Robotics for Engineers",McGraw-Hill Publication, International edition, 1987
3. Craig, J. J.,"Introduction to Robotics: Mechanics and Control", Pearson Prentice-Hall Publications, 3rd edition, 2005.
4. Schilling R. J."Fundamentals of Robotics, Analysis and Control",, Prentice-Hall Publications, Eastern Economy edition, 2007

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BoS Members
9th Combined Board of Studies Panel
for UG and PG courses in Electronics & Communication Engineering academic year 2021-22

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REVA UNIVERSITY
Bengaluru, India

School of Electronics & Communication Engineering

10th Combined Board of Studies for UG and PG courses in Electronics & Communication Engineering
Academic Year: 2022-23

Sl. No.	Name	Status	Designation and Affiliation
1	**Dr. R. C. Biradar**	**Chairperson**	Pro-Vice Chancellor(Engineering), REVA University Rukmini Knowledge Park, Yelahanka, Bangalore - 560 064 Email: dir.ece@reva.edu.in Mobile: 9902679446, Phone: +9180 65687563/64/65

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BoS Chairperson
School of ECE

School of Electronics and Communication Engineering
BoS Members
9th Combined Board of Studies Panel
for UG and PG courses in Electronics & Communication Engineering academic year 2021-22

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Approved Scheme for 2020-24 and 2021-25 Batch in BOS-2022

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0501	Digital Communication	HC	3	0	0	3	3
2	B20EN0502	Signals and Systems	HC	3	0	1	4	5
3	B20EN0503	Verilog for FPGA Development	HC	3	0	0	3	3
4	B20ENS5XX	Professional Elective-1	SC	3	0	0	3	3
5	B20ENS5XX	Professional Elective-2	SC	3	0	0	3	3
6	B20XXO5XX	Open Elective-1	OE	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B20EN0504	Digital Communication Lab	HC	0	0	1	1	2
8	B20EN0505	Verilog for FPGA Development Lab	HC	0	0	1	1	2
9	B20EN0506	Technical Documentation	FC	1	0	0	1	1
10	B20EN0507	Research based project	HC	0	0	1	1	2
TOTAL				**1**	**0**	**3**	**4**	**7**
TOTAL SEMESTER CREDITS					**23**			
TOTAL CUMULATIVE CREDITS					**108**			
TOTAL CONTACT HOURS					**27**			

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC /OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EN0601	Control Engineering	HC	3	0	1	4	5
2	B20EN0602	Digital Signal Processing	HC	3	0	0	3	3
3	B20EN0603	Computer Networks	HC	3	0	0	3	3
4	B20EN0604	Computer Architecture and organization	HC	3	0	0	3	3
5	B20ENS6XX	Professional Elective-3	SC	3	0	0	3	3
6	B20XXO6XX	Open Elective-2	OE	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Sessional								
7	B20EN0605	Digital Signal Processing lab	HC	0	0	1	1	2
8	B20EN0606	Computer Networks Lab	HC	0	0	1	1	2
9	B20EN0607	Mini project/Internship	HC	0	0	2	2	4
10	B20PA0501	Indian Tradition and Culture	FC	1	0	0	1	2
TOTAL				**1**	**0**	**3**	**5**	**8**

TOTAL SEMESTER CREDITS	**24**
TOTAL CUMULATIVE CREDITS	**132**
TOTAL CONTACT HOURS	**28**

VII SEMESTER

Sl. No	**Course Code**	**Title of the Course**	**HC/FC/SC/OE**	**Credit Pattern & Credit Value**				**Contact Hours/ Week**
				L	**T**	**P**	**Total**	
1	B20EN0701	Microwaves and Antenna	HC	3	0	0	3	3
2	B20EN0702	CMOS VLSI Circuits	HC	3	0	0	3	3
3	B20ENS7XX	Professional Elective-4	SC	3	0	0	3	3
4	B20ENS7XX	Professional Elective-5	SC	3	0	0	3	3
5	B20XXO7XX	Open Elective-3	OE	3	0	0	3	3
TOTAL				**15**	**0**		**15**	**15**
Practical /Term Work / Sessional								
6	B20EN0703	Microwaves and Antenna Lab	HC	0	0	1	1	2
7	B20EN0704	CMOS VLSI Circuits Lab	HC	0	0	1	1	2
8	B20EN0705	Major Project Phase – 1	HC	0	0	1	1	2
TOTAL				**0**	**0**	**3**	**3**	**2**
TOTAL SEMESTER CREDITS					**18**			
TOTAL CUMULATIVE CREDITS					**150**			
TOTAL CONTACT HOURS					**21**			

VIII SEMESTER

Sl. No	**Course Code**	**Title of the Course**	**HC/FC/SC/OE**	**Credit Pattern & Credit Value**				**Contact Hours/ Week**
				L	**T**	**P**	**Total**	
1	B20XXO8XX	Open Elective-4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessional								
2	B20EN0801	Major Project Phase – 2	HC	0	0	0	7	14
TOTAL				**0**	**0**	**0**	**7**	**14**
TOTAL SEMESTER CREDITS					**10**			
TOTAL CUMULATIVE CREDITS					**160**			
TOTAL CONTACT HOURS					**17**			

OPEN ELECTIVES OFFERED FROM SCHOOL OF ECE							
5TH SEM /OE1		**6TH SEM /OE2**		**7TH SEM /OE3**		**8TH SEM /OE4**	
Course code	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**	**Course code**	**Course Name**
B20ECO501	PCB Fabrication	B20ECO601	Basics of Communication Systems	B20ECO70 1	Automotive Electronics	B20ECO801	Consumer Electronics
B20ECO502	Embedded Systems	B20ECO602	Sensors and Instrumentation	B20ECO70 2	Robotic Systems	B20ECO802	Healthcare Electronics

	PROFESSIONAL ELECTIVES						
PE	**Course Code**	**Domain1: Electronics**	**Course Code**	**Domain 2:Communication**	**Course Code**	**Domain3: Computers**	
PE-1 / 5TH SEM	B20ENS511	ARM Processors and Applications	B20ENS512	Optical Fiber Communication	B20ENS513	Theory of Algorithms	
PE-2 / 5TH SEM	B20ENS521	Automotive Electronics	B20ENS522	Information Theory and Coding	B20ENS523	Database Management Systems	
PE-3 / 6TH SEM	B20ENS631	Power Electronics	B20ENS632	Cryptography and Network Security	B20ENS633	JAVA Programming	
PE-4/ 7TH SEM	B20ENS741	Analog and Mixed mode VLSI	B20ENS742	Wireless and Multimedia Communication	B20ENS743	Machine Learning	Operating Systems
PE-5 / 7TH SEM	B20ENS751	MEMS and Nano Technology	B20ENS752	RF Communications and Applications	B20ENS753	Web Programming	Compiler Design

Detailed Syllabus

V Semester

Course Title	**Digital Communication**				**Course Type**		**HC**	
Course Code	B20EN0501	**Credits**	3		**Class**		**V Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**		**50 %**	**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

6. Introduce the fundamentals of Sampling, quantization, PCM, DPCM and DM modulation methods.
7. Familiarize with several modulation methods like BASK, BFSK, BPSK, QPSK, DPSK schemes, draw signal space diagrams, and compute spectra of modulated signals.
8. Compute the probability of error for several demodulators, and compare modulation methods based on the error rate and spectral efficiency.
9. Familiarize the optimum receivers used for digital modulation techniques.
10. 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	Intrepret 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-jsTlpA
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

Course Title	**Signals and Systems**			**Course Type**	**HC Integrated**
Course Code	**B20EN0502**	**Credits**	**4**	**Class**	**V Semester**

	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment inWeightage	
	Lecture	3	3	3				
	Tutorial	-	-	-				
	Practice	1	2	2	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	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 OBJECTIVES:

The objectives of this course are :

5. Provide insight into fundamentals of Continuous and Discrete-time signals and systems, their properties and representations.
6. Introduce time domain representation of Linear Time invariant Systems such as Convolution Sum, Convolution Integral.
7. Provide understanding of signal representation in Fourier domain such as Fourier Series, Fourier transform, discrete time Fourier transform.
8. 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.	1,2,3,4,5,9,10	1,2
CO2	Apply Convolution operation on an LTI System to calculate the output.	1,2,3,4,5,9,10	1,2
CO3	Represent the continuous and Discrete time periodic signals in frequency domain and calculate the Fourier Coefficients	1,2,3,4,5,9,10	1,2,3
CO4	Represent the continuous and Discrete time Aperiodic signals in frequency domain and interpret the Frequency Spectrum	1,2,3,4,5,9,10	1,2,3
CO5	Analyze the stability of Discrete time system by applying Z-transform.	1,2,3,4,5,9,10	1,2,3
CO6	Represent the discrete time system in Z-domain and determine the behavior of Causal LTI system using properties of Z-Transform.	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	1	1	2				2	2			2	3	
CO2	3	3	2	1	2				2	2			2	3	
CO3	3	2	1	1	2				2	2			2	3	
CO4	3	3	1	1	2				2	2			2	3	
CO5	3	3	2	1	2				2	2			2	3	
CO6	3	2	1	1	2				2	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, Basic operations on signals, Classification of signals, Properties of systems, Numerical on each topic.
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, Fourier Representation of Periodic Signals: **Analysis using** CTFS and DTFS of basic signals. Numerical on each topic.
UNIT - 3 **Fourier Transform and its applications** FT representation of CT signals – Definition of FT, FT of standard CT signals, Properties and their significance, Inverse FT, Solving differential equations using FT. FT representation of DT signals-Definition of DTFT, DTFT of standard DT signals, Properties and their significance. Numerical on each topic.
UNIT - 4 **Z-Transforms and its applications** Z -Transforms: Definition, Properties of Z transform, ROC, Inversion of Z – transforms, transform analysis of LTI Systems. Z-Transforms and its application to solve difference equations. Numerical on each topic.

PRACTICE SESSION:

Sl.	**Name of the Practice Session**	**Tools and**	**Expected Skill**

No.		Techniques	/Ability
14.	c) Generation and Plotting of Sine Waves d) Generation and Plotting of Elementary Signals	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
15.	Perform Operations on Dependent Variable of a Signal.	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
16.	Perform Operations on Independent Variable of a Signal.	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
17.	To Calculate Signal Power and Signal Energy	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
18.	To Compute the Linear Convolution of The Given Input Sequence x(n) & The Impulse Response of The System h(n). (Causal Sequences)	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
19.	To Compute the Linear Convolution of The Given Input Sequence x(n) & The Impulse Response of The System h(n). (Non-Causal Sequences)	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
20.	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
21.	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
22.	c) Fourier synthesis of square wave in MATLAB d) Fourier synthesis of a triangular wave in MATLAB	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
23.	Demonstration of Sampling Theorem.	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
24.	To Compute the Linear Convolution of The Given Input Sequence x(n) & The Impulse Response of The System h(n) using TMS320C6713 Kit.	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification
25.	Solve Any Given Difference Equation of An LTI System Without Initial Conditions Using TMS320C6713 Kit.	Simulation of Mathematical Model in CCS Studio. Dumping and Verification of Simulated code in TMS320C6713 Kit.	Program synthesis, Debugging, Simulation and Verification
26.	Demonstration of Sampling Theorem.	Simulation of Mathematical Model in Octave or MATLAB scripting.	Program synthesis, Debugging, Simulation and Verification

TEXT BOOKS:

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

REFERENCE BOOK:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

11. https://ieeexplore.ieee.org/abstract/document/9244176
12. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
13. https://www.khanacademy.org/science/electrical-engineering/ee-signals
14. http://bonnie.ece.gatech.edu/book/TUTORIAL/tutorial.html
15. https://stanford.edu/~boyd/ee102
16. https://www.springer.com/journal/34
17. https://www.inderscience.com/jhome.php?jcode=ijsise
18. https://ieeexplore.ieee.org/document/1143815
19. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=79
20. https://www.ieee.org/membership-catalog/productdetail/showProductDetailPage.html?product=PER310-PRT

SWAYAM/NPTEL/MOOCs:

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

Course Title	**Verilog for FPGA Development**				**Course Type**	**HC**
Course Code	**B20EN0503**	**Credits**	**3**		**Class**	**V Semester**
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage
	Lecture	3	3	3		
	Tutorial	-	-	-		

	Practice	-	-	-	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**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:

5. Understand the Verilog HDL syntax and programming structure
6. Understand behavioural and RTL modelling of digital circuits
7. Simulate, synthesize, and program their designs on a development board
8. 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	1,2,3	1,2,3
CO3	Develop Verilog programs for digital circuits using gate, dataflow, behavioral and switch 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	1,2,3	1,2,3
CO6	Demonstrate the FPGA design flow by implementing digital circuits	1,2,3	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										1	2	1
CO2	3	3	3										3	2	1
CO3	3	3	2										3	3	2
CO4	3	3	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, why Verilog HDL?, trends in HDLs. **Hierarchical Modeling Concepts:** Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.
UNIT - 2 **Basic Concepts:** Lexical conventions, data types, system tasks, compiler directives. **Modules and Ports**: Module definition, port declaration, connecting ports, hierarchical name referencing.
UNIT - 3 **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 - 4

Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements

Logic Synthesis with Verilog: Verilog HDL Synthesis, Synthesis design flow,Verification of Gate-Level Netlist.

Field Programmable Gate Arrays: Field Programmable Gate Arrays, The Role of FPGAs in the ASIC Market, FPGA Technologies, XILINX Virtex FPGAs, Verilog-Based Design Flows for FPGAs, Synthesis with FPGAs

TEXT BOOKS:

2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education.
2. M.D.Ciletti, "Modeling, Synthesis and Rapid Prototyping with the Verilog HDL", PHI, 1999.

REFERENCE BOOK:

2. J Bhaskar, "A Verilog HDL Primer (3/e)", Kluwer, 2005.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

4. http://in.ncu.edu.tw/ncume_ee/digilogi/vhdl/Verilog_Reference_Guide.pdf
5. https://www.xilinx.com/support/documentation/university/Vivado-Teaching/HDL- Design/2013x/Nexys4/Verilog/docs-pdf/Vivado_tutorial.pdf
6. 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/
4. https://www.udemy.com/topic/verilog-hdl-programming/
5. https://www.udemy.com/course/learn-verilog-programming-with-vivado-design-suit/

Professional Elective 1

Course Title	ARM Processors and Applications				Course Type		SC	
Course Code	B20ENS511	Credits	3		Class		V Semester	
	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:

5. Understand the architectural features and instruction set of 32bit microcontroller ARM Cortex M3.
6. Program ARM Cortex M3 using the various instructions and C language for different applications.
7. Study the concepts of Exceptions and interrupts for architectural Support for High level languages.
8. 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	Analyze and Compare various Processor and Controller Architectures with ARM Cortex-M3.	1,2,3	1,2
CO2	Apply the knowledge of programming in assembly language and C language.	4,5	1,2,3
CO3	Demonstrate programming proficiency using the various exceptions and interrupts	1,2,3,4,5	1,2,3
CO4	Illustrate the concept of memory mapping and bit banding for Cortex series microcontrollers	1,2,3,5	1,2,3

CO5	Program ARM Cortex-M3 MCUs by identifying the software development tools.	1,2,3,4,5	1,2,3
CO6	Program ARM Cortex-M3 MCUs for Serial Communication 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 **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.
UNIT - 2 **Instruction Sets-** Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming.

UNIT - 3
Exceptions and Interrupts- Exceptions types, fault exceptions, basic interrupt configuration, example procedures in setting up an interrupt, interrupt/exception sequences, tail-chaining interrupts, late arrivals, interrupt latency.
UNIT - 4
Cortex M3 Programming- Overview of NxP's LPC1768, understanding different functional blocks and their Applications in LPC 1768, pin connect block, GPIO programming, System Control, Clock Control and Power Control, Timers/counters, WDT, RTC, ADC, I2C, SPI, UART, serial communication.

Text book:

2. 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:

11. https://researchdesignlab.com/lpc1768-arm-cortex-m3-development-board.html#:~:text=The%20NXP%20LPC1768%20is%20an,popular%208%2Dbit%20prototyping%20alternatives.
12. 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
13. https://www.electronicshub.org/getting-started-with-lpc1768/
14. https://developer.arm.com/ip-products/processors/cortex-m/cortex-m3
15. https://www.arm.com/products/silicon-ip-cpu/cortex-m/cortex-m3
16. https://en.wikipedia.org/wiki/ARM_Cortex-M
17. st.com/content/st_com/en/arm-32-bit-microcontrollers/arm-cortex-m3.html
18. https://class.ece.uw.edu/474/peckol/doc/StellarisDocumentation/IntroToCortex-M3.pdf
19. https://www.silabs.com/mcu/32-bit/arm-cortex-m3-32-bit-microcontroller
20. https://copperhilltech.com/blog/a-brief-introduction-to-the-arm-cortex-m3-processor/

SWAYAM/NPTEL/MOOCs:

4. https://nptel.ac.in/courses/106/105/106105193/
5. https://nptel.ac.in/courses/117/106/117106111/
6. https://nptel.ac.in/courses/108/102/108102045/

<table>
<tr><td>Course Title</td><td colspan="3">Optical Fiber Communication</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS512</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"></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 inWeightage</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:

Optical Fiber communication covers very relevant topics that make them aware of importance of fundamentals of Light and latest developments in Coherent Optical communication and necessary to communication engineers to address future needs of high data rate communications. The course will give you the knowledge in order to understand both the fundamentals and the rapid development, that you as professional engineer can use the fiber optics efficiently. Further the course focus on characteristics of optical fibers, laser diodes, optical detectors, and receivers from physical and transmission system point of view. Finally, the course will conclude with outlook for future research in extending the capabilities of these networks to higher bandwidths and secured communications.

COURSE OBJECTIVES:

The objectives of this course are to:

1Comprehend the knowledge of mathematically propagation of optical signals over optical Fiber cables.

2.Conceptualize the degradation of signals during propagation of optical signals over optical fiber.

3.Explain the characteristics of optical sources and detectors.

4.Analyze various techniques for coherent transmission and system performance factors in optical Communication system.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the optical fiber communication link, structure, propagation, fiber configurations, and modes of transmission in fiber.	1,2,3,4	1,2,3
CO2	Estimate the signal degradation factors/losses associated with optical fibers	1,2,3,4	1,2,3
CO3	Apprise the properties of various optical components in optical communication systems	1,2,3,4	1,2,3
CO4	Analyze the characteristics of optical sources and photo detectors	1,2,3,4	1,2,3
CO5	Design short haul and long haul analog/digital optical fiber communication system	1,2,3,4	1,2,3
CO6	Analyze the performance of optical receiver based on receiver sensitivity/channel selectively	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	3	3	1	1									3	2	1
CO3	3	3	1	1									3	3	1
CO4	3	3		1									3	3	1
CO5	3	3		1									3	3	1
CO6	3	3		1									3	3	1

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1 **Overview to Optical Fiber Communication:**Electromagnetic spectrum, Optical spectral Bands, General system Advantages and Applications of fiber optic transmission systems, Basic Optical laws and Definitions, Ray theory transmission , TIR, Numerical Aperture, Acceptance angle, Parameters of fiber optic cable: Acceptance angle, Numerical aperture, Skew rays, Mode, Index Profile, V number. Single mode fibers - Cutoff wavelength, Mode Field Diameter, Fiber Birefringence, Average optical power, Fiber Materials, Manufacturing process of fiber optic cable.
UNIT – 2 **Signal Distortion in Optical Fibers:**Attenuation, Fiber attenuation measurement, Demonstration of Measurement of attenuation loss and bending loss for various lengths of fiber optic cable, Scattering Losses – Rayleigh, Mie, Brillouin and Raman Scattering, Fiber Bend Loss, Dispersion - Concepts of Modal Dispersion, Material Dispersion, Waveguide Dispersion, Polarization Mode Dispersion; Optical Time Domain reflectometer (Principle, concept & applications)

UNIT - 3
Optical Transmitter and Receiver Optical sources: Light emitting diode: LED structures, LED characteristics, Practical parameters - Quantum efficiency, LED Power, Laser Diodes - Modes & threshold conditions, Principle operation of Semiconductor Laser, Configuration of Fabry-Perot resonator for laser diode, Practical parameters - Quantum efficiency, Resonant frequency; **Optical detectors/ Photo detectors:** Optical detection principles, Characteristics of optical detector, Physical Principle of PIN and APD, Practical parameters - Quantum efficiency, Detector responsitivity, Cutoff wavelength, Response time **Optical sensors:** Basic concept, Intrinsic fiber sensors, Extrinsic fiber sensors Optical Amplifier - EDFA Amplification Mechanism, EDFA Architecture,
UNIT – 4
OFC System and system design considerations: Optical Receiver: Fundamental Receiver Operation, Practical parameters - Receiver sensitivity, Quantum Limit, Eye diagrams, Concepts of Coherent detection. Analog Links – Overview of Analog Links, CNR(concept), Multichannel Transmission Techniques(concept), Link Parameters Definitions – Gain, Noise Figure, SFDR; Digital Links – Simplex Point to point link, Link Power Budget and Rise Time Budget with examples, Power Penalties, Modal noise, Mode-Partition Noise, Reflection Noise, Chirping

TEXT BOOKS:

1. Gerd Keiser "Optical Fiber Communications", TMH, 4th Edition, 2008.
2. John M. Senior, "Optical Fiber Communications", Pearson Education, 3rd Edition, 2009

REFERENCE BOOK:

1.D.K. Mynbaev, S.C. Gupta and Lowell L. Schemer, "Fiber Optic Communications", Pearson Education, 2005.
2.G. P. Agarawal, "Fiber Optics Communication Systems", John Wiley New York, 1997.
3.Joseph C Palais ,"Fiber Optic Communication", 4th Edition, Pearson Education.

SWAYAM/NPTEL/MOOCs:

3. https://nptel.ac.in/courses/108/106/108106167/
4. https://nptel.ac.in/courses/117/104/117104127/

Course Title	**Theory of Algorithms**				**Course Type**		**SC**	
Course Code	B20ENS513	**Credits**	3		**Class**		**V Semester**	
	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:

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 problems.	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:

https://www.youtube.com/watch?v=STL8ESuETmM
https://www.youtube.com/watch?v=5g7K86jYto8

https://www.youtube.com/watch?v=M7Wt8rIL6SQ
https://www.youtube.com/watch?v=6VF2Q0pgUFI
https://www.youtube.com/watch?v=D6xkbGLQesk

Professional Elective 2

<table>
<tr><td>Course Title</td><td colspan="4">Automotive Electronics</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS521</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"></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 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:

9. Understand the functions of electronic systems in modern automobiles, modern electronics technology to improve the performance, safety, comfort and related issues
10. Study the principles of automotive sensors and interfacing techniques, design, model and simulate interfacing systems with sensors
11. Know the principles and functionalities of various Automotive Communication Protocols (ACPs) and Exhaust after treatment systems.
12. 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	Explain power train and drive train components in automotive systems	1,2	1,2,3
CO2	Discuss the role of electronics in engine control systems	2,3	1,2
CO3	Analyze the Exhaust After-Treatment systems in automotive systems	1,2,3	1,2
CO4	Illustrate the concepts of in-vehicle networking	2,3,7	2
CO5	Describe automotive safety systems & infotainment systems.	2,3,4,7	3
CO6	Recognize the On-board diagnostics, Off-board diagnostics.	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											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   **Automotive Industry and Modern Automotive Systems:** Vehicle classifications and specifications, need for electronics in automobiles, Automotive Fundamentals Overview – Four Stroke Cycle, Electronic Ignition systems, Spark plug, Spark pulse generation, Ignition Timing. Transmission Control - Automotive transmissions, Drive Train, Brakes, Steering System - Steering Control, Starting System- Battery, Air/Fuel Systems, Fuel Handling, Air Intake System.
UNIT - 2   **Introduction to automotive sensors and Actuators:**   Air/ Fuel Management Sensors – Oxygen (O2/EGO) Sensors, Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Sensors for occupant safety.   Actuators – Solenoid actuator , Fuel Metering Actuator, Fuel Injector, Ignition Actuator , Sensor and actuator interfacing techniques.
UNIT - 3   **Exhaust After-Treatment Systems and Communication Protocols:** Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR) and it's control, Exhaust Gas Recirculation Actuator, Evaporative Emission Systems, Electronic Fuel Control System, Electronic Ignition control, Idle speed control.   Automotive Communication Protocols: SPI, I^2C, USB, CAN, LIN, FLEXRAY, MOST protocols.
UNIT - 4   **Electronics for Passenger Safety and Convenience:** Electronics for Passenger Safety and Convenience – SIR, Air bag and seat belt pretension systems, Tire pressure monitoring systems, TCS , ESP, Collision Avoidance Radar warning Systems, Radio navigation, Advance Driver Information System.   Integrated Body – Climate Control Systems, Electronic HVAC Systems, Lighting, Entertainment Systems, Alternative Fuel Engines, Lighting, wipers, Power windows, Remote keyless entry systems.   Automotive Diagnostics – On-board diagnostics, Off-board diagnostics.Introduction to autonomous vehicles.

TEXT BOOKS:

10. Denton, "Automotive Electrical and Electronic Systems, Burlington", MA 01803, Elsevier Butterworth-Heinemann, 2004.
11. William B. Ribbens, "Understanding Automotive Electronics, 8th Edition, Newnes, 2017.

REFERENCE BOOK:

3. Ronald K. Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 2007.
4. Robert Bosch GmbH, "Bosch Automotive Electrics & Electronics: Systems and Components, Networking and Hybrid Drive", Robert Bosch GmbH, 3rd Edition, 1999.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:
https://nptel.ac.in/courses/108/102/108102121/

Course Title	Information Theory and Coding			Course Type	SC
Course Code	B20ENS522	Credits	3	Class	V Semester

	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**	**0**	**50 %**	**50 %**

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

5. Explain fundamental concept of information theory and entropy.
6. Illustrate various source coding techniques.
7. Summarize reliability of data transmission using error-control coding techniques,
8. 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 correction.	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:

2. 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

<table>
<tr><td>Course Title</td><td colspan="4">Database Management Systems (DBMS)</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS523</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"></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>0</td><td>50 %</td><td>50 %</td></tr>
</table>

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:

5. Provide a knowledge of Database architecture
6. Provide students to understand and use a relational database system
7. Introduction to Databases, Conceptual design using ERD,
8. 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 applications.	1,2,3	1,2,3
CO2	Make use of the concepts of relational algebra to solve quaries over database.	1,2,3	1,2
CO3	Construct the database for given real world application and solve quaries over it using SQL commands.	1,2,3	1,2
CO4	Develop an optimized database using design gidelines 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 quaries..	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	1
CO2	2	1	1										3	1	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. **SQL[10 Hrs]**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, 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:

5. Elmasri and Navathe, "**Fundamentals of Database Systems**", 5^{th} Edition, Pearson Education, 2007.
6. Raghu Ramakrishnan and Johannes Gehrke, **"Database Management Systems**", 3^{rd} Edition, McGraw Hill, 2003
7. Phill Pratt, "Concepts of Database Management, Cengage Learning", 8th Edition, 2014.
8. Jeffrey A Hoffer, "Modern Database Management, Pearson", 12th Edition, 2015.

REFERENCE BOOK:

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

12. 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 Elective -1

Course Title	**PCB Fabrication**				**Course Type**		**Open Elective**	
Course Code	**B20ENO501**	**Credits**	3		**Class**		**V Semester**	
PCB Fabrication	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:

This course discusses the basic design rules of PCB Designing and also the types of error. Also describes the modern tools for designing the PCB and Fabrication Process. The main objective of learning the PCB development process is to launch onto the production line and in the market.

Course Objectives:

The Course Objectives are

5. To understand the basic design rules for PCB Designing.
6. To acquainted with the production techniques of PCB Designing.
7. To introduce the modern tools for designing of PCB.
8. To understand the fabrication process of Single layer and Double layer PCB.

Course Outcomes:

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the basic rules of PCB designing.	1,2,3,9,11,12	1,2
CO2	List the design rules in designing PCB	1,2,3,9,11,12	1,2
CO3	Explain the EMI/EMC requirement of PCB	1,2,3,7,9,11,12	1,2
CO4	Apply advance techniques, skills and modern tools for designing of PCBs	1,2,3,5,9,11,12	1,2
CO5	Enumerate the PCB Etchning process	1,2,3,5,9,11,12	1,2,3, ,
CO6	Demonstrate the Fabrication of designed PCB.	1,2,3,5,7,9, 11,12	1,2

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	PO 10	PO11	PO12	PSO1	PSO2	PS O3
CO1	1	2	1						1		2	2	3	1	
CO2	1	3	3						1		3	2	2	1	
CO3	1	2	1				1		1		2	2	3	1	
CO4	1	1	3		3		1		1		3	2	1	1	
CO5	1	1	3		3		1		1		3	2	1	1	
CO6	1	1	3		3		1		1		3	2	1	1	

Course Content:

Contents

UNIT – 1
Introduction to Printed circuit board: Fundamental of electronic components, different packages of components, SMD and PTH components, understanding selection criteria for components based on power specifications, size constraints, connection orientation requirement, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork. **Design rules for PCB**: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.DRC errors like Pad to Pad error, Cm-P,Cm-B,Cm-Cm,T-P,T-T,T-V etc.
UNIT-2
Introduction printed circuit board production techniques: Photo printing, film master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations. **PCB design for EMI/EMC:** Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques.
UNIT - 3
Introduction to Electronic design automation(EDA) tools for PCB designing: Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, creating report of design, creating manufacturing data (GERBER) for design.
UNIT - 4
Fabricate single-side PCB for simple network: Fabricate single-sided PCB, mount the components and assemble in a cabinet for any one of the electronic circuits. Components library creation, net list generation, DRC check by using PCB Design EDA tool. **Design and Fabricate Double-side PCB:** Understanding need of double side PCB board, inter layer signal passing through vias and bias, plated holes. Double layer board fabrication using tonner transfer method.

Text Books:

2. Printed circuit board design, fabrication assembly and testing by R. S. Khandpur, Tata McGraw Hill 2006

Reference Books:

8. Printed circuit Board Design and technology, Walter C. Bosshart
9. Printed Circuits Handbook, Sixth Edition, by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016
10. Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition 2009
11. Introduction to System-on-Package, Rao R Tummala &Madhavan Swami Nathan, McGraw Hill, 2008.
12. EMC and Printed circuit board, Design theory and layout, Mark I Montrose IEEE compatibility society
13. Flexible Printed circuit board Design and manufacturing, By Robert torzwell
14. Web-based Current literature.

Additional Resources:

4. https://www.youtube.com/watch?v=gMxVK3h5K1g
5. https://www.youtube.com/watch?v=4mewixM67Uc&list=PLSLZd4oi2O9rOSAuj0GvXGAa4D9ezeEVM
6. https://www.youtube.com/watch?v=IuG2vuwdMXc

Course Title	Embedded Systems				Course Type	Open Elective	
Course Code	B20ENO502	**Credits**	**3**		**Class**	**V Semester**	
Embedded Systems	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:

9. Give a brief idea about the Embedded system, Classification and Major applications of Embedded Systems
10. Understand the various components of embedded systems, Characteristics and Attributes of Embedded Systems.
11. Study the fundamental Issues in Hardware Software Co-Design.
12. 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 Actuator 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

https://nptel.ac.in/courses/108/102/108102045/

https://nptel.ac.in/courses/108/102/108102045/

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https://nptel.ac.in/courses/108/102/108102045/

<table>
<tr><td>Course Title</td><td colspan="4">Digital Communication Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0504</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
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<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 conditions	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 DivisionMultiplexing 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

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	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.	**Name of the Practice Session**	**Tools and**	**Expected Skill**

No.		Techniques	/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,Multimeter, CRO) and design equations	Design and circuit debugging. 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 BOOK:

4. K. Sam Shanmugam, "**An introduction to analog and digital Communication system**", John Wiley publication, 3rd edition, 2008.

5. Bernad Sklar, "Digital **Communication**", Pearson education 2007.

6. T L Singal, **"Digital Communication"**, McGraw Hill Education 2015

Course Title	Verilog for FPGA Development Lab				Course Type		HC	
Course Code	B20EN0505	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	Practical	IA	SEE
	-							
	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 in programming 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, DC motor 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	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
9	Display messages on the 7-segment display	Xilinx, Modelism and FPGA board	Design and circuit debugging. Working in a team
10	Control speed and direction of DC motor	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 Edition David 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	**Technical Documentation**				**Course Type**		**FC**	
Course Code	**B20EN0506**	**Credits**	**1**		**Class**		**V 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:

COURSE OBJECTIVES:

The objectives of this course are to:

4. Acquire language skills
5. Develop linguistic and communicative competencies
6. 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.	8,9,10,12	**1**
CO2	Learn to avoid communication problems that distract the readers, causing confusions, distrust, or misunderstanding.	8,9,10,12	**1**
CO3	Learn to the practice of various verbal reasoning and grammar practice.	8,9,10,12	**1**
CO4	To search engineering information, both in traditional ways and online.	8,9,10,12	1
CO5	Write research/design reports with special emphasis on content and style.	8,9,10,12	1
CO6	learn strategies for preparing and delivering presentations, single or in team	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			2	2		2	1		
CO2						1			2	2		2	1		
CO3						1			2	2		2	1		
CO4						1			2	2		2	1		

CO5						1			2	2		2	1		
CO6						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
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:

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

<table>
<tr><td>Course Title</td><td colspan="4">Research based project</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B20EN0507</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td></td><td>28</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

Research-based project course targets to promote and develop student competencies related to research practice and to benefit students through activities linked to research. This course denotes the application of learning and teaching strategies that link research with teaching. One of the main advantages would be to awaken student's interest in knowledge and the main problems that society faces in order that students may broaden their perspectives and focus their study areas.

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	Observe students research in the real world	1,4,6,7,8,9,10,11,12	1,2,3
CO2	Present research methods and approaches	1,4,6,7,8,9,10,11,12	1,2,3
CO3	Show experimental procedures and real exercises of computational issues in scientific disciplines.	1,4,6,7,8,9,10,11,12	1,2,3
CO4	Perform searches from the bibliography of a research paper, analyzing figures, diagrams, tables and simulators presented in the paper	1,4,6,7,8,9,10,11,12	1,2,3 ,
CO5	Describe a peer review of a research process	1,4,67,8,9,10,11,12	1,2,3
CO6	Relate the current result with the literature	1,4,6,7,8,9,10,11,12	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

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

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

Detailed Syllabus

VI Semester

Course Title	**Control Engineering**				**Course Type**		**HC Integrated**	
Course Code	**B20EN0601**	**Credits**	**4**		**Class**		**V I Semester**	
Control Engineering	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	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 critera ,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 observabilty and discrete control system design using state space is briefly discussed.

COURSE OBJECTIVES:

The objectives of this course are:

6. Explain modeling of system and to find overall gain of complex system by applying standard reduction technique.
7. Introduce the basic building blocks of digital control systems.
8. Explain time response of first order and second order system and to find system response to test input signals.
9. Explain stability criteria requirement of system in Laplace domain and different stability analysis methods
10. 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:

11. 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.
12. https://www.electrical4u.com/time-domain-analysis-of-control-system/
13. https://www.tutorialspoint.com/control_systems/control_systems_stability_analysis.htm
14. https://edurev.in/studytube/Chapter-5-Stability-Analysis-Of-Control-Systems-No/c11204e3-f86f-4851-bc0c-f2363917ee2a_t
15. https://www.tutorialspoint.com/control_systems/control_systems_construction_root_locus.htm
16. https://electronicscoach.com/bode-plot.html
17. https://www.electrical4u.com/nyquist-plot/
18. 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
19. https://electricalacademia.com/control-systems/state-space-representation-and-analysis-state-space-modeling/
20. https://www.sciencedirect.com/topics/engineering/state-space-representation

SWAYAM/NPTEL/MOOCs:

5. https://nptel.ac.in/courses/107/106/107106081/
6. https://nptel.ac.in/courses/108/107/108107115/
7. https://nptel.ac.in/courses/108/104/108104049/
8. https://nptel.ac.in/courses/108/102/108102097/

Course Title	**Digital Signal Processing**				**Course Type**		**HC**	
Course Code	**B20EN0602**	**Credits**	3		**Class**		**VI Semester**	
Digital signal processing	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	-	-	-				
	-	-	-	-				
		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:

7. Explain the concept of DFT and FFT.
8. Calculate the DFT of a sequence, relate it to the DTFT, and use the DFT to compute the linear convolution of two sequences.
9. Apply the concept of FFT algorithms to compute DFT.
10. Design IIR filter using impulse invariant, bilinear transform.
11. Describe the concept of linear filtering Technique.
12. 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, efficient computation of th 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 Windows (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:

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

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:

10. 1.https://www.youtube.com/watch?v=b-JxoHKv27Ye3
11. https://www.youtube.com/watch?v=5LERZVZGw60
12. https://www.youtube.com/watch?v=Ytn3fhjyxf8
13. https://www.youtube.com/watch?v=KcqJGC-SpMg
14. https://www.youtube.com/watch?v=yqrLro_ueFU
15. https://www.youtube.com/watch?v=lc6QT8VjqVc
16. https://www.youtube.com/watch?v=-10FG_DXRwY
17. https://www.youtube.com/watch?v=3QWvi8EC_DI
18. https://www.youtube.com/watch?v=twbtNKg3hrM&list=PLxWwb-b9LnpA9ycTTqC3f8PpfSLVvBndH

Course Title	Computer Networks				Course Type		HC	
Course Code	B20EN0603	Credits	3		Class		VI Semester	
Computer Communication Networks (I)	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:

The main objective of this course is to provide a foundational view of communication networks: the principles upon which the Internet and other computer networks are built; how those principles translate into deployed protocols and hands-on experience on solving challenging problems with network protocols. Computer communication networks course will include topics such as link-layer technology, switching, routing protocols, the Internet Protocol, reliability, flow control, congestion control, and their embodiment in TCP and UDP, Quality of Service and application layer protocols such as HTTP, etc. The course will involve a significant amount of network simulator tool to design the basic network topologies and protocols.

COURSE OBJECTIVES:

The objectives of this course are to:

5. Understand the basics of data communication and networking.
6. Classify multiple access methods and identify different LANs.
7. Illustrate functions of network layer and Demonstrate different routing protocols
8. Discuss transport layer and application layer protocols

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the fundamental concepts of basic networking, Protocols, Standards and Layered models	1,2,3	1,2,3
CO2	Compare OSI Model & TCP/IP Suite	1,2,3	1,2,3
CO3	Differentiate multiple access methods and LANs	1,2,3	1,2,3

CO4	Demonstrate the concepts of network layer and build sub-nets and routing mechanism.	1,2,3,5	1,2,3
CO5	Evaluate different transport layer protocols	1,2,3,5	1,2,3
CO6	Evaluate different application layer protocols	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	1										1	2	1
CO2	3	2	1										1	2	1
CO3	3	2	1		3								3	2	1
CO4	3	2	1		3								3	2	1
CO5	3	2	1		3								3	2	1
CO6	3	2	1		3								3	2	1

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Introduction to Data Communication and Networking:** Layered tasks, OSI Model, TCP/IP Suite, and Comparison of OSI Model & TCP/IP Suite. Addressing of TCP/IP Model. Framing, Flow and Error Control, Protocols: Noiseless channels and noisy channels, HDLC
UNIT - 2 **Multiple Access &LANs:** Random access, Controlled access, Channelization. Wired LAN, Ethernet, IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11

<table>
<tr><td>UNIT - 3
Network Layer: Logical addressing, Ipv4 addresses, Ipv6 addresses, Internetworking, Ipv4 Header Format and Ipv6 Header Format, Transition from Ipv4 to Ipv6. Distance vector routing, link state routing.</td></tr>
<tr><td>UNIT - 4
Transport layer & Application Layer: Process to Process Delivery, UDP, TCP, SCTP, Domain Name System, Resolution</td></tr>
</table>

Text Books:

1. B Forouzan "Data Communication and Networking", 4th Ed, TMH 2006.

Reference Books:

4. James F. Kurose, Keith W. Ross "Computer Networks", Pearson Education, 2nd Edition, 2003.
5. Wayne Tomasi"Introduction to Data communication and Networking" Pearson Education 2007.
6. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch01.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch02.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch11.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch12.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch13.ppt
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http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch22.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch23.ppt
http://highered.mheducation.com/sites/dl/free/0072967757/281735/ch25.ppt

SWAYAM/NPTEL/MOOCs:

<table>
<tr><td>Course Title</td><td colspan="4">Computer architecture and organization</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B20EN0604</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">Computer architecture and organization</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</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:

Computer architecture and organization typically deals with the basic principles of computer organization, operation and architecture. It provides an overview of computer hardware and software and how the basic functional units are interconnected to form a complete computer system. The basics of I/O data transfer synchronization, interrupts and Direct Memory Access methods are presented. Bus protocols and standards are also presented with PCI, SCSI, and USB standards being used as representative commercial examples.

COURSE OBJECTIVES:

The objectives of this course are to:

14. Make the students to understand the fundamental concepts of computer system architecture.
15. Provide an understanding of memories in computer, basic structure, I/O organization.
16. Provide an understanding of the concepts of interrupts, direct memory access and standard I/O interfaces.
17. Illustrate the organization of different types of semiconductor and other secondary storage memories.
18. Illustrate the simple processor organization based on hardwired control and micro programmed control.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe basic structure of computer system and memories.	1,2,3	1,2,3
CO2	Interpret the different types of addressing modes	1,2,3	1,2,3
CO3	Describe the Input/output organization and interrupt handling mechanisms.	1,2,3	1,2
CO4	Analyze the organization of different types of semiconductor and other secondary storage memories.	1,2,3	1,2,3
CO5	Differentiate the types of memories in a computer	1,2,3	1,2,3,
CO6	Distinguish between simple processor organization based on hardwired control and micro programmed control.	1,2,3	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO5	✓	✓	✓			
CO6	✓	✓	✓			

COURSE ARTICULATION MATRIX

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

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: Numbers, arithmetic operations and characters, 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 Accesses, Buses, Interface Circuits, Standard I/O interfaces.
UNIT – 3 **The Memory System:** Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Synchronous DRAMs, Read Only Memories, Cache Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks.

UNIT – 4
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control.

TEXT BOOKS:

12. Carl Hamacher, Z Varnesic and S Zaky, "Computer Organization", Fifth Edition, McGraw Hill 2002.

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:

Memory Organization and Assembly Language Programming - ScienceDirect
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

Professional Elective-3

Course Title	**POWER ELECRONICS**				**Course Type**		SC	
Course Code	B20ENS631	**Credits**	3		**Class**		**VI Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial							
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**--**	**50%**	**50%**

COURSE OVERVIEW:

This course provides the basics of power devices, semiconductor devices control characteristics and its application is discussed. It also covers analysis of power converters for R, RL, RLE load conditions. The different types of modulation technique for control and conversion of power is also discussed.

COURSE OBJECTIVES:

The objectives of this course are:

4. Explain various power Semiconductor devices and applications.
5. Prepare the students to analyze different power converter circuits.
6. Provide understanding of modulation techniques used in power electronics.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Choose suitable power semiconductor device for a given application.	1,2,3,4	1,2,3
CO2	Design Controlled rectifier circuit for given specifications		
CO3	Analyze AC to DC and DC-DC, DC-AC and AC-AC converters for different load conditions.	1,2,3,4	1,2,3
CO4	List the advantages of Multi level Inverters	1,2,3,4	1,2,3
CO5	Analyze the different types of modulation techniques used to control and convert the power.	1,2,3,4	1,2,3
CO6	Analyze Bidirectional controllers and Single phase controllers for Inductive loads	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	1	1									3	3	3
CO2	3	3	3	3									3	3	3

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

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

COURSE CONTENT
THEORY:

Contents
Unit-1 **Power semiconductor devices:** Survey of power Semiconductor devices, Power diode, SCR, GTO, LASCR, RCT, SITH, BJT, MOSFET, IGBT etc., Switching losses, applications . **Controlled Rectifiers (Converters):** Single Phase, Half wave / full wave, half controlled /fully controlled converters with R and RL loads, Dual converters.
UNIT - 2 **DC- DC Converters :** Introduction, Principle of step down operation, step down converter with RL load, Principle of step up operation, step up converter with R-load, performance parameters, converter classification.
UNIT - 3 **Inverters:** Introduction, Single Bridge inverters with R load, Voltage control, modulation techniques, SPWM, Boost inverter. Current source inverters. **Multi-level inverters:** Introduction, multilevel concept, diode clamped multilevel inverter.
UNIT - 4 **AC voltage controllers :** Introduction, principle of on- Off control, single phase bidirectional controllers with R-load, single phase controllers with inductive loads.

Text Books:

3. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Third Edition, 2004
4. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition, 1994

Reference Books:

3. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995.
4. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1996.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

https://www.youtube.com/watch?v=KTzQgAFTbCY
https://www.youtube.com/watch?v=Fl_oU71L-e4
https://www.youtube.com/watch?v=wHvF-yGOVos
https://www.youtube.com/watch?v=TKrtGkgsMA0
https://www.youtube.com/watch?v=ZbvWe9xBu3Q&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO
https://www.youtube.com/watch?v=djbJm-xWo2w
https://www.youtube.com/watch?v=ObM42PgvFh8

https://www.youtube.com/watch?v=vvLwZ36fVa4

Course Title	**Cryptography and Network Security**				**Course Type**		**SC**	
Course Code	B20ENS632	**Credits**	**3**		**Class**		**VI Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	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:

2. William Stallings, "**Cryptography and Network Security, Principles and Practice**", 6th edition, Pearson/Prentice Hall, 2011.

Reference Books:

3. Atul Kahate, "**Cryptography and Network Security**", 2nd edition, Tata McGraw Hill, 2007
4. Eric Maiwald, "**Fundamentals of Network Security**", McGraw-Hill, 2003

<table>
<tr><td>Course Title</td><td colspan="4">JAVA Programming</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS633</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="6">JAVA Programming</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 inWeightage</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="3">Theory</td><td rowspan="3">Practical</td><td rowspan="3">IA</td><td rowspan="3">SEE</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</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:

Java is an object-oriented language that enables learners to create real-world applications. Java technology based software works just about everywhere from the smallest devices to super computers! Java technology components are not impacted by the kind of computer, phone, smart device or operating systems they are running on. The architecture-neutral nature of Java technology is important in a networked world where one cannot predict the kind of devices that partners, suppliers and employees use to connect to their organizations. The Java Programming in course is the first step for developing such applications. This course provides an introduction to object-oriented concepts and its implementation in Java technology programs. In addition, it covers syntax and semantics of the Java programming language.

COURSE OBJECTIVES:

The objectives of this course are:

5. Illustrate the creation of classes and objects in Java
6. Demonstrate concept reusing of code using inheritance and interfaces
7. Use proper program handling mechanism to write robust programs
8. Familiarize advance java concepts like Threads, Streams, IO, JDBC

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop simple programs using Java language concepts such as variables, conditional, methods and construct	1,2,3,5	1,3
CO2	Apply the concept of Classes and objects in developing program	1,2,3,5	1,3
CO3	Apply program structure like interface to develop programs	1,2,3,5	1,3
CO4	Build application using the concept of packages, exception handling and file handling	1,2,3,5	1,3
CO5	Discuss the concepts like threads, JDBC, Servlets,	1,2,3,5	1,3
CO6	Implement the Concept of **Threads, Streams, IO, JDBC in programs**	1,2,3,5	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT - 1
Java Revolution: Revolutionary programming language; **Object -Oriented Fundamentals:** Object oriented programming, how java is better than C++; **Java Language Introduction:** Hello World, Step by step, Variables; Types; Operators; Flow Control, Java User input, Input types. **Class:** Object references, Instance variables, the new operator, The Dot operator, Method declaration, Method calling, this, Constructors,

UNIT - 2
Inheritance: Inheritance: Super, Method overloading, Method overloading, Method Overriding, Dynamic method dispatch; final, finalize, static, Abstract class and method. **Interfaces:** The interface statement, The implement statement, Variables in interfaces. **String Handling:** String constructors, Special String Syntax, Character Extraction, Comparison, String copy modification;(Handson)
UNIT – 3
Package: The package statement, Compiling classes in packages, the import statement, Access protection; **Exception Handling:** Fundamentals, Exception types, try and catch, Multiple catch clauses, Nested try statements. **Input/output:** Files, Input Stream, Output Stream, File streams.(Handson)
UNIT – 4
Threads: Single threaded event loop, The java thread model, Thread, Runnable, Thread priorities, Thread Synchronization; **Introduction to Advance Java:** JDBC – Introduction, Architecture, Steps to create JDBC application, Java Servlets – Introduction, life-cycle, JAVA Data Structures Maps, Linked List, Concurrent Data Structures Introduction to JAVA Memory Management (Handson)

TEXTBOOKS:

3. Patrick Naughton, "The Java Handbook", Tata McGraw-Hill, 2006
4. Herbert Schildt, Java™: The Complete Reference, McGraw-Hill, Tenth Edition, 2018.

REFERENCE BOOK:

5. Bruce Eckel, "Thinking in Java", III Edition, Pearson 2004.
6. Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015
7. Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011
8. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

4. Ed Burnette; Eclipse IDE Pocket Guide : Using the Full-Featured IDE, O'Reilly Media, Inc, USA
5. Oracle Java Documentation https://docs.oracle.com/javase/tutorial/
6. https://www.edureka.co/blog/advanced-java-tutorial

SWAYAM/NPTEL/MOOCs:

4. https://onlinecourses.nptel.ac.in/noc21_cs03/preview
5. https://www.coursera.org/specializations/core-java
6. https://www.coursera.org/learn/java-programming

Open Elective -2

Course Title	Communication Systems				Course Type	OPEN ELECTIVES	
Course Code	B20ENO601	Credits	3		Class	VI Semester	
Embedded Systems	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:

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:

13. Give a brief idea about communication system,
14. Understand the radio signal propagation, transmitter, and receiver.
15. Gain the knowledge of fundamental of GSM module and architecture.
16. 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 importance's 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, modulatio 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 communicatio 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 networ 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:

3. Michael Moher Simon Haykin "An Introduction to Analog & Digital Communications", Wiley; Second edition (1 January 2012).
4. Rappaport "Wireless Communications", Pearson ISBN: 9788131731864, 8131731863 (2010).

REFERENCE BOOK:

2. K. Sam Shanmugan "Digital and Analog Communication Systems", Wiley India Pvt Ltd (21 August 2006)

Link

2. https://www.youtube.com/watch?v=F3slBe2r8vA&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru

Course Title	**Sensors and Instrumentation**				**Course Type**		**OE**	
Course Code	B20ENO602	**Credits**	**3**		**Class**		**VI Semester**	
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**3**	**3**	**3**	**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:

6. To make students familiar with the constructions and working principle of different types of **s**ensors and transducers.
7. To make students aware about the measuring **instruments** and the methods of measurement and the use of different transducers.
8. To provide the knowledge about virtual instruments
9. 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 level	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

	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	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:

7. https://courses.p2pu.org/en/courses/3109/content/6858/f
8. https://scholar.google.co.in/scholar?q=wearable+sensors+journal&hl=en&as_sdt=0&as_vis=1&oi=scholart
9. https://journals.lww.com/jcejournal/citation/1978/07000/medical_instrumentation_application_and_design.17.aspx

SWAYAM/NPTEL/MOOCs:

6. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
7. https://www.mooc-list.com/tags/sensors
8. https://www.coursera.org/learn/internet-of-things-sensing-actuation
9. https://onlinecourses.nptel.ac.in/noc19_ee41/preview
10. https://mooc.es/course/sensors-and-actuators/

Course Title	**Digital Signal Processing Lab**				**Course Type**		**HC**	
Course Code	B20EN0605	**Credits**	1		**Class**		**VI 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				
	-	-	-	-				
		1	**2**	**2**	**-**	**28**	**50 %**	**50 %**

COURSE OVERVIEW:

COURSE OBJECTIVES:

The objectives of this course are:

The objectives of this course are:

7. Explain the concept of DFT and FFT.

8. Calculate the DFT of a sequence, relate it to the DTFT, and use the DFT to compute the linear convolution of two sequences.
9. Apply the concept of FFT algorithms to compute DFT.
10. Design IIR filter using impulse invariant, bilinear transform.
11. Describe the concept of linear filtering Technique.
12. 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 domain	1,2,3,4,5,9,10	1,2,3
CO4	Design and analyze IIR and FIR	1,2,3,4,5,9,10	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	1,2,3,4,5,9,10	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	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)		**SLO:5,14,18**
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 approximation behavior 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:

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

Reference Books:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

19. 1.https://www.youtube.com/watch?v=b-JxoHKv27Ye3
20. https://www.youtube.com/watch?v=5LERZVZGw60
21. https://www.youtube.com/watch?v=Ytn3fhjyxf8
22. https://www.youtube.com/watch?v=KcqJGC-SpMg
23. https://www.youtube.com/watch?v=yqrLro_ueFU
24. https://www.youtube.com/watch?v=lc6QT8VjqVc
25. https://www.youtube.com/watch?v=-10FG_DXRwY
26. https://www.youtube.com/watch?v=3QWvi8EC_DI
27. https://www.youtube.com/watch?v=twbtNKg3hrM&list=PLxWwb-b9LnpA9ycTTqC3f8PpfSLVvBndH

Course Title	**Computer Networks Lab**				**Course Type**		**HC**	
Course Code	**B20EN0606**	**Credits**	**1**		**Class**		**VI Semester**	
Computer Communication Networks (I)	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-						
	Practice	1	2	2				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**1**	**2**	**2**		**28**	**50 %**	**50 %**

COURSE OVERVIEW:

COURSE OBJECTIVES:

The objectives of this course are to:

1. Identify the necessary software and hardware to constitute a designed computer network
2. Implement a simple LAN Network
3. Describe, Analyze and evaluate a number of datalink, network, and transport layer protocols
4. Describe routing protocols

.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Write and debug the code for various error detection, Congestion Control Techniques		
CO2	Write and test the code using different security techniques to secure the messages,		
CO3	Write the program and Evaluate different network layer and transport layer protocols		
CO4	Write the code for different wired and wireless network scenarios and test the performance using simulators		
CO5	Evaluate various design parameters such as latency, error rate, throughput, and their influence on node/link utilization and performance		

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

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

PRACTICE SESSION:

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	Write a program for bit stuffing & de-stuffing using HDLC.	C/C++ Software	Identify bit stuffing and destuffing
2	Write a program for character stuffing & de-stuffing using HDLC.	C/C++ Software	Identify byte stuffing and destuffing
3	Perform the Encryption and Decryption of a given message using substitution method.	C/C++ Software	Analyze the Encryption and Decryption of a given message using substitution method.
4	Choose the two prime numbers, p=17 and q=11.Write a program for public key encryption system using RSA algorithm to encrypt and decrypt the message.	C/C++ Software	Understand the key concept of public key encryption system using RSA algorithm to encrypt and decrypt the message.
5	Write a program to implement the congestion control b using the leaky bucket algorithm. Examine node transmitting/receiving packets to/from other nodes. Using a random function; vary the packet size.	C/C++ Software	Analyze the leaky bucket algorithm for congestion control
6	Write a program for distance vector algorithm to find the shortest path for transmission.	C/C++ Software	Analyze to find the shortest path using the distance vector algorithm
7	Create a three node network topology and connect the duplex links between them. Tcl script to observe the packet flow for the given network in network animator (NAM)	NS2 Simulator Software	Understand the concept of duplex link in a given three node topology, and analyze the packet flow.
8	Simulate a four node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3, n1-n3. Apply relevant applications over TCP agents by changing the parameters and hence determine the number of packets transmitted.	NS2 Simulator Software	Analyze the concept of TCP agent for a given four node network and determine the number of packets transmitted
9	Simulate a four node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply UDP agent between n0-n3, n1-n3. Apply relevant applications over UDP agents by changing the parameters and hence determine the number of packets transmitted.	NS2 Simulator Software	Analyze the concept of UDP agent for a given four node network and determine the number of packets transmitted
10	Simulate a three nodes point-to point network and connect the duplex links between them. Set the queue size, vary the transmission speeds	NS2 Simulator Software	Evaluate the concept of duplex link in a given three node topology, and analyze queue size, the

	(bandwidth)and find the number of packets dropped.		transmission speeds (bandwidth)and the number of packets dropped.
11	Simulate an Ethernet LAN using N-nodes (6-10) with UDP/TCP connection. Apply relevant applications over UDP/TCP agents by changing the parameters and hence determine the number of packets transmitted.	NS2 Simulator Software	Analyze packet transmission in 802.3 Ethernet using UDP/TCP
12	Simulate a wireless network for n nodes. For a wireless network consisting of three mobile nodes (n0-n2), Nodes are configured with the specific parameters of a wireless node. Initial location of the node is fixed. Nodes are given mobility with fixed speed and fixed destination location. TCP agent is attached to node0 and TCP sink agent is attached to node1. Both the agents are connected and FTP application is attached to TCP agent. Write a Tcl script and make an ad-hoc simulation to analyze the output in the trace file. Use the routing protocol as Adhoc on demand distance vector (AODV).	NS2 Simulator Software	Design and analyze AODV protocol for wireless networks.

Text Books:

1. B Forouzan "Data Communication and Networking", 4th Ed, TMH 2006.

Reference Books:

3. James F. Kurose, Keith W. Ross "Computer Networks", Pearson Education, 2nd Edition, 2003.
4. Wayne Tomasi"Introduction to Data communication and Networking" Pearson Education 2007.

S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education

Course Title	**Mini Project/ Internship**				**Course Type**		**FC**	
Course Code	B20EN0607	**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
6. Make a presentation of research methods and approaches
7. Show experimental procedures and real exercises of computational issues in scientific disciplines.
8. Ask students to read and perform searches from the bibliography of a research paper, analyzing figures, diagrams, tables and simulators presented in the paper
9. 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 Traditions and Culture				Course Type		FC	
Course Code	B20PA0501	Credits	1		Class		VI 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 OBJECTIVES:

The objectives of this course are to:

1.Provide conceptual knowledge of Indian culture and traditions

2.Introduce students to the science and technological advancements related to Indian culture

3.Help students understand the Indian spiritual aspects of Indian culture

4.Help learners understand the factors which unite the diverse cultures of India

COURSE OUTCOMES (COs)

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	1
CO2	Describe various ancient theories in treatment of any disease.	6	1
CO3	Appreciate the science and technological advancements in ancient India.	6	1
CO4	Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.	6	1
CO5	Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food	6	1
CO6	Understand India as a land united by cultural diversity.	6	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	✓	✓				
CO5	✓	✓				

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
Unit 1: Indian Tradition xi. 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 xii. Religion – Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity xiii. Art – Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, puppetry xiv. Architecture – Engineering and Architecture in Ancient India; Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India xv. Literature- Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

Unit 2: Contribution of ancient India to Science and Maths

i. Development of Science in Ancient India- Astronomy, Mathematics, Medicine, Metallurgy.

ii. Scientists of Ancient India:

g. Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya
h. Science- Kanad, Varahamihira, Nagarjuna
i. Medical Sciences (Ayurveda and Yoga)- Susruta, Charaka, Yoga and Patanjali

iii. Science and Scientists in Medieval India- Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.

iv. Scientists in Modern India- Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir Bhabha, Dr, Vikram Ambalal Sarabhai, ,Dr. APJ Abdul Kalam

Unit 3: Indian Spiritual Aspects

I. Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

ii. Hata Yoga and Pranayama- Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga; Bhakti Yoga – yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

iii. Buddhist, Jaina Spiritualities- Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - Ashtanga Marga

Unit IV: Unity in Diversity

vii. Commensality and the Significance of Food – Eating Together as Family and as a Society, Food at Rituals; annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World

viii. Celebrating Diverse Festivals – Festival Types: Religious and Seasonal, Religious - Holi, Diwali, Ganesh Chaturthi, Janmashtami, Mahavir Jayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals) - Baisakhi, Pongal, Sankranti

ix. Attire - Indus Valley Civilization, Vedic period, Modern India

Text Books

1. Sundararajan K.R., "Hindu Spirituality - Vedas through Vedanta, Cross Road Publications", New York, 1997.

2. Griffiths Bede, "Yoga and the Jesus Prayer Tradition, Asian Trading Corporation", Bangalore, 1992

3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998

4. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.

5. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

Proposed Syllabus for VII and VIII Semester

Detailed Syllabus

<table>
<tr><td>Course Title</td><td colspan="4">Microwaves and Antennas</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EN0701</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Microwave and Antennas</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</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>4</td><td>5</td><td>5</td><td>36</td><td>26</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	1,2,3,4,9, 10, 12	1,2,3
CO2	Identify Microwave passive and active devices for several applications.	1,2,3,4,9, 10, 12	1,2,3
CO3	Design Microwave amplifiers and Filters	1,2,3,4,9, 10, 12	1,2,3
CO4	Describe the process of microwave measurements	1,2,3,4,9, 10, 12	1,2,3
CO5	Analyze the various performance parameters related to antenna in wireless communication applications	1,2,3,4,9, 10, 12	1,2,3
CO6	Analyze The Micro strip patch antenna , Smart Antenna and feeding mechanism	1,2,3,4,9, 10, 12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1 **Microwave Wave Guides :** Concept of Mode, features of TEM , Rectangular Waveguide Construction, TE and TM Modes, Losses associated with Microwave Transmission**.** **Microwave Passive Components and Active Devices:** Scattering Parameters**,** directional Coupler, Power Divider, Magic Tee, resonator, GUNN diode, IMPATT, Schottky diode, PIN diode, Parametric amplifier
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 analyzer and Measurement of Scattering parameters
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.

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:

9. John D. Ryder, “Networks, Lines and Fields”, PHI, 2009.
10. Samuel Y. Liao, “Microwave Devices and Circuits”, Pearson education, 3rd Edition, 2011.
11. Reinhold.Ludwig and Pavel Bretshko ‘RF Circuit Design”, Pearson Education, Inc., 2006.
12. Constantine Balanis A., “Antenna Theory: Analysis and Design”, John Wiley and Sons, 3rd Edition, 2012.
13. 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:

34. IEEE Transactions on antennas and Propagation
35. IEEE Transactions on Microwave Theory and Techniques
36. IEEE Microwaves and Wireless components letters
37. IEEE antennas and Wireless propagation letters
38. International journal of Antennas and propagation

SWAYAM/NPTEL/MOOCs:

6. **https://onlinecourses.nptel.ac.in/noc20_ee20/**
7. **https://www.coursera.org/learn/microwave-antenna**
8. https://www.classcentral.com/course/rf-mmwave-circuit-design-32152

9. https://www.3ds.com/products-services/simulia/training/course-descriptions/cst-studio-suite-microwave-and-antenna/

10. https://www.colorado.edu/ecee/academics/online-programs/ms-ee-coursera/curriculum/electromagnetics-rf-microwaves-and-remote

Course Title	CMOS VLSI Circuits				**Course Type**		**HC Integrated**	
Course Code	B20EN0702	**Credits**	**4**		**Class**		**VII Semester**	
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**4**	**5**	**5**	**36**	**26**	**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:

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	Summarize the steps involved in fabrication of nMOS and pMOS device	1,2,3,5,9,10	1,2

CO2	Analyze the characteristics Transfer characteristics of CMOS inverter	1,2,3,5,9,10	1,2
CO3	Correlate the electrical properties of various MOS and BICMOS circuits.	1,2,4,9,10	1,2
CO4	Sketch the physical design/layouts in CMOS and nMOS technology	2,3,4,5,9,10	1,2
CO5	Examine the basic storage concept , memory circuits in VLSI design	2,3,4,5,9,10	1,2
CO6	Apply verification and Testing principles to verify the characteristics of Digital Circuits	1,4,5,9,10	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	1	2	3		3				2	3			1	2	
CO2	1	2	3		3				2	3			1	2	
CO3	2	1		3					2	3			1	2	
CO4		2	3	1	2				2	3			1	2	
CO5		2	3	1	2				2	3			1	2	
CO6	1			2	3				2	3			2	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, problems 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. **Basic Circuit Concepts**: Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter
UNIT - 3
MOS and BiCMOS 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, Memory cell arrays. **Testing and Verification:** Introduction, Testers, Test Fixtures and Test Programs, Logic Verification Principles, Manufacturing Test Principles, DFT.

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	Cadence Virtuoso tool	Understand, develop and simulate Verilog code. Woking in a team.

	verification with gate level simulation		
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.
4	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	Design schematic and perform analysis while working in a team.
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	Design schematic and perform analysis while working in a team.
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	Design schematic and perform analysis while working in a team.
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	Design schematic and perform analysis while working in a team.

TEXT BOOKS:

9. Neil H. E. Weste, David Money Harris, “CMOS VLSI Design- a circuits and systems perspective”, 2thEdition, Addison-Wesley, 2010.
10. Sung- Mo Kang and Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, Tata McGraw-Hill, 3rd Edition, 2007.
11. Douglas A Pucknell, Kamran Eshraghian “Basic VLSI DESIGN” , EEE 3rd Edition
12. Sedra/Smith “Microelectronic circuits”, Oxford,, 5th Edition,2007.

REFERENCE BOOK:

3. 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:

9. https://nptel.ac.in/courses/117/101/117101058/
10. https://nptel.ac.in/courses/117/101/117101058/
11. https://nptel.ac.in/courses/108/106/108106158/
12. https://nptel.ac.in/courses/117/103/117103125/

Professional Elective -4

Course Title	Analog & Mixed Mode VLSI				Course Type		Integrated	
Course Code	B20ENS741	Credits	3		Class		VII Semester	
Analog & Mixed Mode VLSI	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50 %**	**50 %**

COURSE OVERVIEW:

This course focuses on transistor-level design of mixed-signal CMOS integrated circuits. After reviewing fundamentals of MOSFET operation, the course will cover design of analog building blocks such as current-mirrors, bias references, amplifiers, and comparators, leading up to the design of digital to-analog and analog-to-digital converters. Aspects of sub-threshold operation, structured design, scalability, parallelism, low power-consumption, and robustness to process variations are discussed in the context of larger systems.

COURSE OBJECTIVES:

The objectives of this course are:

7. Introduce the concept of analog and digital discrete signals.
8. Provide specifications of data converters.
9. Calculate DAC & ADC parameters
10. Design R-2R Ladder for given parameter.

11. Introduce analog MOS circuits and non-linear analog circuits like comparators, and analog multipliers.
12. Understand the analog layout design concerns for mixed signal.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Analyze different types of Analog MOS Circuits	1,2,3,5,10,12	1,2,3
CO2	Design and characterize basic CMOS comparator	1,2,3,5,10,12	1,2,3
CO3	Compare Analog and Digital Converters specifications and analyze the impact of various parameters on design choice.	1,2,3,5,10,12	1,2,3
CO4	Design and analyze different types of Analog to Digital Converters	1,2,3,5,10,12	1,2,3
CO5	Design and analyze different types of Digital to Analog Converters	1,2,3,5,10,12	1,2,3
CO6	Apply the layout techniques for mixed signal circuits.	1,2,3,5,10,12	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		3					2		2	3	2	2
CO2	3	3	2		3					2		2	3	2	2
CO3	2	3	2		3					2		2	3	2	2
CO4	3	3	3		3					2		2	3	2	2
CO5	3	3	3		3					2		2	3	2	2
CO6	3	3	3		3					2		2	3	2	2

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1
Analog MOS circuit : Introduction, MOS transistor analog model, current mirrors - simple, Wilson and Widlar, Single stage amplifier – common source amplifier, Differential amplifier and two stages MOS operational amplifiers. **Non Linear Analog Circuits** : Basic CMOS Comparator Design, characterizing the comparator, Analog Multipliers, Multiplying Quad (excluding stimulation), Level Shifting (excluding input level shifting for multiplier).
UNIT - 2 **Data Converter Fundamentals**: Analog versus Digital, Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications, Mixed-Signal Layout Issues.
UNIT – 3 **Data Converter Architectures** : DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC. ADC Architectures, Flash, 2-Step Flash ADC, Pipeline, ADC, Integrating ADC, Successive Approximation ADC.
UNIT – 4 **Analog layout design for mixed signal :** Introduction, analog layout techniques and Passive component layout - capacitor, resistor and inductor, Floor planning of analog and digital components, power supply and ground pin issues, matching, shielding, interconnection issues.

TEXT BOOKS:

1. R. Jacob Baker, Harry W Li, David E Boyce, —"Design, Layout, Simulation, CMOS Circuit" ,PHI Education, 3rd Edition 2005.
2. R. Jacob Baker, "CMOS- Mixed Signal Circuit Design,(Vol II of CMOS: Circuit Design, Layout and Simulation)", John Wiley India Pvt. Ltd, 2008. 2nd Edition

REFERENCE BOOK:

1. B Razavi, "Design of Analog CMOS Integrated Circuits", First Edition, McGrawHill, 2001.
2. Phillip. E. Allen and D R Holberg, "CMOS Analog Circuit Design", 2nd Edition, Oxford University Press, 2002.
3. Gray, Meyer, Lewis and Hurst "Analysis and design of Analog Integrated Circuits", 4thEdition Willey International, 2002

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

9. http://www.ee.ucl.ac.uk/~ademosth/E757/Topic7a.pdf
10. https://www.elprocus.com/digital-to-analog-converter-dac-applications/
11. https://training.ti.com/precision-dacs-architectures?cu=1136484
12. https://www.analog.com/en/analog-dialogue/articles/the-right-adc-architecture.html
13. https://www.taylorfrancis.com/chapters/nonlinear-analog-components-tertulien-ndjountche/10.1201/b10943-6
14. https://link.springer.com/chapter/10.1007/978-3-642-83677-0_2
15. https://resources.pcb.cadence.com/blog/2019-types-of-analog-signals-and-unique-layout-considerations#:~:text=%20Here%20are%20some%20best%20practices%20for%20analog,digital%20grounds%20for%20PCB%20testing%20later...%20More%20

16. http://smdpc2sd.gov.in/downloads/IGF/IGF%201/Introduction%20to%20Analog%20Layout%20Design.pdf

SWAYAM/NPTEL/MOOCs:

8. https://nptel.ac.in/courses/117/106/108106105/
9. https://nptel.ac.in/courses/117/101/117101105/
10. https://nptel.ac.in/courses/117/106/117106034/

Course Title	**Multimedia Communication**				**Course Type**		**SC**	
Course Code	**B20ENS742**	**Credits**	3		**Class**		**VII Semester**	
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**56**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

The course introduces Multimedia Data Representations. The representation of data is critical in the study of multimedia, and we look at the most important data representations for use in multimedia applications. Specifically, graphics and image data, video data, and audio data are examined in detail. Next, multimedia data compression turns out to be a very important enabling technology that makes modern multimedia systems possible. Therefore, it introduces with lossless and lossy compression methods, supplying the fundamental concepts necessary to fully understand these methods. For the latter category, lossy compression, arguably JPEG still-image compression standards, including JPEG2000, are the most important. But, since a picture is worth 1,000 words, and so video is worth more than a million words per minute, we examine the ideas behind the MPEG standards MPEG-1, MPEG-2, MPEG-4, MPEG-7, and beyond into new video coding standards H.264 and H.265. Multimedia Communications and Networking considers the great demands multimedia communication and content sharing places on networks and systems. We go on to consider wired Internet and wireless mobile network technologies and protocols that make interactive multimedia possible.

COURSE OBJECTIVES:

The objectives of this course are:

1. To analyze the impact of multimedia communication techniques on day to day human life.
2. To evaluate various representations of graphics, image & video for multimedia communication
3. To apprise processing, storing and communication of multimedia data.
4. To analyze multimedia communication over wireless networks.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify and appreciate various multimedia applications in day to day human life.	1,2,3,4,12	1,2,3
CO2	Represent the given picture in various formats	1,2,3,4,12	1,2,3
CO3	Compare the various industry standard processing and storage techniques for digital audio and video	1,2,3,4,12	1,2,3
CO4	Analyze various industry standard compression techniques for effective bandwidth utilization of the media and also storage capacity.	1,2,3,4,12	1,2,3
CO5	List the characteristics of Multimedia networks	1,2,3,4,12	1,2,3
CO6	Evaluate the impact of multimedia techniques on wireless networks.	1,2,3,4,12	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	✓	✓	✓			
CO5	✓	✓	✓			
CO6	✓	✓	✓	✓		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
UNIT-1 **Graphics, Image & Video Representation:** Graphics/Image data types, popular file formats, Color science – camera systems, XYZ to RGB transform, Color models in video, Fundamental concepts in video
UNIT-2 **Digital Audio & Compression Algorithms** : Digitization of sound, MIDI, Quantization & transmission of audio, Lossless compression: Basics of information theory, RLC, VLC – Shannon Fano, Huffman, LZW, Arithmetic Coding, LPC, APC, APC, Lossy compression: Distortion measures, rate distortion theory, quantization, transform coding.
UNIT - 3 **JPEG & MPEG:**JPEG Standard, Video compression based on motion compensation, Search for motion vectors, H.261, H.263, MPEG-1, MPEG-2, MPEG-4, MPEG-7, MPEG-21
UNIT - 4 **Multimedia Communication**: Multimedia networks, Multimedia applications, Network QoS and application QoS, Quality of multimedia transmission, Multimedia over IP, Media on demand, Multimedia over wireless network, C-Bird Case Study.

Text Books:

8. Ze-Nian Li, Mark S. Drew, “Fundamentals of Multimedia”, Pearson Education, 2008.
9. Fred Halsall, “Multimedia Communications”, Pearson education, 2001.

REFERENCE BOOK:

5. Ralf Steinmetz, KlaraNahrstedt, “Multimedia – Computing, Communications & Applications”, Pearson Education, 2004

14. **JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:**
15. https://www.youtube.com/watch?v=ulOTz5Rv9CM
16. https://www.youtube.com/watch?v=GfCCADMhQ8c
17. https://www.youtube.com/watch?v=rC16fhvXZOo
18. https://www.youtube.com/watch?v=HrGGKBdUAW4
19. https://youtu.be/7BZvAKYhf3U
20. https://youtu.be/qzQ6EvsqsGs
21. https://youtu.be/kf_p60xSQSs
22. https://youtu.be/gfaC6NxP72g
23. https://youtu.be/LJg7aH7c6Bc
24. https://youtu.be/x0-qoXOCOow
25. https://youtu.be/3dET-EoIMM8
26. Predictive Coding - Lossless Compression | Coursera

Professional Elective -5

<table>
<tr><td>Course Title</td><td colspan="4">MEMS and Nano Technology</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS751</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5"></td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</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:

Micro-Electro-Mechanical Systems (MEMS) is a multidisciplinary area that includes a design and fabrication of sensors and actuators which are capable of micron-size mechanical movements. Lectures cover a wide range of topics in design, fabrication and packaging of MEMS.

COURSE OBJECTIVES:

The objectives of this course are:

7. Describe the various MEMS materials, devices and applications.
8. Demonstrate the three fundamental pillars of MEMS, i.e. design, fabrication and micromachining techniques.
9. Evaluate different packaging materials used for MEMS.
10. understand the unique demands, environments and applications of MEMS devices

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate the application of scaling laws in the design of microsystems.	1,2,4,7,9,12	1,3
CO2	List the characteristics of MEMs materials		

CO3	Describe the various steps involved in MEMS fabrication.	1,2,3,4,57,9, 11	1,3
CO4	Analyze the critical performance aspects of electromechanical transducers, including sensors and actuators.	1,2,3,4,5,6,9, 12	1,3
	Describe the principles behind Nanoscience engineering and Nanoelectronics.	1,2,3,4,57,9, 11	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

COURSE CONTENT

Contents

UNIT - 1

Introduction to MEMS

Why Miniaturization? Microsystems versus MEMS, Why Microfabrication? MEMS and Microsystems, Typical MEMS and Microsystem Products, Evaluation of Microfabrication, Microsystem and Microelectronics, The Multidisciplinary Nature of Microsystem Design and Manufacture, Microsystem Miniaturization, Smart Materials, Structures and Systems, Integrated Microsystems, Applications of Smart Materials and Microsystems.

Materials for MEMS: Silicon compatible material System-Silicon, Czochralski Crystal Growing, Silicon oxide and Nitride, Thin metal Films, Polymers, Other material and substrates.

UNIT - 2

Microsystems Fabrication Process

Epitaxy: Introduction, Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation.

Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography. Photolithography, Ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process.

UNIT – 3

Micro Sensors, Actuators, Systems and Smart Materials: silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conduct metric gas sensor, silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic comb-drive and magnetic micro relay, portable clinical analyzer, active noise control in a helicopter cabin

VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, CMOS IC Technology, MOS Memory IC Technology, Bipolar IC Technology, IC Fabrication.

UNIT - 4

Introduction to NANO Electronic:

Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moore's law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometerlength scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems

TEXT BOOKS:

5. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, "Micro and Smart Systems", Wiley India, 2010.

6. Chang Liu, “Foundation of MEMS” Pearson Education International, 2006.
7. Tai Ran Hsu, “MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering, Wiley, 2008.
8. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, —Nanoscale Science and Technology‖, John Wiley, 2007.

REFERENCE BOOKS:

5. S. M. Sze, “VLSI Technology”, McGraw-Hill, Second Edition.
6. Nadim Maluf, Kirt Williams “An Introduction to Microelectromechanical Systems Engineering” Second addition.
7. Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, —Hand Book of Nanoscience Engineering and Technology‖, CRC press, 2003.
8. Charles P Poole, Jr, Frank J Owens, —Introduction to Nanotechnology‖, John Wiley, Copyright 2006, Reprint 2011.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

39. https://www.sciencedirect.com/science/article/abs/pii/S092150930100956X
40. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=581729http://bonnie.ece.gatech.edu/book/TUTORIAL/tutorial.html
41. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1627742https://www.springer.com/journal/34
42. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4554610https://ieeexplore.ieee.org/document/1143815
43. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=735330.
44. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1258171
45. https://www.mdpi.com/2072-666X/11/4/434/htm

SWAYAM/NPTEL/MOOCs:

11. https://nptel.ac.in/courses/117/105/117105082/
12. https://nptel.ac.in/courses/108/108/108108113/
13. https://www.coursera.org/learn/sensor-manufacturing-process-control#syllabus

<table>
<tr><td>Course Title</td><td colspan="4">Web Programming</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B20ENS753</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">7 Semester</td></tr>
<tr><td rowspan="4"></td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

	Total	3	3	3	39		50 %	50 %

COURSE OVERVIEW:

This course introduces students to basic web design using HTML,CSS,JavaScript and PHP. Throughout the course students are introduced to planning and designing effective web pages. Implementing web pages by writing HTML and CSS code, enhancing web pages with the use of page layout techniques, text formatting, tables, images, and multimedia; and producing a functional, multi-page website. Validating the user data using Client side scripting language JavaScript and PHP is used to process the forms. Upon successful completion of this course, students will have a good foundation in web design and data validation using HTML,CSS, JavaScript and PHP and students will be prepared to study more advanced web design topics.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Illustrate the Semantic Structure of HTML and CSS.
2. Compose forms and tables using HTML and CSS.
3. Design Client-Side programs using JavaScript.
4. Design Server-Side programs using PHP.
5. Impart skills required to develop web applications and services.
6. Provide students with conceptual and practical knowledge of web applications.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Adapt XHTML and CSS syntax and semantics to build web pages.	1,2,3,5	1,2,3
CO2	Compose forms and tables using HTML and CSS.		
CO3	Identify tools and technologies for Web applications.	1,2,3,5	1,2,3
CO4	Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to	1,2,3,5	1,2,3
CO5	Develop user-interfaces for Web applications.	1,2,3,5	1,2,3
CO6	Develop user-interfaces for Web Servers	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	1		2								2	1	3
CO2	3	2	1		2								3	1	2
CO3	3	1	2		2								3	2	1
CO4	3	2	1		2								2	3	1
CO5	3	2	1		2								2	3	1
CO6	3	2	1		2								2	3	1

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Fundaments of Computers and Internet** Introduction to Computers and Internet, World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, MIME, Hypertext Transfer Protocol. Introduction to XHTML-1: Standard XHTML document structure, Basic Text Markup, Images, Hypertext Links, Creation of Lists in XHTML, Creation of Forms.
UNIT - 2 **XHTML-2:** Creation of Tables and Frames in XHTML, Syntactic differences between HTML and XHTML. **Cascading Style Sheets:** Introduction, Levels of Style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, The Box Model, Background Images, The <span> and <div> tags
UNIT - 3 **The Basics of JavaScript:** Overview of JavaScript, Object Orientation and JavaScript, General Syntactic characteristics, Screen output and keyboard input, Control statements, Functions, Arrays in JavaScript, Constructors, Pattern Matching using Regular Expressions, Events and Event handling

UNIT - 4

Introduction, PHP Basics, General Syntactic characteristics, Control statements, Arrays, Functions, Pattern Matching, Files, Cookies, Session Tracking, Database Access with PHP and MySQL.

PRACTICE SESSION:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	Create a XHTML form which includes Name, Address and Comment, Hyperlinks, Images Lists.	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML
2	Validate the user input using JavaScript. (Ex: Validating the student SRN).	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML
3	Create a XHTML form with SRN, Name, and Address fields and it also includes tables and Forms. On submitting the form, it should store the values in MySQL table.	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML
4	PHP code to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page.	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML
5	PHP code to store page views count in SESSION and to show the count on web page	Notepad++, open with chrome	Basics of computer, syntax of HTML,CSS,XML

TEXT BOOKS:

4. Robert W. Sebesta, "Programming the World Wide Web**"**, 7th Edition. Addison-Wesley, 2012.
5. Kogent Learning Solutions Inc., **"**Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML Black Book**",** Dream tech Press, ISBN-13: 978-9351192510, Paperback – 19 Dec 2013
6. Robin Nixon, **"**Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML**5",** 4th Edition, O'Reilly Publications, 2015

REFERENCE BOOK:

3. Navneet Mehra, Bunny Mehra, **"**Website Development Using HTML and CSS - A Practical Step-By-Step Guide to Develop E-Commerce Store**"**, Unicorn Books (2012)

4. Jon Duckett, "HTML and CSS: Design and Build Websites**",** Wiley; 1 edition, ISBN-13: 978-1118008188

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

46. https://www.tutorialspoint.com/internet_technologies/websites_development.htm
47. https://www.tutorialspoint.com/internet_technologies/css.htm
48. https://www.w3schools.com/xml/

49. https://ieeexplore.ieee.org/document/8400266
50. https://2019.programming-conference.org/track/proweb-2019-papers
51. https://ieeexplore.ieee.org/document/4221621

SWAYAM/NPTEL/MOOCs:

7. https://nptel.ac.in/courses/106/ 05/106 05084/
8. https://nptel.ac.in/courses/106/105/106105084/
9. https://nptel.ac.in/courses/106/105/106105084/
10. https://nptel.ac.in/courses/106/105/106105084/
11. https://nptel.ac.in/courses/106/105/106105084/
12. https://nptel.ac.in/courses/106/105/106105084/

Open Elective -3

<table>
<tr><td>Course Title</td><td colspan="4">Introduction to CMOS VLSI</td><td colspan="2">Course Type</td><td colspan="2">OE</td></tr>
<tr><td>Course Code</td><td>B20ECO701</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">VII 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>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:

This course explain the MOSFET functionality, and operating regions the circuits using nMOS technology, CMOS technology and compare 2 draw the layouts in CMOS and nMOS technology compare various flavors of CMOS technology 3 determine geometrical ratios/parameters at the transistor level, for the mask layout describe the general steps required for processing of CMOS integrated circuits 4 Describe the basic storage concept and memory circuit

COURSE OBJECTIVES:

The objectives of this course are to:

9. Describe the operation of semiconductor devices.
10. Learn crystal growing process using CZ process
11. Classification of MOSFETs
12. Building of digital circuits using MOS technology

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basics of semiconductor theory	1,2,3,4,5,9,10	1,2,3
CO2	Learn the process of silicon wafer preparation	1,2,3,4,5,9,10	1,2,3
CO3	Enumerate various types of MOS FETs	1,2,3,4,5,9,10	1,2,3

CO4	Explain the working of MOSFETs with emphasis on regions of operation	1,2,3,4,5,9,10	1,2,3
CO5	Draw the VI characteristics of MOS FETs	1,2,3,4,5,9,10	1,2,3
CO6	Write the digital circuit using MOS technology	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	1	
CO2	3	2											2	1	
CO3	3	2											2		
CO4	3	2											2		
CO5	3	2			1								2		
CO6	3	2			1								2		

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

COURSE CONTENTS:
THEORY:

Contents
UNIT – 1 **Basic MOS Technology:** Basics semiconductors, Crystal growth process, Integrated circuits era. Moore's law and its implications. Classification of MOS transistors, Enhancement mode transistor action, depletion mode transistor action,

UNIT – 2
Fabrication of MOS structures: NMOS IC fabrication. CMOS, N-well, P-well and Twin tub process details. Introduction to BiCMOS technology
UNIT – 3
Field Effect Transistors: Construction, working and Characteristics of MOSFETs, VI Characteristics
UNIT - 4
CMOS Digital circuits: Construction of basic and universal gates using CMOS style. 2:1, 4:1 Multiplexer using MOSFETs Circuit

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 3rdEdition

REFERENCE BOOKS

3. R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", John Wiley India Pvt. Ltd,2008.
4. Wayne Wolf, "Modern VLSI Design: System on Silicon", Prentice Hall PTR/Pearson Education, 2nd Edition, 1998

Course Title	**Microprocessors and Microcontrollers**				**Course Type**		**OE**	
Course Code	**B20ECO702**	**Credits**	**3**		**Class**		**VII Semester**	
Microcontrollers and Applications	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	**IA**	**SEE**
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

This course introduces various microprocessor and microcontroller architectures, and memory organization. It provides the block level approach to the interfacing of various sensor and actuators. This course also provides a overview of certain interfacing communication protocols that are popular in the industry. This fundamental knowledge on microcontrollers lead to explore large number of controller families like ATMEGA, TI and PIC that are used in industrial and automation applications.

COURSE OBJECTIVES:

The objectives of this course are:

1. To introduce various Microprocessors and Microcontroller Architectures.
2. To give an overview of interfacing various modules with microprocessor and microcontroller.
3. To introduce various communication protocols.

.

COURSE OUTCOMES (Cos)

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

CO#	Course Outcomes	Pos	PSOs
CO1	Describe the various Microprocessors Architectures.	1,3	1,3
CO2	Describe the various Microcontroller Architectures.	1,3	1,3
CO3	Explain the various peripherals available on microcontrollers	1,3	1,3
CO4	Explain the working principle and the interfacing of the various sensors and actuators.	1,3	1,3
CO5	Discuss various communication protocols used during interfacing	1,3	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
UNIT – 1 **Microprocessor Architectures:** Introduction to Microprocessors and Microcontrollers, RISC and CISC architecture, von Neumann and Harvard Architecture. Introduction to Microprocessor 8085 architecture, memory interface, pin description. Introduction to Microprocessor 8086 architecture, memory interface, pin description. Introduction to Raspberry Pi architecture.
UNIT – 2 **Microcontroller Architectures:** Introduction to Microprocessor 8051 architecture, memory interface, pin description. Architecture and memory organization: PIC16F877A, MSP430, ARM Cortex-3, AtMega32
UNIT – 3 **Peripheral Modules**: Introduction to the architecture and pin descriptions of 8255. Introduction to Timer and Counter, interrupts, UART, SPI, I2C, CCP(compare, capture and PWM), ADC, DAC.
UNIT – 4 **Sensors and Actuators:** Working principles and block level interfacing of LDR, Thermistor, ultrasonic sensor, soil moisture sensor, photovoltaic cells, LED, dc motor, stepper motor, LCD

TEXT BOOKS:

13. Kenneth J. Ayala, “The 8051 microcontroller architecture, programming and applications” Thomson publication, 3rd edition, 2007
14. 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.
15. Sandhu, Harprit singh. “Making PIC microcontroller instruments and controllers / Harprit Singh Sandhu.” McGraw-Hill (2009).
16. A. P. Godse, D. A. Godse, “Microprocessors and Microcontroller System”, Techinical Publications (2009)

SWAYAM/NPTEL/MOOCs:

1. https://e2echina.ti.com/group/c8df485b47/m/msp430/11060/download
2. https://www.arm.com/zh/files/word/Yiu_Ch1.pdf
3. http://ce.sharif.edu/~pourmohammadi/AVR%20Microcontroller%20and%20Embedded%20Systems/AVR%20Microcontroller%20and%20Embedded%20Systems.pdf

VIII Semester

Open Elective-4

Course Title	**Automotive Electronics**				**Course Type**	**OE**
Course Code	B20ECO801	**Credits**	**3**		**Class**	**VIII Semester**
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment in

	Theory	3	3	3	Per Semester		Weightage	
	Practice	-	-	-	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50 %**	**50 %**

COURSE OVERVIEW:

The course covers 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:

13. Understand the functions of electronic systems in modern automobiles, modern electronics technology to improve the performance, safety, comfort and related issues
14. Study the principles of automotive sensors and interfacing techniques, design, model and simulate interfacing systems with sensors
15. Know the principles and functionalities of various Automotive Communication Protocols (ACPs) and Exhaust after treatment systems.
16. 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	Explain power train and drive train components in automotive systems	1,2,5	1,2,3
CO2	Discuss the role of electronics in engine control systems	2,3,5	1,2
CO3	Analyze the Exhaust After-Treatment systems in automotive systems	1,2,3	1,2
CO4	Illustrate the concepts of in-vehicle networking	7,9,10	2
CO5	Describe automotive safety systems & infotainment systems.	4,7,8	3
CO6	Recognize the On-board diagnostics, Off-board diagnostics.		

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

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Automotive Industry and Modern Automotive Systems:** Vehicle classifications and specifications, need for electronics in automobiles, Automotive Fundamentals Overview – Four Stroke Cycle, Electronic Ignition systems, Spark plug, Spark pulse generation, Ignition Timing. Transmission Control - Automotive transmissions, Drive Train, Brakes, Steering System - Steering Control, Starting System- Battery, Air/Fuel Systems, Fuel Handling, Air Intake System.
UNIT - 2 **Introduction to automotive sensors and Actuators:** Air/ Fuel Management Sensors – Oxygen (O2/EGO) Sensors, Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Sensors for occupant safety. Actuators – Solenoid actuator , Fuel Metering Actuator, Fuel Injector, Ignition Actuator , Sensor and actuator interfacing techniques.

UNIT - 3
Exhaust After-Treatment Systems and Communication Protocols: Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR) and it's control, Exhaust Gas Recirculation Actuator, Evaporative Emission Systems, Electronic Fuel Control System, Electronic Ignition control, Idle speed control Automotive Communication Protocols: SPI, I^2C, USB, CAN, LIN, FLEXRAY, MOST protocols.
UNIT - 4
Electronics for Passenger Safety and Convenience: Electronics for Passenger Safety and Convenience – SIR, Air bag and seat belt pretension systems, Tire pressure monitoring systems, TCS , ESP, Collision Avoidance Radar warning Systems, Radio navigation, Advance Driver Information System. Integrated Body – Climate Control Systems, Electronic HVAC Systems, Lighting, Entertainment Systems, Alternative Fuel Engines, Lighting, wipers, Power windows, Remote keyless entry systems Automotive Diagnostics – On-board diagnostics, Off-board diagnostics.

TEXT BOOKS:

17. Denton, "Automotive Electrical and Electronic Systems, Burlington", MA 01803, Elsevier Butterworth-Heinemann, 2004.
18. William B. Ribbens, "Understanding Automotive Electronics, 5th Edition, Newnes, 2006.

REFERENCE BOOK:

5. Ronald K. Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 2007.
6. Robert Bosch GmbH, "Bosch Automotive Electrics & Electronics: Systems and Components, Networking and Hybrid Drive", Robert Bosch GmbH, 3rd Edition, 1999.

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

Course Title	Robotics and Automation				**Course Type**	**Open Elective**
Course Code	B20ECO802	**Credits**	3		**Class**	**VIII Semester**
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment in

Robotics and Automation	Theory	3	3	3	Per Semester		Weightage	
	Practice	0	0	0				
	-	-	-	-	Theory	Practical	**IA**	**SEE**
	Total	**3**	**3**	**3**	**42**	**0**	**50 %**	**50 %**

COURSE OVERVIEW:

Robotics is the interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots as well as computer systems for their control, sensory feedback, and information processing. Automation and Robotics are two closely related technologies. Automation as the technology that is concerned with the use of mechanical, electronic, and computer based systems in the operation and control of production. The course provides robot classification and anatomy, Robot kinematics, Trajectory Planning and control, Sensors and vision systems used in robots and Robot Programming.

COURSE OBJECTIVES:

The objectives of this course are:

1.To Introduce types of Robot anatomy and automaton concepts.

2.To Understand kinematics involved in Robotics

3. To study various types of Sensors used in robots.

4.To introduce applications of Machine vision and Artificial Intelligence in Robotics

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	. List the types of Robot anatomy and automaton concepts.	1,2,3,4,9,10, 12	1,2,3
CO2	Describe the kinematics involved in Robotics	1,4,6,7,12	1,2,3
CO3	Develop application of D-H matrices to different robot configurations.	1,2,3,4,9,10, 12	1,2,3
CO4	Summarize the characteristics of various types of Sensors used in robots.	1,2,3,4,9,10, 12	1,2,3
CO5	Solve problems on joint trajectory planning	1,2,3,4,9,10, 12	1,2,3
CO6	Describe the applications of Machine vision and Artificial Intelligence in Robotics	1,4,6,7,9,10, 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	3					2	2		2	3	3	2
CO2	2	2	2	3					2	2		2	3	3	2
CO3	2	2	2	3					2	2		2	3	3	2
CO4	3	2	2	3					2	2		2	3	3	2
CO5	3	2	2	3					2	2		2	3	3	2
CO6	3	2	2	3					2	2		2	3	3	2

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Introduction to robotics** Definition, anatomy of robot, classification configurations, robot links and joints, robot specifications, resolution accuracy and repeatability, simple numerical problems, robot drive systems, hydraulic, pneumatic and electric drive systems, wrist and its motions, end effectors, types of end effectors, mechanical grippers, methods of constraining parts in grippers, types of gripper mechanisms, simple numerical problems, vacuum cups, magnetic grippers, adhesive grippers, hooks, scoops and other gripper devices, tool as end effectors, examples.

UNIT - 2 **Robot motion analysis & Robot control**
Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composit rotation matrix, rotation matrix about an arbitrary axis, links, joints and their parameters, Denavit-Hertenberg (D-H) representation, application of D-H matrices to different robot configurations. Basic control systems and models, transfer function with examples, transfer function for spring-mass-damper system, transient response of a second order system, transfer function of a robot joint, different types of controllers, proportional (P) controller, integral (I) controller, derivative (D) controller, PID controller, simple numerical problems
UNIT - 3 **Robot trajectory planning & Robot sensors**
Trajectory planning, definition, steps in trajectory planning, joint space techniques, use of a p-degree polynomial as interpolation function, cubic polynomial trajectories, linear function with parabolic blends, joint space verses Cartesian space trajectory planning, simple numerical problems on joint space trajectory planning. Classification of robot sensors and their functions, touch sensor, tactile sensor, binary sensor, analog sensor, proximity sensor, range sensor, force and torque sensor
UNIT – 4 **Machine vision and Artificial Intelligence in Robotics:**
Machine vision, functions of machine vision system, sensing and digitizing, imaging devices, object recognition, robotic machine visior applications. Artificial Intelligence in Robotics: Applications of Artificial Intelligence in Robotics: health care, agriculture, Vehicular technology, Space exploration, Industry, Military, Ethics and risks of artificial intelligence in robotics.

Text Books:

10. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey, " Industrial Robotics,", McGraw-Hill Publications, International Edition, 2008.
11. James G. Keramas, " Robot Technology Fundamentals", Cengage Learning, International Edition 1999.
12. Robin R Murphy, "Introduction to AI Robotics", PHI Publication, 2000

REFERENCE BOOK:

5. Fu K. S., Gonzelez R. C., Lee C. S. G: Robotics, " Control, Sensing, Vision, Intelligence ", McGraw Hill Book Co., International edition, 2008.
6. Appu Kuttan K. K, " Robotics, International Publications", First Edition, 2007.
7. R. K. Mittal, I. J. Nagrath, " Robotics and Control", Tata-McGraw-Hill Publications, 2007.
8. Francis X Govers, " Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques" , August 2018, Packt publishers

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

https://www.youtube.com/watch?v=fH4VwTgfyrQ
https://www.youtube.com/watch?v=lR7c2rEFOH0
https://www.youtube.com/watch?v=yCXm5cgG0UA

https://www.youtube.com/watch?v=zFikq_cJ4mQ
https://www.youtube.com/watch?v=JE_aLDq0FFQ

School of Electronics and Communication Engineering
BoS Members

Sl. No.	Name, Designation & Affiliation	Status	Correspondence Address
1	**Dr. R. C. Biradar** Director, School of ECE, REVA University	**Chair Person**	Dr. R C Biradar, Director, School of ECE, REVA University, Rukmini Knowledge Park, Yelahanka, Bangalore - 560 064
2	**Dr. Rathna G. N.** Principal Research Scientist, E&E Dept., IISc.	**Member**	Dr. Rathna G. N., Principal Research Scientist, DES, E&E Dept. Office Room No. 211, Indian Institute of Science, Bangalore-560 012
3	**Dr. T. Srinivas** Associate Professor,IISc. Bangalore	**Member**	Dr. T. Srinivas, SPW 102, Electrical Communication Engineering, Indian Institute of Science, Bangalore 560012
4	**Mrs. Sandhya** - Vice President, SEBU Centum Electronics Ltd	**Member**	**Mrs. Sandhya** - No.44, KHB Industrial Area, Near Shintila Apartment, Yelahanka New Town, Bengaluru, Karnataka 560106
5	**Dr. G. T. Raju** Vice Principal, SJCIT, Chikkaballapur	**Member**	Dr. G. T. Raju, P.B, No. 20, BB Rd, Chikkaballapur, Karnataka 562101
ty6	**Mr. Jwalanth Joshipura** Director, SoC Design, NXP Semiconductors India Pvt. Ltd.	**Invited Member**	Mr. Jwalanth Joshipura, Director, SoC Design, NXP Semiconductors India Pvt. Ltd. Bangalore.
7	**Mr. Rajakrishnamoorthy** Director, Cognizant	**Member**	Mr. Rajakrishnamoorthy, Director, Cognizant, Bangalore
8	**Dr. Bharathi S. H.** Professor, School of ECE, REVA University	**Member (Internal)**	Dr. Bharathi S. H., Professor, School of ECE, REVA University, Yelahanka, Bangalore 560064
9	**Dr. P. I. Basarkod** Professor, School of ECE, REVA University	**Member (Internal)**	Dr. P. I. Basarkod,Professor, School of ECE, REVA University, Rukmini Knowledge Park, Bangalore 560 064

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10th Combined Board of Studies for UG and PG courses in Electronics & Communication Engineering
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