



REVA
UNIVERSITY

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Rukmini Educational
Charitable Trust

SCHOOL OF
ELECTRONICS AND
COMMUNICATION
ENGINEERING

**B. TECH - ELECTRONICS &
COMMUNICATION ENGINEERING**

HANDBOOK : 2018-22

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 Teachers/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and 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

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.



School of Electronics & Communication Engineering

Handbook

B. Tech in Electronics & Communication Engineering

**First Year to Fourth Year
(First Semester to Eighth Semester)**

2018-2022

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Rukmini Educational
Charitable Trust

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Chancellor's Message

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

- Nelson Mandela.

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

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

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

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

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



Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

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

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

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

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

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

Incubation Centers” in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

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

Welcome to the portals of REVA University!

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's and projects along with open electives, soft skill and skill development courses.

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.

The curriculum caters to and has relevance 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.

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.

Prof. Rajashekhar C. Biradar

Director

School of Electronics and Communication Engineering

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 27th February, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

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

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, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been

recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC², VMware, SAP, Apollo etc, to facilitate student exchange and teacher-scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

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

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

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges.

During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vedaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga class'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 standards

Mission

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

Objectives

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

ABOUT SCHOOL OF 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 VLSI, Embedded Systems, Communication and Networking and pursue research in interested domains for doctoral degree.

Vision

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

Mission

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

Programme Overview

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 the included 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 radio waves 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. *Fiber 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 engineering 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 (PEO's)

The programme educational objectives of the Electronics and Communication Engineering of REVA University is to prepare graduates

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)

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals for the solution of complex problems in Electronics and communication Engineering.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
- 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.**
- 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.
- 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 (PSO)

After successful completion of the programme, the graduates shall be able to

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.
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.
3. Design, Model, Analyze and Build Electronics and Communication Systems to solve real life and industry problems.

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

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

1. Title and Commencement:

1.1. These Regulations shall be called the “**REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Engineering Graduate Degree Programs, 2020**”.

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

2. The Programs:

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

B Tech in:

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

3. Definitions:

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

(i) L= Lecture (ii) T= Tutorial (iii) P=Practice; where:

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

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

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

4. Courses of study and Credits

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

4.1.1. In terms of credits, every one hour session of L amounts to 1 credit per Semester.

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

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

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

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

4.1.5. Different Courses of Study are labeled and defined as follows:

a. Core Course:

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

b. Foundation Course (FC):

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

c. Hard Core Course (HC):

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

d. Soft Core Course (SC):

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

e. Open Elective Course:

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

f. Project Work / Dissertation:

Project work / Dissertation denoted as “D” is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Minor project normally will be assigned with 4-6 credits and a major project/dissertation will be assigned with 8-16 credits. **A Minor Project work may be a hard core or a Soft Core as decided by the BoS / concerned. But the Major Project shall be Hard Core.**

5. Eligibility for Admission:

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

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B Tech)	4 Years	Passed 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry Biotechnology / Biology / Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together.
2	Bachelor of Technology(B Tech)	Lateral entry to second year	<p>(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.</p> <p>(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.</p> <p>(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.</p> <p>(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.</p> <p>(E) Provided further that students, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc Degree from a recognized University as defined by UGC, shall also</p>

			be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first year class in case the vacancies at lateral entry are exhausted. However the admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above.
3	Bachelor of Technology (B Tech)	Lateral entry to fourth year (final year)	(F) Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester in the concerned branch of study, provided he/she fulfils the university requirements.
4	B Sc (Honors) in Computer Science (with specialization in Cloud and Big Data)	4 Years (8Semesters)	Pass in PUC /10+2 examination with Physics, Mathematics as compulsory subject along with at least one of the Chemistry, / Bio-Technology / Biology / Computer Science / Electronics / Technical Vocational subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC / ST category) in the above subjects taken together of any board recognized by the respective State Government / Central Government / Union Territories or any other qualification recognized as equivalent there to.

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

6. Scheme, Duration and Medium of Instructions:

6.1. B Tech degree program is of 8 semesters - 4 years duration. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B Tech degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

6.2. The medium of instruction shall be English.

7. Credits and Credit Distribution

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

Course Type	Credits
	For B Tech Degree (8 Semesters)
Foundation Core Course	A minimum of 08
Hard Core Course	A minimum of 136, but not exceeding 156

Soft Core Course	A minimum of 24 but not exceeding 44
Open Elective	A minimum of 04
Total	192

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

Sl. No.	Course Title	Number of Credits
1	English for Technical Communication	4
2	Environmental Studies	2
3	Indian Constitution and Professional Ethics	2

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

7.4. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 192 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

8. Assessment

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

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

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

The details as given in the table

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

Note: IA or CIA includes C1, C2, and C3

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

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

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

9. Setting question paper and evaluation of answer scripts.

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

- iii. **The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation. It is the responsibility of the BoE to see that all questions contained in the question paper are within the prescribed syllabus of the concerned course.**
- iv. **There shall be single valuation for all theory papers by internal examiners. However, there shall be moderation by the external examiner who has the subject background. In case no external examiner with subject background is available, a senior faculty member within the discipline shall be appointed as moderator.**
- v. **The SEE examination for Practical work / Field work / Project work/Internship will be conducted jointly by internal and external examiners as detailed below: However, the BoE on its discretion can also permit two internal examiners.**
- vi. **If a course is fully of (L=0):T:(P=0) type or a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.**

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

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

- a) **Knowledge of relevant processes;**
- b) **Skills and operations involved;**
- c) **Results / products including calculation and reporting.**

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

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

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

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

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

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

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

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

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

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

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

1	First project presentation describing the problem definition	Should be done a semester before the project semester	Weightage: 0%
2	Project Progress presentation-1	7th week from the start date of project semester	Weightage: 25%
3	Project progress presentation-2	14th Week from the start date of project semester	Weightage -25%
4	Final project Viva and Project Report Submission	17th -20th Week of project Semester	Weightage: 30% for Project Report Weightage : 20% for Final Viva Voce

11. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1,C2 and C3 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if

the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

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

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

12. Eligibility to Appear for Semester End Examination

12.1. Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the course(s), as provided in the succeeding sections, shall be eligible to appear for SEE examination.

12.2. Requirements to Pass a Course

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

12.3. Requirements to Pass the Semester

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

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

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

Examples:-

- b. Student "A" has failed in 1 Course in First Semester and 3 Courses in Second Semester. He / she is eligible to seek admission for Third Semester and appear for C4 examination of 1 failed Course of First Semester concurrently with Third Semester C4 examination. Likewise, he / she is eligible to appear for C4

examination of 3 failed Courses of Second Semester concurrently with Fourth Semester C4 examination. However, he / she has to clear all the failed Courses of First and Second Semesters before seeking admission to Fifth Semester.

- c. Student "B" has failed in 2 Courses in Third Semester and 2 Courses in Fourth Semester and has passed in all Courses of First and Second Semesters. He / she is eligible to seek admission to Fifth Semester and appear for C4 examination of 2 failed Courses of Third Semester concurrently with Fifth Semester C4 examination. Likewise he / she is eligible to appear for C4 examination of 2 failed Courses of Fourth Semester concurrently with Sixth Semester C4 examination. However, he / she is not eligible to seek admission to Seventh Semester unless he / she passes in all the failed courses of Third and Fourth Semesters.
- d. Student "C" has failed in 4 Courses in Fifth Semester but has cleared all the courses in Sixth Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "C" is eligible to seek admission for Seventh Semester and appear for C4 examination of 4 failed Courses of Fifth Semester concurrently with Seventh Semester C4 examination. However, he / she has to pass all the failed courses of Fifth Semester along with Seventh and Eighth Semesters courses to earn B Tech Degree.
- e. Student "D" passed in 1 to 4 semesters, but failed in 3 courses of 5th Semester and in 1 course of 6th Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "D" is also eligible to seek admission for 7th Semester and appear for C4 examination of 3 failed courses of 5th Semester concurrently with 7th Semester C4 examination and one failed course of 6th Semester concurrently with 8th Semester C4 examination. However, he / she has to pass all the 3 failed courses of Fifth Semester and 1 course Sixth Semester along with Seventh and Eighth Semester courses to earn B Tech Degree.

13.1. Re-Registration and Re-Admission:

- a) In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for end semester examination (C4) and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.
- b) In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

14. Attendance Requirement:

- 14.1.** All students must attend every lecture, tutorial and practical classes.
- 14.2.** In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.
- 14.3.** Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester (C4) examination and such

student shall seek re-admission as provided in 7.8.4.

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

15. Absence during Mid Semester Examination:

In case a student has been absent from a mid-semester (C1,C2 and C3) examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special test for such candidate(s) well in advance before the C4 examination of that respective semester. Under no circumstances C1, C2 & C3 test shall be held after C4 examination.

16. Grade Card and Grade Point

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

- 16.2. Final Grade Card:** Upon successful completion of B Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

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

Marks P	Grade G	Grade Point (GP=v x G)	Letter Grade
91-100	10	v*10	O
81-90	9	v*9	A+
71- 80	8	v*8	A
61-70	7	v*7	B+
55-60	6	v*6	B
50- 54	5.5	v*5.5	C
40-49	5	v*5	P
0-39	0	v*0	F
ABSENT			AB

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

Here, P is the percentage of marks ($P = [C_1 + C_2 + C_3 + C_4]$) secured by a candidate in a course which is **rounded to nearest integer**. v is the credit value of course. G is the grade and GP is the grade point.

16.3.1. Computation of SGPA and CGPA

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

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e:

$SGPA (S_i) = \frac{\sum(C_i \times G_i)}{\sum C_i}$ where C_i is the number of credits of the i th course and G_i is the grade point scored by the student in the i th course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A+	9	4X9=36
Course 2	4	A	8	4X8=32
Course 3	3	B+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	P	5	3X5=15
Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			188

Thus, $SGPA = 188 \div 24 = 7.83$

Illustration No. 2

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

Thus, $SGPA = 175 \div 24 = 7.29$

Illustration No.3

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

Thus, **SGPA = 199 ÷ 24 = 8.29**

16.4. Cumulative Grade Point Average (CGPA):

16.4.1. Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (192) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = $\sum(C_i \times S_i) / \sum C_i$**

Where S_i is the SGPA of the i th semester and C_i is the total number of credits in that semester.

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

Illustration:**CGPA after Final Semester**

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

Thus, **CGPA = $\frac{24 \times 6.83 + 24 \times 7.29 + 24 \times 8.11 + 26 \times 7.40 + 26 \times 8.29 + 24 \times 8.58 + 24 \times 9.12 + 24 \times 9.25}{196} = 8.10$**

16.4.2. CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.10 x 10=81.0

16.4.3. Classification of Results

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

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

Overall percentage=10*CGPA

17. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for C3 component.

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

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

B. Tech in Electronics and Communication Engineering

Scheme 2018-2022

Sl. No.	Course Code	Course Title	Course Type	Credit Pattern and Value				Weekly Contact Hours	Teaching School/Dept.
				L	T	P	C		
First Semester: Physics Cycle									
1	B18EC1010	Engineering Mathematics-I	HC	3	1	0	4	5	Mathematics
2	B18EC1020	Engineering Physics	HC	2	1	0	3	4	Physics
3	B18EC1030	Elements of Mechanical Engineering	HC	1	1	0	2	3	Mech.
4	B18EC1040	Basic Electrical and Electronics	HC	2	1	0	3	4	ECE
5	B18EC1050	Computer Concepts and C Programming (I)	HC	2	0	1	3	5	C&IT
6	B18EC1060	Constitution of India and Professional Ethics	FC	2	0	0	2	2	LAW
7	B18EC1070	Technical English-1	FC	0	0	2	2	4	Arts and Humanities
8	B18EC1080	Basic Electrical and Electronics Lab	HC	0	0	2	2	3	ECE
9	B18EC1090	Engineering Physics Lab	HC	0	0	2	2	3	Physics
Total Credits for the First Semester:							23	33	
Second Semester: Chemistry Cycle									
1	B18EC2010	Engineering Mathematics-II	HC	3	1	0	4	5	Mathematics
2	B18EC2020	Engineering Chemistry	HC	3	0	0	3	3	Chemistry
3	B18EC2030	Analog Electronics	HC	3	0	0	3	3	ECE
4	B18EC2040	Python Programming (I)	HC	2	0	1	3	5	C&IT/ECE
5	B18EC2050	Environmental Sciences	FC	2	0	0	2	2	Chemistry
6	B18EC2060	Technical English -2	FC	0	0	2	2	4	Arts and Humanities
7	B18EC2070	Computer Aided Engineering Drawing (I)	HC	1	0	1	2	5	Mech.
8	B18EC2080	Analog Electronics lab	HC	0	0	2	2	3	ECE
9	B18EC2090	Chemistry Lab	HC	0	0	2	2	3	Chemistry
Total Credits for the Second Semester:							23	33	
Note: Analog Electronics subject is a project based learning. Students are required to do Mini Project on Electronic Circuits									

Sl. No.	Course Code	Course Title	Course Type	Credit Pattern and Value				Weekly Contact Hours	Teaching School/ Dept.
				L	T	P	C		
Third Semester:									
1	B18EC3010	Engineering Mathematics-III	HC	2	1	0	3	4	Mathematics
2	B18EC3020	Linear Integrated Circuits	HC	3	0	0	3	3	ECE
3	B18EC3030	Digital Electronics & VHDL	HC	3	1	0	4	5	ECE
4	B18EC3040	Signals & Systems (I)	HC	2	1	1	4	5	ECE
5	B18EC3050	Network Theory	HC	2	1	0	3	4	ECE
6	B18EC306X	Soft Core – 1 (SC-1)	SC	3	0	0	3	3	ECE
7	B18EC3070	Linear Integrated Circuits Lab	HC	0	0	2	2	3	ECE
8	B18EC3080	Digital Electronics and VHDL Lab	HC	0	0	2	2	3	ECE
9	B18EC3090	Soft Skill - 1	RULO	0	0	2	2	2	UIIC/ECE
10	B18EC3X10	YOGA/MUSIC/SPORTS/DANCE/ THEATRE	RULO	0	0	2	2	2	Physical Education/ Performing Arts
Total Credits for the Third Semester:							28	34	

Note: Linear Integrated Circuit subject is project based learning. Students are required to do Mini Project on the basics. ***RULO:REVA Unique Learning Opportunity**

Fourth Semester:

1	B18EC4010	Engineering Mathematics-IV	HC	2	1	0	3	4	Mathematics
2	B18EC4020	Analog Communication	HC	3	0	0	3	3	ECE
3	B18EC4030	Electromagnetic Field Theory	HC	2	1	0	3	4	ECE
4	B18EC4040	Microcontrollers and Applications	HC	3	0	0	3	3	ECE
5	B18EC4050	Control systems (I)	HC	3	0	1	4	5	ECE
6	B18EC406X	Soft Core -2 (SC-2)	SC	3	0	0	3	3	ECE
7	B18EC4070	Microcontrollers and applications Lab	HC	0	0	2	2	3	ECE
8	B18EC4080	Analog Communication Lab	HC	0	0	2	2	3	ECE
9	B18EC4091	Soft Skill-2	RULO	0	0	2	2	2	UIIC/ECE
10	B18EC4101	Skill Development	RULO	0	0	0	2	2	UIIC/SDC
Total Credits for the Fourth Semester:							27	33	

Note: Students are required to do Mini Project and Compulsory for Project Exhibition

Sl. No.	Course Code	Course Title	Course Type	Credit Pattern and Value				Weekly Contact Hours	Teaching School/ Dept.
				L	T	P	C		
Fifth Semester									
1	B18EC5010	Digital Communication	HC	2	1	0	3	3	ECE
2	B18EC5020	RF and Microwave Engineering	HC	2	1	0	3	4	ECE
3	B18EC5030	Digital Signal Processing (I)	HC	2	1	1	4	5	ECE
4	B18EC5040	Entrepreneurship and Innovator Skills	HC	2	0	0	2	2	Mgmt./ECE
5	B18EC505X	Soft Core – 3 (SC-3)	SC	3	0	0	3	3	ECE
6	B18EC506X	Soft Core – 4(SC-4)	SC	3	0	0	3	3	ECE
7	B18EC507X	Soft Core – 5(SC-5)	SC	3	0	0	3	3	ECE
8	B18EC5080	RF and Microwave Lab	HC	0	0	2	2	3	ECE
9	B18EC5090	Digital Communication Lab	HC	0	0	2	2	3	ECE
10	B18EC5X10	Soft Skill-3	RULO	0	0	2	2	2	UIIC/ECE
11	B18EC5X20	MOOCs-Swayam/NPTEL /EDx/COURSERA/ Mini Project	RULO	0	0	2	2	2	Others
Total Credits for the Fifth Semester:							29	33	

Note: Industrial visits will be organized for a day to Public/Private Sectors in Bengaluru. Aptitude development program will be conducted for two days.

Sixth Semester

1	B18EC6010	Antenna and wave Propagation	HC	2	1	0	3	4	ECE
2	B18EC6020	CMOS VLSI Circuits	HC	3	0	0	3	3	ECE
3	B18EC6030	Computer Communication and Networks (I)	HC	3	0	1	4	5	ECE
4	B18EC604X	Soft Core – 6(SC-6)	SC	3	0	0	3	3	ECE
5	B18EC605X	Soft Core – 7(SC-7)	SC	3	0	0	3	3	ECE
6	B18EC606X	Soft Core – 8(SC-8)	SC	3	0	0	3	3	ECE
7	B18EC6070	Antenna Lab	HC	0	0	2	2	3	ECE
8	B18EC6080	CMOS VLSI Circuits Lab	HC	0	0	2	2	3	ECE
9	B18EC6090	Soft Skill -4	RULO	0	0	2	2	3	UIIC/ECE
10	B18EC6X10	MOOCs / SWAYAM/ NPTEL /EDx/COURSERA/Mini Project	RULO	0	0	2	2	2	Others
Total Credits for the Sixth Semester:							27	32	

Note: All students must participate in a Mini Project Exhibition. Industrial visits will be organized for a day to Public/ Private Sectors related to Communication.

Sl. No	Course Code	Course Title	Course Type	Credit Pattern and Value				Weekly Contact Hours	Teaching Dept.
				L	T	P	C		
Seventh Semester									
1	B18EC7010	IoT and Cyber physical systems (I)	HC	3	0	1	4	5	ECE
2	B18EC702X	Soft Core –9 (SC-9)	SC	3	0	0	3	3	ECE
3	B18EC703X	Soft Core – 10(SC-10)	SC	3	0	0	3	3	ECE
4	B18EC704X	Soft Core – 11(SC-11)	SC	3	0	0	3	3	ECE
5	B18EC705X	Open Elective	OE	4	0	0	4	4	ECE
6	B18EC7060	Project Dissertation Phase-I	HC	0	0	4	4	4	ECE
Total Credits for the Seventh Semester:							21	22	
<i>Note: The project work phase-1 of project dissertation of 8thSemester will begin in 7thSemester, where student has to form a project group and perform literature survey and define the problem tools and technologies to be used. Options for 8thSemester must be selected in 7thSemester.</i>									
Eighth Semester									
1	B18EC801X	Internship/Global Certification Program/ Soft Core-12 (SC-12)	SC	3	0	0	3	3	ECE/Others
2	B18EC802X	Internship/Global Certification Program/ Soft Core-13 (SC-13)	SC	3	0	0	3	3	ECE/Others
3	B18EC8030	Project & Dissertation Phase - II	HC	0	0	8	8	8	ECE
Total Credits for the Eighth Semester							14	14	
Total Credits for all Eight Semesters:							192		

Total Credits = 192 (including Credits for Sports/Yoga/Music/Dance/Theatre)

Scheme of Soft Core (SC) & Open Elective (OE) with Specialization Groups

A: Electronics/VLSI, B: Computers & IT, C: Communication Engg. D: Interdisciplinary

Sl. No.	Soft-core Group No. / Semester	Name of the Course	Course Code	L	T	P	C	Specialization Group
1	SC-1 / Semester-3	Instrumentation Engineering	B18EC3061	3	0	0	3	A
2		Computer Organization and Architecture	B18EC3062	3	0	0	3	B
3		Object Oriented Programming Using C++	B18EC3063	3	0	0	3	B
5	SC-2 / Semester - 4	Solid state Devices Theory (SSDT)	B18EC4061	3	0	0	3	A
6		Data Structures Using C & C++	B18EC4062	3	0	0	3	B
7		Power Electronics	B18EC4063	3	0	0	3	A
8		Probability & Random Processes	B18EC4064	3	0	0	3	D
9	SC-3/ Semester- 5	Microelectronics	B18EC5051	3	0	0	3	A
10		JAVA Programming	B18EC5052	3	0	0	3	B
11		Optical Fiber Communication	B18EC5053	3	0	0	3	C
12		Research Methodology & IPR	B18EC5054	3	0	0	3	D
13	SC-4 / Semester 5	ARM Processors and applications	B18EC5061	3	0	0	3	A
14		Theory of Algorithms	B18EC5062	3	0	0	3	B
15		Biomedical Signal Processing	B18EC5063	3	0	0	3	C
16		Automotive Electronics	B18EC5064	3	0	0	3	D
17	SC-5 / Semester 5	System Verilog	B18EC5071	3	0	0	3	A
18		Relational Data Base Management System (RDBMS)	B18EC5072	3	0	0	3	B
19		Digital signal Processor Architecture(DSPA)	B18EC5073	3	0	0	3	C
20		Mechatronics	B18EC5074	3	0	0	3	D
21	SC-6 / Semester 6	Embedded Systems	B18EC6041	3	0	0	3	A
22		Data Mining	B18EC6042	3	0	0	3	B
23		Image Processing	B18EC6043	3	0	0	3	C
24		Machine Learning & Deep Learning	B18EC6044	3	0	0	3	D
25	SC-7 / Semester 6	Real Time Systems	B18EC6051	3	0	0	3	A
26		UNIX fundamentals	B18EC6052	3	0	0	3	B
27		Adaptive Filters	B18EC6053	3	0	0	3	C
28		Project Management	B18EC6054	3	0	0	3	D
29		Component Engineering	B18EC6055	3	0	0	3	D
30	SC-8 / Semester 6	MEMS	B18EC6061	3	0	0	3	A
31		Web Programming	B18EC6062	3	0	0	3	B

32		Information Theory and Coding	B18EC6063	3	0	0	3	C
33		Alternate Engineering	B18EC6064	3	0	0	3	D
34	SC-9 / Semester 7	Analog Mixed Mode VLSI	B18EC7021	3	0	0	3	A
35		Cloud Computing	B18EC7022	3	0	0	3	B
36		Wireless Communication	B18EC7023	3	0	0	3	C
37		Robotics & Automation	B18EC7024	3	0	0	3	D
38		Software Engineering	B18EC7025	3	0	0	3	D
39	SC-10 / Semester 7	ASIC Design	B18EC7031	3	0	0	3	A
40		Big data and Data Science	B18EC7032	3	0	0	3	B
41		Satellite Communication	B18EC7033	3	0	0	3	C
42		Medical Electronics	B18EC7034	3	0	0	3	D
43	SC-11 / Semester 7	SOC Design	B18EC7041	3	0	0	3	A
44		Grid computing	B18EC7042	3	0	0	3	B
45		Multi Media Communication (MMC)	B18EC7043	3	0	0	3	C
46		Reliability Engineering	B18EC7044	3	0	0	3	D
47	SC-12 / Semester 8	Low power VLSI	B18EC8011	3	0	0	3	A
48		Parallel Processing	B18EC8012	3	0	0	3	B
49		Ad-hoc Networks	B18EC8013	3	0	0	3	C
50		Avionics	B18EC8014	3	0	0	3	D
51	SC-13 / Semester 8	Digital Testing & Testability	B18EC8021	3	0	0	3	A
52		Pervasive & Ubiquitous Computing	B18EC8022	3	0	0	3	D
53		Network Security	B18EC8023	3	0	0	3	B
54		Radar and Navigational Aids	B18EC8024	3	0	0	3	C
55	OE / Semester 7	Embedded Systems	B18EC7051	4	0	0	4	*
56		Robotics and Automation	B18EC7052	4	0	0	4	*
57		IOT and Cyber physical system	B18EC7053	4	0	0	4	*

Detailed Syllabus

Semester I:

B18EC1010	Engineering Mathematics-I	L	T	P	C
Duration:14 Wks		3	1	0	4

Prerequisites:

Knowledge of basics limits, continuity, differentiation, integration, matrices, determinants, and geometry.

Course Description:

This course covers the topics: Successive derivatives, mean value theorems, Taylor's series, partial derivatives, extreme values, multiple integrals, differential equations. The purpose of this course is to provide students with skills and knowledge required to perform mathematical procedures and processes for solution of engineering problems. This course is widely used particularly in the field of Electronics and Communication Engineering, for ex., Differential equations are used in AC power analysis, AC circuit analysis, E&M, transmission lines, control systems, signal conditioning/processing, etc.

Course Objectives:

The objectives of this course are:

1. To understand the concepts of differential calculus and its applications.
2. To familiarize with partial differentiation and its applications in various fields.
3. To familiarize with linear algebraic applications and different reduction techniques.
4. To familiarize with concept of vector calculus and its applications.

Course Outcomes:

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

1. Apply the knowledge of differential calculus in the field of wave theory and communication systems.
2. Apply the knowledge of Differential Equations in the field of Engineering.
3. Analyze and implement the concepts of Divergence and curl of vectors which play significant roles in finding the Area and volume of the closed surfaces.
4. Apply the knowledge of convergence of the series, which help in forming JPEG image compression.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
B18EC1010	CO1	3	3	3		1				3			3	3	1	1
	CO2	3	3	3		1				3			3	3	1	1
	CO3	3	3	3		1				3			2	3	1	1
	CO4	3	3	3	1	1				3			3	3	1	1

Course Contents:

Unit-1: Differential Calculus-I

[10L+7T]

Successive differentiation-nth derivatives (no proof and simple problems), 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, mean value theorem of integral calculus (no proof). Taylor's series and Maclaurin's series expansion for function of one variable (only problems).

Polar curves- Angle between the radius vector and the tangent, angle between two curves, Pedal equation for polar curves.

Unit-2: Differential Calculus-II

[11L+7T]

Derivative of arc length – concept and formulae (without proof) Radius of curvature-Cartesian, parametric, polar and pedal forms (without proof) problems.

Indeterminate forms and solution using L'Hospital's rule.

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

Unit-3: Differential Calculus-III and Differential equations

[10L+7T]

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). Differential equations: Exact equation and reducible to exact form (1. Close to expression M or N and find IF, 2. $y f(x) dx + x g(y) dy$).

Unit-4: Integral Calculus

[11L+7T]

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.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd 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.

B18EC1020	Engineering Physics	L	T	P	C
Duration :14 Wks		2	1	0	3

Prerequisites:

Knowledge of Basic physics and mathematics of pre-university level

Course Description:

Engineering Physics provides the fundamental knowledge of basic principles of Physics which is required for foundation in engineering education irrespective of branch, it provides the knowledge of quantum mechanics and its importance and applications. It also provides the knowledge of different theories of solids to explain electrical conductivity of materials and recent trends in NDT and nano technology.

Course Objectives:

The Course Objectives are

1. To make students learn and understand basic concepts and principles of physics to analyse practical engineering problems and apply its solutions effectively and meaningfully.
2. To understand building up of models, design issues, practical oriented skills and problem-solving challenges are the great task of the course.
3. To know about Semiconductors and practical applications is the prime motto to introduce new technology at the initial stage of Engineering.
4. Students should be getting knowledge of different physical systems, basic quantum mechanics and nanomaterials etc.

Course Outcomes:

By the end of the course, the students will be able to....

1. Describe wave mechanics and apply knowledge to solve quantum mechanics basic problems.
2. Understand the basics of quantum computation
3. Explain the basics of semiconductors, diodes & transistor
4. Summarize superconductivity with applications. Compare the different display technologies.
5. Distinguish synthesis of nanomaterials.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
B18EC1020	CO1	3	3	1						2	1		3	1	1	
	CO2	3	3	2	3	2				1	1		3	2	1	2
	CO3	3	1		3	1				2			1	2	1	
	CO4	3	1		3	1				1			1	1	2	1

Course Contents:

Unit- 1: Wave mechanics

[7L+7T]

Introduction to Wave mechanics, De-Broglie hypothesis. Expression for de-Broglie wavelength of an electron in terms of accelerating potential. Phase velocity and group velocity, Relation between phase velocity and group velocity.

Quantum Physics: Heisenberg's uncertainty principle, its significance and its applications (nonexistence of electron inside the nucleus). Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time- dependent and independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – energy Eigen values of a free particle, Particle in one dimensional infinite potential well. Problems.

Unit -2: Semiconductors and Semiconductors devices

[7L+7T]

Review of band theory. Intrinsic Semiconductors – extrinsic Semiconductor- expression for carrier concentration (derivation for both holes and electrons) – impurity states in energy band diagram. Formation of P-N junction, depletion region, Biased P-N junction, Zener diode – characteristics. Photo diodes, LED (principle, working and applications). Transistors: Transistor action, Characteristics (CB,CC,CE mode), Bipolar Junction Transistors - Junction Field-Effect Transistors- Metal-Semiconductor FETs (MeSFETs) - Metal-Oxide-Semiconductor FETs working and characteristics.

Unit- 3: Superconductors

[7L+7T]

Critical temperature (T_c), Critical field (H_c), Critical current density (J_c), Perfect diamagnetism, Meissner effect, Type I and Type II superconductors, Isotope effect, BCS theory of superconductivity, Applications- Superconducting magnets and Maglev vehicle.

Display technology: Touch screen technologies: Resistive and capacitive touch screen and Displays: CRT, Field emission display, Plasma display, LED display, OLED display, LCD display.

Unit- 4: Nanomaterials

[7L+7T]

Introduction to nanoscience, nanomaterials and their applications, Synthesis of nanomaterials using bottom-up method (arc-discharge method), top-down methods (ball milling method),

Carbon Nanotubes: properties and applications.

Quantum Computation: Quantum wires (one dimensional), Quantum dots (zero dimensional); the idea of “qubit” and examples of single qubit logic gates- Classical bits, Qubit as a two level system.

Self-learning component:

Magnetic storage devices, solid state storage devices, optical storage devices, and characteristics of materials used in manufacture of Microprocessors/desktops (body, internal circuit connection), heat sink cooling, liquid cooling, fan based cooling, laser printer working, accelerometers. Gold Nano particles as storage devices.

Text Books:

1. R. K. Gaur and S.L. Gupta, “Engineering Physics”, DhanpatRai Publications (P) Ltd, New Delhi, 2014.

2. M.N. Avadhanulu and P.G. Kshirsagar, "A Text book of Engineering Physics", S. Chand and company, New Delhi, 2018.
3. S. O. Pillai, "Solid State Physics", New Age International publishers, New Delhi, 2018.
4. Janglin Chen, Wayne Cranton, Mark Fihn, "Handbook of Visual Display Technology" Springer Publication, 2012.
5. William T. Silfvast, "Laser Fundamentals", Cambridge University press, New York, 2004.
6. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley and Sons, New York, 2020.
7. Charls Kittel, "Introduction to Solid State Physics", Wiley, Delhi, 2019
8. Arthur Beiser, "Concepts of modern Physics", Tata McGraw Hill publications, New Delhi 8th Edition, 2017.

Reference Books:

1. William T. Silfvast, "Laser Fundamentals", Cambridge University press, New York, 2004.
2. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley and Sons, New York, 2020.
3. Charls Kittel, "Introduction to Solid State Physics", Wiley, Delhi, 2019
4. Arthur Beiser, "Concepts of modern Physics", Tata McGraw Hill publications, New Delhi 8th Edition, 2017.

B18EC1030	Elements of Mechanical Engineering	L	T	P	C
Duration:14 Wks		1	1	0	2

Prerequisites:

Basics of Physics

Course Description:

This is a basic course which explains the basics of mechanical engineering which is required to the knowledge of B Tech students irrespective of their branch. This course deals with working operations of certain motors and machines and gives the insight to materials and their structures, combustion engines, steam engines, power transfer pulleys etc.

Course Objectives:

The objectives of this course are:

1. To develop the basic knowledge of steam utilization, working of various turbines and IC engines.
2. To incorporate the concepts of metal joining process, their applications and power transmission modes like belt drives, gears and gear trains.
3. To understand various machines and its operations in Mechanical Engineering.
4. To give exposure to basic power transmission elements.

Course Outcomes:

By the end of the course, the students will be able to

1. Explain the formation of steam, turbines and solve the numerical on steam properties.
2. Describe the construction and working of IC engines, refrigeration systems, air conditioning and solve the numerical on IC engines.
3. Distinguish between the machine tools, metal joining processes and choose the machine tool operation.
4. Illustrate the transmission systems, solve the numerical on gears trains.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	P2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC1030	CO1	3	2	2	-	1	-	-	-	-	3	-	-	-	1	1
	CO2	3	2	2	-	1	-	-	-	-	3	-	-	-	1	1
	CO3	3	2	1	-	1	-	-	-	-	3	-	-	-	1	1
	CO4	3	1	1	-	1	-	-	-	-	3	-	-	-	-	-

Course Contents:

Unit - 1: Properties of steam

[3L+4T]

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

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

Unit - 2: Internal Combustion Engines

[4L+4T]

Introduction, Classification of IC engines, parts of IC engine, working principle of four stroke (petrol and diesel), differences between petrol & diesel engines, Numerical on BP, IP and Mechanical efficiency.

Refrigeration and Air conditioning- Introduction, Principle of refrigeration, parts of refrigerator, Principle and working of vapor compression refrigeration and vapor absorption refrigeration systems. Refrigerants, Properties of refrigerants Ton of Refrigeration, COP, Working of window air conditioner.

Unit – 3: Machine Tools

[3L+4T]

Introduction, working principle and classification of lathe, major parts of a lathe and their functions, lathe operations, specifications of lathe, introduction of drilling, parts of radial drilling machine, drilling operations.

Metal joining processes: Introduction, classification of metal joining processes, principle of welding, electric arc welding, soldering and brazing and their differences.

Unit – 4: Power Transmission

[4L+4T]

Introduction to transmission systems and its classification, types of belt drives, velocity ratio, idler pulley,

stepped pulley, fast & loose pulley. **Gears** - Definitions, Spur gear terminology, Types and applications of Gears. **Gear Trains** – Simple and compound gear trains, Simple problems on gear trains

Text Books:

1. K.R. Gopalkrishna, “A Text Book of Elements of Mechanical Engineering”, Subhash Publishers, 2017.
2. Kestoor Praveen and M.R. Ramesh, “Elements of Mechanical Engineering”, Suggi Publications, 2nd Edition, 2011.

Reference Books:

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

B18EC1040	Basic Electrical and Electronics	L	T	P	C
Duration :14 Wks		2	1	0	3

Prerequisites:

Basics of Physics, Mathematics and Number systems.

Course Description:

The Basic Electrical and Electronics typically deals with the study of Electrical parameters like AC and DC voltage and current and behavior 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 analyze 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 to:

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:

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

1. Describe basic composition of electrical circuits and their behavior.
2. Analyze the working principle and construction details of electrical machines.
3. Analyze the working applications and characteristics of Diode, BJT, FET
4. Design the digital circuits using various logic gates.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC1040	CO1	3	3		2								3		3	
	CO2	3	3		2								3		3	
	CO3	3	3		2								2		3	
	CO4	3	2		2								2		2	

Course Contents:

Unit -1: Basics of Electrical Engineering

[7L+7T]

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 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

[7L+7T]

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: Digital Electronics and Number Systems

[7L+7T]

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 using Universal gates. Half adder and Full adder Implementations.

Unit -4: Semiconductor Diodes and Transistors

[7L+7T] 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.

Text Books:

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

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

References:

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

B18EC1050	Computer Concepts and C programming (I)	L	T	P	C
Duration :14 Wks		2	0	1	3

Prerequisites:

Basics of Mathematics

Course Description:

The objectives of this course is to make students learn basic principles of problem solving, present the syntax and semantics of the "C" language, implement through C language using constructs offered by the language.

Course Objectives:

The objectives of this course are to:

- Explain the different programming constructs of C to be used for a given application.
- Illustrate the Usage of control Statements for solving the real world problems.
- Demonstrate the use of parameter passing mechanism in functions for solving real world problems.
- Illustrate the use of structures and unions for solving the real world problems.

Course Outcomes:

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

- Identify the basic constructs of C program, suitable for computing the roots of quadratic equation.
- Develop a C program to find transpose of a matrix using iterative statements (loops) and Arrays.
- Design a C program to concatenate two strings by using parameter passing mechanism.
- Apply the basic concepts Union & Structures to read and print employee's details.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC1050	CO1	3	2	3	3	2						1		1		3
	CO2	3	2	2	3	2								3	2	2
	CO3	2	1	2	3	1								2	2	3
	CO4	2	1	3	3	1						1		2	1	3

Course Contents:

Unit -1: Fundamentals of problem solving and introduction to C-language

[7L+7P]

Algorithm and flowchart & advantages of algorithm (pseudo code), basic flow chart symbols, structure of c program with example, c language & its features, c tokens, data types in c, variables, constants, input / output functions

Operators: (unary operator, assignment operator, arithmetic operator, relational operators, logical operators & bitwise operator, conditional operator, increment and decrement operator, special operator).

Expressions & statements: Postfix, primary, prefix, unary, binary, ternary & assignment

Unit 2: Branching constructs Conditional statements: [7L+7P]

if statement, if-else statement, nested if, switch statement.

Unconditional statements: break and continue statement, goto statement, return statement

Iterative statements (loops): while loop, do while, difference between while and do while for loop.

Arrays: one dimensional array, two dimensional array, searching techniques, sorting.

Unit -3: Functions [7L+7P]

Function definition, types of function, location of function in a program, structure of a function, parameter passing mechanisms, call by value & call by address

Strings: string operations with and without using inbuilt string functions (string length, string compare, string copy, string concatenation, string reverse).

Unit -4: Structures & Union [7L+7P]

Derived types: structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, Union, Type def.

Pointers: Introduction to pointers.

File Operations: Formatted Input & Output, Character Input and Output Functions, Direct Input and Output Functions, File Positioning Functions, Error Functions.

Self-Learning component:

Fundamentals of computer graphics: output primitives – Line, Circle and Ellipse drawing algorithms - Attributes of output primitives Two dimensional Geometric transformation.

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. B.S. Anami, S.A. Angadi and S. S. Manvi, "Computer Concepts and C Programming: A Holistic Approach", second edition, PHI, 2008.
4. NanjeshBennur, Dr. C. K. Subbaraya, "Programming in C", 2nd Edition, Excellent Publishing House, 2015.

Reference Books:

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

Computer Concepts and C Programming Lab

Lab Objectives:

The objectives of this course are to:

1. Learn basic and fundamental C programming concepts
2. Learn searching and sorting algorithms
3. Develop a C program that contains functions and parameters.
4. Develop a C program that contains sequence, selection and iteration control structures.

Lab Outcomes:

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

1. Illustrate the Representation of Numbers, Alphabets and other Characters in the memory of Computer System;
2. Analyze the Software Development Tools; like Algorithms, Pseudo Codes and Programming Structures;
3. Apply different programming constructs to develop a Computer Program.
4. Demonstrate the use of Engineering Solutions to simple (moderate) mathematical and logical problems.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC1050(L)	CO1	3	2	3	3	2								1	1	3
	CO2	3	2	2	3	2								3	2	2
	CO3	2	1	2	3	1								2	2	3
	CO4	2	1	3	3	1								2	1	3

Lab Experiments:

Experiment No.	Program	Course Outcome
1	Introduction to Computer Software & hardware. Types of Operating System. Basic Commands in Unix. Assembling hardware's of computer.	1,2
2	a) Program to print the name, college name, Address of a student. b) A company for aadhar card want's to collect its employees information. Write a program to take input of employee name and age.	1,2
3	a) Program to read and print the size of variables of different data type. b) A person has deposited some amount in bank. Write a program to calculate simple interest and compound interest on amount for a period.	1,2

4	<p>a) Arithmetic operations are widely used in many programs. Write a program to perform addition, subtraction, multiplication, modulo division, and division operations.</p> <p>b) In Delhi, four wheelers run on the basis of even or odd number. Write a program to identify whether vehicle registration number is even or odd.</p>	1,2
5	<p>People frequently need to calculate the area of things like rooms, boxes or plots of land where quadratic equation can be used. Write a program to find the coefficients of a quadratic equation and compute its roots.</p>	2,3
6	<p>a) Consider the age of 3 persons in a family, Write a program to identify the eldest person among three of them.</p> <p>b) Consider student's marks in Computer Test. Write a Program display the grade obtain by student in Computer Test based on range.</p>	2,3
7	<p>Calculator allows you to easily handle all the calculations necessary for everyday life with a single application. Write a program to design a basic calculator that performs the basic operations and you want to give choice to user to perform</p> <ol style="list-style-type: none"> Addition of two numbers Subtraction of two numbers Multiplication of two numbers. Division of two numbers. Wrong choice 	2,3
8	<p>In a stock market at the end of the day we do the summation of all the transactions.</p> <ol style="list-style-type: none"> Write a program to display numbers (transactions) from 1 to n. Write a program to find the sum of n natural numbers. 	2,3
9	<p>a) Read your ATM Pin Number. Write a program to identify your Pin Number is palindrome or not.</p> <p>b) Read your Landline Number. Write a program to print the reverse of it and also find sum of digits of your Landline Number.</p>	2,3
10	<p>a) Create a Contact list of n friends, Write a program to read and print the Phone number of your friend's.</p> <p>b) In computer based applications, matrices play a vital role in the projection of three dimensional image into a two dimensional screen, creating the realistic seeming motions. Write a program to perform matrix Multiplication and check compatibility of matrix.</p>	2,3
11	<p>You have joined a startup company of N employees; Write a program is to sort all employee ID.</p>	2,3

12	A student has taken 10 books from the library. Every time he takes the book, Librarian read's its ISBN Number. Write a program to identify whether book is issued to him or not based on ISBN Number.	2,3
13	Suppose students have registered for workshop, and their record is maintained in ascending order based on student id. Write a program to find whether a particular Student has registered for that particular workshop or not.	2,3
14	In a CCP test you scored less marks compared to your friend, Write a program to swap your marks with your friend.	2,3
15	a) In a memory game, you first enter a string wait for a time and again enter second string, Write a program to check both sting were same or not. b) Read your first and last name in two different strings; Write a program to combine these two strings into third string.	2,3
16	a) Assume a person has entered a Password ,Write a program so that he can know the length of his password, b) Read a meaningful word in English, Write a program to identify the word when inversed yields the same or not.	2,3
17	a) Write a c program to implement Digital Differential Analyzer line generating algorithm	3,4
	b) Write a C program to generate a circle using Bresenham's midpoint algorithm.	3,4
	c) Write a C program to implement Bresenham's line drawing algorithm	3,4

B18EC1060	Constitution of India and Professional Ethics	L	T	P	C
Duration :14 Wks		2	0	0	2

Prerequisites:

Basics of Indian Constitution, fundamental rights and duty

Course Description:

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

Course Objectives:

Course objectives are:

1. To explain basic knowledge required to understand Constitution of India.
2. To summarize the Fundamental Rights, Duties and other Rights.

- To apply the knowledge of Constitution and more importantly practice it in a right way.
- To explore Ethical standards followed by different companies.

Course Outcomes:

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

- Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution.
- Demonstrate the practicality of Constitution perspective and make them face the world as a bonfire citizen.
- Summarize ethical standards followed by different companies.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC1060	CO1						3	1								1
	CO2						3	1								1
	CO3								3		2		2			

Course Contents:

Unit -1: Constitution of India

[7 Hrs]

Making of Indian Constitution, features of Indian Constitution Preamble to the Constitution of India, Fundamental Rights under Part III; Rights to Equality, Right to Freedom, Right against Exploitation, Rights to Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Fundamental Duties of the Citizen, Significance and Characteristics. Elements of National Significance; National Flag, National Anthem, National Emblem.

Unit -2: Legislature and Executive

[7 Hrs]

Organs of the Government; Legislature, Executive and Judiciary. Union and State Executives: President, Vice President, Prime Minister, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission.

Unit -3: Judiciary

[7 Hrs]

Supreme Court of Indian, High Court, Right to Information Act 2005, Consumer Protection- Consumer Rights- Caveat Emptor and Caveat Vendor.

Unit 4: Professional Ethics

[7 Hrs]

Definition Scope and need of Ethics for professional, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees. Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence.

Text Books:

- Kapoor, S.K., "Human rights under International Law and Indian Law", Prentice Hall of India, New Delhi, 2002.
- Basu, D.D., "Indian Constitution", Oxford University Press, New Delhi, 2002.
- Chakraborty, S.K., "Values and ethics for Organizations and Theory Practice", Oxford University Press,

New Delhi, 2001.

Reference Books:

1. M V Pylee, "An Introduction to Constitution of India".
2. M Govindarajan, S Natarajan, V S Senthil Kumar, Engineering.
3. Dr. Durga Das Basu, "Introduction to constitution of India".
4. M V Pylee, "An introduction to constitution of India".

B18EC1070	Technical English - 1	L	T	P	C
Duration:14 Wks		0	0	2	2

Prerequisites

Fundamentals in Spoken English.

Course Description

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

Course Objectives

The objectives of this course are to:

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

Course Outcomes

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

1. Interpret audio files and comprehend different spoken discourses/ excerpts in different accents.
2. Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies.
3. Make use of reading different genres of texts adopting various reading strategies.
4. Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	P2	PO3	PO4	PO5	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC1070	CO1		1					3	3			3			
	CO2		1					2	3			3			
	CO3		2					2	3			3			
	CO4		1					3	3			3			

Course Contents:

Unit -1: Functional English

[7P]

Grammar: Prepositions; Modal Auxiliaries

Listening: Listening to audio (verbal & sounds)

Speaking: Debating Skills

Reading: Skimming a reading passage; Scanning for specific information

Writing: Email communication

Unit -2: Interpersonal Skills

[7P]

Grammar: Tenses; Wh-questions

Listening & Speaking: Listening and responding to video lectures / talks

Reading: Reading Comprehension; Critical Reading; Finding key information in a given text **Writing:** Process descriptions (general/specific); Recommendations

Unit -3: Multitasking skills

[7P]

Grammar: Conditional Sentences

Listening & Speaking: Listening to specific task; focused audio tracks and responding

Reading: Reading and interpreting visual material

Writing: Channel conversion (flowchart into process); Types of paragraph (cause and effect / compare and contrast / narrative / analytical); Note Taking/ Note Making

Unit -4: Communication skills

[7P]

Grammar: Direct and indirect speech

Listening & Speaking: Watching videos / documentaries and responding to questions based on them; Role plays.

Reading: Making inference from the reading passage; predicting the content of a reading passage.

Writing: Interpreting visual materials (line graphs, pie charts etc.); Different types of Essay Writing

Text Books:

- Green, David, "Contemporary English Grammar Structures and Composition", New Delhi: MacMillan Publishers, 2010.
- Thorpe, Edgar and Showick Thorpe, "Basic Vocabulary", Pearson Education India, 2012.
- Leech, Geoffrey and Jan Svartvik, "A Communicative Grammar of English", Longman, 2003.
- Murphy, Raymond, "Murphy's English Grammar with CD", Cambridge University Press, 2004.
- Rizvi, M. Ashraf, "Effective Technical Communication", New Delhi: Tata McGraw-Hill, 2005.

6. Riordan, Daniel, "Technical Communication", New Delhi: Cengage Publications, 2011.
7. Sen et al, "Communication and Language Skills", Cambridge University Press, 2015.

B18EC1080	Basic Electrical and Electronics Lab	L	T	P	C
Duration :14 Wks		0	0	2	2

Prerequisites:

Semiconductor Physics, Basics of Electrical & Electronics, Principles of Electronics.

Course Description:

All basic electronic devices and their characteristics, applications will be studied. Using these devices the small electronic circuits can be constructed and checked. In order to introduce the students with basic components of electronics this lab is furnished with advanced CROs, function generators and digital multimeters. Students can perform practical on P-N junction diode, Zener Diode, rectifiers and filters, transistor biasing and their characteristics in different modes, RC coupled amplifiers and FETs.

Course Objectives:

The objectives of this course are to:

1. Demonstrate the application of KCL and KVL in DC circuit
2. Make students understand about leading and lagging concepts of electrical circuits.
3. Demonstrate working of DC motor.
4. Demonstrate the basic operation of diode and diode circuits like rectifiers, clippers and Clampers.
5. Demonstrate the basic operation of Zener diode circuit.
6. Analyse the input and output characteristics of Common Emitter configuration of BJT.
7. Demonstrate the characteristics of SCR.
8. Design various logic circuits.

Course Outcomes:

On completion of this course the student will be able to:

1. Demonstrate the application of KCL and KVL in DC circuit.
2. Design and test various diode circuits like rectifiers, clippers and clampers.
3. Assess the voltage and current characteristics of nonlinear devices like Diode, Zener diode and BJT.
4. Design and test the characteristics of an electronics device like SCR. and logic gates.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC1080	CO1	3	3		3								3	3		
	CO2	3	3		3								3	3		
	CO3	3			3								3	3		

	CO4	3	3									3	3		
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Lab Experiments

Introduction to basics of electronic components and instruments

1. To verify KCL and KVL
2. Testing of Lead & Lag networks by using R-C components.
3. To Study and test the working of DC motor
4. Study and analysis of V-I Characteristics of Silicon, Germanium and Zener PN Junction diodes (Both Forward and Reverse Characteristics).
5. To find the Voltage regulation of Zener diode
6. Design half wave, **Full wave-center tap** and Bridge rectifier with and without capacitive filter and measure efficiency and ripple factor.
7. Design of Clippers and clampers with reference voltages.
8. Study and analysis of V-I Characteristics of SCR.
9. Study and analysis of input output characteristic of CE configuration of BJT.
10. Verification of basic logic gates using discrete components.

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 Books:

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

B18EC1090	Engineering Physics Lab	L	T	P	C
Duration:14 Wks		0	0	2	2

Prerequisites:

Knowledge of Higher secondary/Pre University level Physics.

Course Description:

Engineering Physics lab provides the fundamental knowledge of basic principles of Physics experiments which is required for foundation in engineering education irrespective of branch, it provides the knowledge of quantum mechanics and its importance and applications. It also provides the knowledge of different practical aspects of solids to explain electrical conductivity of materials, series and parallel resonance circuits.

Course Objectives:

The objectives of this course are:

Ref: RU/BoS/ECE/CEC/June-2018-6

1. To make the students gain practical knowledge to co-relate with the theoretical studies.
2. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipment.
3. To design of circuits using new technology and latest components and to develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.

Course Outcomes:

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

1. Gain knowledge of new concept in the solution of practical oriented problems and develop skills to impart practical knowledge in real time solution.
2. Apply the knowledge of new technology and comparison of results with theoretical calculations.
3. Design circuits with practical knowledge.
4. Use measurement technology, usage of instruments for real time applications in engineering studies.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	P2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC1090	CO1	3	3	3	2					2			2	2	2	1
	CO2	2	3	3	1	1				2			2	2	2	2
	CO3	1	2	3	2	1				2			2	2	1	2
	CO4	2	2	2	1					2			2	1	1	2

Lab Experiments

1. Velocity of ultrasonic waves in non-conducting medium by piezo-electric method.
2. Band gap of intrinsic Semi-conductor using four probe method
3. Value of planck's constant by using light emitting diode
4. I-V Characteristics of Zener Diode. (Determination of knee voltage, zener voltage and forward resistance)
5. To find the laser parameters—wavelength and divergence of laser light by diffraction method.
6. Photo Diode Characteristics (Study of I-V characteristics in reverse bias and variation of photocurrent as a function of reverse voltage and intensity)
7. Dielectric constant of a capacitor by charging and discharging of a capacitor.
8. Attenuation and propagation characteristics of optical fibre cable.
9. Determination of particle size using laser.
10. Construction and study of IC regulation properties of a given power supply
11. Determination of numerical aperture of a given optical fibre.
12. Determination of electrical resistivity of germanium crystal and study the variation of resistivity with temperature by four probe method
13. Characteristics of Transistor (Study of Input and Output characteristics and calculation of input resistance, output resistance and amplification factor.
14. Series and parallel LCR Circuits (Determination of resonant frequency and quality factor)

Text books:

1. Thiruvadigal, J. D., Ponnusamy, S.Sudha.D. and Krishnamohan M., "Physics for Technologists", Vibrant Publication, Chennai, 2013.

2. R.K.Shukla and Anchal Srivastava, "Practical Physics", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

Reference Books:

1. G.L.Souires, "Practical Physics:", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.
3. B.L. Worshnop and H.T. Flint, "Advanced Practical Physics", Littlehampton Book Services Ltd, United Kingdom, 1951.
4. S. L. Gupta &V. Kumar, "Practical Physics", Pragati prakashan, New Delhi, 2018.
5. Chauhan & Singh, "Advanced Practical Physics" Vol. I& II –, PragatiPrakashan, 2013.

DETAILED SYLLABUS

Semester - II:

B18EC2010	Engineering Mathematics – II	L	T	P	C
Duration: 14 Weeks		3	1	0	4

Prerequisites:

Knowledge of basics of derivatives, vectors, and complex numbers.

Course Description:

This course covers the topics: Linear Algebra differential equations Vector calculus, inverse Laplace transforms, This course is widely used in all streams of Engineering, particularly in the field of Electronics and Communication Engineering, for ex., Electromagnetic field theory, Control systems, Analog and Digital communication.

Course Objectives:

The objectives of this course are to:

1. To understand the concepts of Linear algebra and its applications in various fields of engineering and Technology.
2. To understand the concepts of Integral calculus and its applications.
3. To familiarize with partial differential equations and its applications to standard problems like Heat, Wave and Laplace.
4. To impart the Knowledge of Laplace transforms and its applications in the field of engineering.

Course Outcomes:

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

1. Apply the knowledge of Linear Algebra in Image processing and digital signal processing.
2. Apply the knowledge of Integral calculus to perform integration and other operations for certain types of functions and carry out the computation fluently.
3. Apply the knowledge of partial differential equations in the field of signals and systems, control systems, magnetic wave theory.
4. Apply the knowledge of Laplace transformation from the time domain to the frequency domain, which transforms differential equations into algebraic equations and convolution into multiplication.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO 1	P 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
B18EC201 0	CO1	3	3	2	1					3			3	3	2	1
	CO2	3	3	3	1					3			3	3	2	1
	CO3	3	3	3	1					3			3	3	2	1
	CO4	3	3	3	1					3			3	3	2	1

Course Contents:

Unit-1: Linear Algebra

[10L+7T] Hrs

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.

Diagonalisation of a matrix, Reduction of a quadratic form to canonical form by orthogonal transformation.

Unit-2: Differential Equations:

[11L+7T] Hrs

Linear Differential Equations: Definitions, Complete solution, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral.

Method of variation of parameters (simple problems), Cauchy's and Legendre's linear differential equations.

Partial differential equations: Formation of Partial differential equations, Solution of Lagranges linear PDE.

Unit-3: Vector Calculus

[10L+7T] Hrs

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 (∇A), curl (∇A), curl (grad ϕ), 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: Laplace Transforms:

[11L+7T] Hrs

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.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd 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.

B18EC2020	Engineering Chemistry	L	T	P	C
Duration : 14 WKS		2	1	0	3

Prerequisites:

Pre University level Knowledge in Chemistry, Physics and Mathematics.

Course Description:

Engineering chemistry provides the very basic knowledge required for engineering students to understand its importance in technology. It provides the knowledge of quantum mechanics, battery technology its importance and applications. It also provides knowledge about corrosion science, construction of PCB's and engineering materials.

Course Objectives:

The course objectives are to:

1. Explain the basic concepts of Atomic and Molecular Structure, energy level diagram and quantum chemistry
2. Design construction and applications of Batteries, fuel cells and solar cells
3. Classify the types of Corrosion, corrosion control and metal finishing techniques
4. Discuss the use of engineering materials like Nano, Polymers Semiconductors, superconductors, magnetic materials, liquid crystals in various applications.

Course Outcomes:

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

1. Analyze the basic concepts of Atomic and Molecular structure, energy level diagrams and quantum mechanics
2. Discuss the construction and working of batteries fuel cells and solar cells
3. Apply the knowledge of corrosion science and metal finishing essential for corrosion control of commercially available materials like PCB and circuits
4. Explain the applications of engineering materials in various fields.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ Cos	PO1	P2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC2020	CO1	2	1		1		1						2	1	1	
	CO2	2	1	3	2	2	3	3		1	1	1	1	1	1	2
	CO3	2	2	3	2	1	3	1		1	1		1	2	2	1
	CO4	2	2	2	2	2	1	2					1	1	1	

Course Contents:

Unit –1: Atomic, Molecular Structure and Periodic Properties

[7L+7T]

Atomic, molecular structure: Classical to quantum mechanical transition, Origin of quantum mechanics, dual nature of light and matter, concept of quantization – Max Planck, Einstein, de Broglie, Schrödinger wave equation, particle in a box (1D)-Energy solutions, quantum states of electron, wave functions in bonding in molecules (H₂).

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

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

Unit – 2: Energy Storage and Conversion Devices

[7L+7T]

Battery: Introduction to electrochemistry, Basic concepts of Cells and Battery, Battery characteristics Primary (Leclanche Cell), Secondary (Lead-Acid), Lithium batteries, Advantage of use of Li as electrode material (Lithium & Lithium ion), super capacitors.

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

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

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

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

Unit-3: Science of Corrosion and Its Control

[7L+7T]

Corrosion: Electrochemical theory of corrosion, galvanic series, types of Corrosion- differential metal corrosion, differential aeration corrosion (Pitting & water line), boiler corrosion, and grain boundary corrosion, Factors

affecting rate of corrosion-Primary, secondary.

Corrosion control: Galvanizing & tinning, cathodic protection & Anodic Protection.

Metal Finishing: Theory of electroplating. Factors required to study electroplating. Effect of plating variables on the nature of electro-deposit- electroplating process, Electroplating of gold. Electro less plating of copper and nickel, PCB manufacture by Electro less plating of copper.

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

Unit -4: Chemistry of Engineering Materials

[7L+7T]

Semiconducting and Super Conducting materials-Principle and some example.

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

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

Adhesives: properties, synthesis and applications of epoxy resin.

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

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

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

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

Text Books:

1. S. S. Dara, S. S. Umare, "A Text book of Engineering Chemistry". S. Chand Publications, New Delhi, 1986.
2. S. Chawla, "Text Book of Engineering Chemistry". Dhanapathirai Publications.
3. P.W. Atkins, "Physical Chemistry". Oxford University press, UK, 2018.
4. S. Agarwal, "Engineering Chemistry: Fundamentals and Applications". Cambridge University Press, UK, 2015.

Reference Books:

1. V. R. Gowrikar, N.N. Viswanathan, J. Sreedhar, "Polymer chemistry". Wiley Eastern Ltd, 1986.
2. Fontana G. Mars, "Corrosion engineering". Tata McGrail Publishing Pvt. Ltd, 3rd edition, 2005.
3. Charles P. Poole Jr., Frank J. Owens, "Introduction to Nanotechnology". Wiley India Publishers, 2004.
4. Krishan K Chawla, "Composite materials – Science and Engineering". Springer International edition, Second edition, 2012.

B18EC2030	Analog Electronics	L	T	P	C
Duration: 14Weeks		3	0	0	3

Prerequisites:

Basic Electrical and Electronics,

Course Description

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:

1. To understand operation of semiconductor devices.
2. To 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. To apply concepts for the design of Amplifiers
4. To verify the design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies using simulators.
5. To implement mini projects based on concept of electronics circuit.

Course Outcomes:

On completion of this course the student will be able to

1. Analyze dc circuits and relate ac models of semiconductor devices with their physical Operation.
2. 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.
3. Develop experience in building and trouble-shooting simple electronic analog and digital circuits (PBL).
4. Assess the concepts of both positive and negative feedback in electronic circuits.

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC2030	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

Course Contents:

Unit-1: Transistor Biasing and BJT AC analysis

[11 Hrs]

Ref: RU/BoS/ECE/CEC/June-2018-6

64

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 Feedback Amplifiers [10 Hrs]

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 and Power Amplifiers [11 Hrs]

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 Circuits-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: FETs and Op-Amps [10 Hrs]

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.

Project Based Learning

Design a public address system which includes a DC Power supply, Two-stage audio preamplifier and a power amplifier connected to speaker.

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.
3. Anil Kumar Maini, VarshaAgrawal,"Electronic Devices and Circuits", John Wiley & Sons, 2009.

B18EC2040	Python Programming (I)	L	T	P	C
Duration:14 Wks		2	0	1	3

Prerequisites:

Computer concepts and C programming

Course Description:

Python is a language with a simple syntax, and a powerful set of libraries. This course is an introduction to the Python programming language for students without prior programming experience. We cover data types, control flow, object-oriented programming, and graphical user interface-driven applications. The purpose of this course is to provide the solid foundations in the basic concepts of Python programming language. The Python Programming Language are a very important to develop 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 Polymorphism, Inheritance which are not present in C Programming Language.

Course Objectives:

The objectives of this course are:

1. To present the syntax and semantics of the python, as well as basic data types offered by the language.
2. To provide the insight into python functions, modules, and packages.
3. To demonstrate the files and exception handling in python programming.
4. To present the object-oriented concepts like encapsulation, inheritance, and polymorphism.

Course Outcomes:

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

1. Use the built-in data types and operators in python programming.
2. Build effective python programs using functions, modules, and packages and by accessing files and directories.
3. Design object-oriented programs using python classes and objects.
4. Demonstrate and use the concept of inheritance and polymorphism for code reusability.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	P O 1	P 2	PO 3	PO4	PO 5	PO 6	P O 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
B18EC2040	CO1	3	3	2	1	2				2			1	3	3	2
	CO2	3	3	3	1	3				2			1	3	3	3
	CO3	3	3	3	1	3				2			1	3	3	3
	CO4	3	3	2	1	3				2			1	3	3	2

Course Contents:

Unit 1: Introduction to python:

[3L+7T+7P]

Features of python programming, application of python, Getting started, keywords and identifier, Python Indentation, statements and comments, variables, Data types: numbers, list, tuple, strings, set, dictionary, type conversion, arrays v/s lists, python I/O, python operators, branching and looping statements.

Unit 2: Python functions and file handling

[4L+7T+7P]

Python functions: Syntax of functions, arguments and return values, scope and lifetime of variables, python global keyword, python modules and packages.

Python files: Python file operation, directory, exceptions, exception handling and user defined exceptions.

Unit 3: Classes and objects:

[3L+7T+7P]

Introduction to object-oriented programming, class, objects, attributes and methods, creating an object in python, self-parameter, constructors in python, deleting attributes and objects.

Unit 4: Inheritance, Polymorphism, and Advanced concepts

[4L+7T+7P]

Inheritance: Python inheritance syntax, Examples on single inheritance and multiple inheritance.

Polymorphism: Method overloading, operator overloading examples.

Advanced concepts: Introduction to Iterators, generators, and decorators.

Text Books:

1. Allen Downey, "Think Python: How to Think like a Computer Scientist", Green Tea Press Needham, Massachusetts, 2nd edition, 2017.
2. Kenneth A. Lambert, "Fundamentals of Python: First Programs (introduction to Programming)", 1st Edition, CENAGE Learning, 2016.
3. Charles R. Severance, "Python for everybody: Exploring data using python 3", Shroff publishers, 2017.

Reference Books:

1. John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle& Associates, 2nd edition, 2015.
2. Michael Dawson, "Python Programming for the Absolute Beginners", 3rd Edition, CENAGE Learning, 2016.

3. Springer, Kent D. Lee, "Python Programming Fundamentals", 2nd Edition, 2015.
4. John V. Guttag, "Introduction to Computation and Programming using Python", MIT Press, 2016.

Python Programming Lab

1. Write a Python program that reads input from the keyboard. The input will consist of some number of lines of text. The input will be terminated by a blank line. Your program should print every third line. For instance, if the input is the following:
"Spot the mistake
in the following argument",
Jack challenged
 $1+(-1+1)+(-1+1)+\dots = (1+ -1)+(1+ -1)+\dots$
so therefore,
 $1 = 0$
??
then the output should be:
Jack challenged
 $1 = 0$
2. "99 Bottles of coke" is a traditional song. It is popular to sing on long trips, as it has a very repetitive format which is easy to memorize, and can take a long time to sing. The song's simple lyrics are as follows:
99 bottles of coke on the wall, 99 bottles of coke. Take one down, pass it around, 98 bottles of coke on the wall.
The same verse is repeated, each time with one fewer bottle. The song is completed when the singer or singers reach zero.
Your task here is to write a Python program capable of generating all the verses of the song.
3. Write a function `matched(s)` that takes as input a string `s` and checks if the brackets "(" and ")" in `s` are matched: that is, every "(" has a matching ")" after it and every ")" has a matching "(" before it. Your function should ignore all other symbols that appear in `s`. Your function should return `True` if `s` has matched brackets and `False` if it does not. Here are some examples to show how your function should work.

```
>>>matched("zb%78")
True
>>> matched("(7)(a)")
False
```
4. In cryptography, a Caesar cipher is a very simple encryption techniques in which each letter in the plain text is replaced by a letter some fixed number of positions down the alphabet. For example, with a shift of 3, A would be replaced by D, B would become E, and so on. The method is named after Julius Caesar, who used it to communicate with his generals. ROT-13 ("rotate by 13 places") is a widely used example of a Caesar cipher where the shift is 13. In Python, the key for ROT-13 may be represented by means of the following dictionary:

```
key = {'a':'n', 'b':'o', 'c':'p', 'd':'q', 'e':'r', 'f':'s', 'g':'t', 'h':'u', 'i':'v', 'j':'w', 'k':'x', 'l':'y', 'm':'z', 'n':'a', 'o':'b',
'p':'c', 'q':'d', 'r':'e', 's':'f', 't':'g', 'u':'h', 'v':'i', 'w':'j', 'x':'k', 'y':'l', 'z':'m', 'A':'N', 'B':'O', 'C':'P', 'D':'Q',
'E':'R', 'F':'S', 'G':'T', 'H':'U', 'I':'V', 'J':'W', 'K':'X', 'L':'Y', 'M':'Z', 'N':'A', 'O':'B', 'P':'C', 'Q':'D', 'R':'E', 'S':'F',
'T':'G', 'U':'H', 'V':'I', 'W':'J', 'X':'K', 'Y':'L', 'Z':'M'}
```

Your task is to implement an encoder/decoder of ROT-13. Once you're done, you will be able to read the following secret message:

Pnrfnepvcure? V zhpucersrePnrfnefnynq!

5. A bank needs an application to keep track of the customer's account balance. The customer has name and balance as the attributes. Build the application to have a class customers, with the following methods:
 - set_balance
 - withdraw
 - deposit
 - check_balance
6. Define three classes: Bear , Rabbit , and Octothorpe . For each, define only one method: eats() . This should return 'berries' (Bear), 'clover' (Rabbit), or 'campers' (Octothorpe). Create one object from each and print what it eats.
7. Define a simple "spelling correction" function correct() that takes a string and sees to it that 1) two or more occurrences of the space character is compressed into one, and 2) inserts an extra space after a period if the period is directly followed by a letter. E.g. correct("This is very funny and cool.Indeed!") should return "This is very funny and cool. Indeed!" Tip: Use regular expressions!
8. HTMLParser which serves as the basis for parsing text files formatted in HTML (HyperText Mark-up Language) and XHTML. Write a program to illustrate all the methods in the parser class
9. Write a program to use DOM API's to parse movies.xml file. The phrase calls the parse(file [,parser]) function of the minidom object to parse the XML file designated by file into a DOM tree object.
10. Implement a function which lets you define parsers that take any input source (URL, pathname to local or network file, or actual data as a string) and deal with it in a uniform manner. Returned object is guaranteed to have all the basic stdio read methods (read, readline, readlines). Just .close() the object when you're done with it.

B18EC2050	Environmental Sciences	L	T	P	C
Duration:14 Wks		2	0	0	2

Prerequisites:

Basic knowledge of Environmental Science studied at higher secondary & school level.

Course Description:

Environmental Science is a multidisciplinary subject which includes various aspects from physics, chemistry,

Ecology, Biology, Earth science & Engineering etc. Environmental Studies includes the introduction to environment, Objectives & guiding principles of Environmental education, environmental ethics, Components of Environment, Impacts of Engineering/human activities on environment, Sustainable development, Role of individual and government in environmental Protection, and various topics related to environmental science imparted through this course.

Course Objectives:

The objectives of this course are to:

1. Discuss Foster clear awareness and concern about economic, social, political and ecological interdependence in urban and rural area
2. Influence the new patterns of behaviors of individuals, groups and society as a whole towards the environment
3. List the knowledge values, attitudes, commitment and skills needed to protect and improve the environment
4. Explain the environmental measures and education programs.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Adapt the environmental conditions and protect it
2. Estimate the role of individual, government and NGO in environmental protection.
3. Interpret the new renewable energy resources with high efficiency through active research.
4. Analyze the ecological imbalances and protect it.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
18EC2050	CO1	1			2	1	3	3			1	1	1		1	1
	CO2						3	3		1		1	1	1		1
	CO3		1			2	3	3			1		2		1	1
	CO4	1					3	3		1			1	1	1	

Course Contents:

Unit-1: Multidisciplinary Nature of Environmental Studies

[7 Hrs]

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

Environmental protection – Role of Government-Assignments of MOEF, Functions of central and state boards, 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 [7 Hrs] Environmental Pollution – Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile pollution-Causes, Effects & control measures.

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

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

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

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

Unit-4: Ecology and ecosystem [7 Hrs] **Ecology:** Definition, branches, objectives and classification, Concept of an ecosystem- Structure and functions, Characteristics of an Ecosystem-Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

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

Text Books:

1. R.J. Ranjit Daniels, Jagadish Krishnaswamy, M.S. Reddy, Chandrasekhar, “Environmental Studies” Wiley India Pvt. Ltd., New Delhi, 2017.
2. Benny Joseph, “Environmental Studies” Revised Edition, Tata McGraw Hill Publishing Company Limited, 2017.
3. Ashish Shukla, Renu Singh, Anil Kumar, “Environmental Science” Revised Edition, IK International Publishing

House Pvt. Ltd, 2018.

4. S. M. Prakash, "Environmental Studies" Elite Publishers Mangalore, 2017.
5. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies" Wiley India Private Ltd., New Delhi, 2009.
6. G. Tyler Miller, S. E. Spoolman, "Environmental Sciences" Cengage Learning, 14th Edition, 2015.

Reference Books:

1. Bharucha Erach, "The Biodiversity of India" Mapin Publishing Pvt. Ltd., Ahmedabad, India, 2017.
2. R. Rajagopalan, "Environmental Studies – from Crisis to cure" Oxford University Press, 2017.
3. Arvind Walia, "Environmental Science" Kalyani Publications, 2018.
4. H. Jadhav, V. M. Bhosale, "Environmental Protection and Laws" Revised Edition, Himalaya Pub. House, Delhi, 2018.
5. B.K Sharma, "Environmental Chemistry" Goel Pub. House, Meerut, 2018.

B18EC2060	Technical English - 2	L	T	P	C
Duration :14 Wks		0	0	2	2

Prerequisites:

Technical English- 1

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 Description:

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

Course Objectives:

The objectives of this course are:

1. To utilize the ability of using language skills effectively in real-life scenarios.
2. To develop the learners' competence in employability skills.
3. To improve the habit of writing, leading to effective and efficient communication.
4. To prioritize specially on the development of technical reading and speaking skills among the learners.

Course Outcomes:

On completion of the course, learners will be able to:

1. Organize their opinions clearly and meaningfully.
2. Demonstrate the ability to speak appropriately in social and professional contexts.

3. Build inferences from the text.
4. Take part in interviews confidently & develop accurate writing skills using different components of academic writing.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	P2	PO3	PO4	PO5	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC2060	CO1	0	1	0	0	0	0	3	3	0	0	3	0	0	0
	CO2	0	1	0	0	0	0	2	3	0	0	3	0	0	0
	CO3	0	3	0	0	0	0	2	3	0	0	3	0	0	0
	CO4	0	2	0	0	0		2	3	0	0	3	0	0	0

Course Contents:

Unit-1: Language Acquisition

[7P Hrs]

Grammar: Active and passive voice, **Listening & Speaking:** Listening to informal conversations and interacting, **Reading:** Developing analytical skills; Deductive and inductive reasoning, **Writing:** Giving Instructions; Dialogue Writing

Unit-2: Persuasive Skills

[7P Hrs]

Grammar: Compound words; Phrasal verbs, **Listening:** Listening to situation based dialogues
Speaking: Group Discussions, **Reading:** Reading a short story or an article from newspaper; Critical reading, **Writing:** Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives)

Unit-3: Cognitive Skills

[7P Hrs]

Grammar: Homonyms; homophones, **Listening:** Listening to conversations; Understanding the structure of conversations, **Speaking:** Presentation Skills, **Reading:** Extensive reading
Writing: Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions - interpretation of data using charts, PPT); Precis Writing

Unit-4: Employability Skills

[7P Hrs]

Grammar: Idioms; Single Word Substitutes, **Listening:** Listening to a telephone conversation; Viewing model interviews (face-to-face, telephonic and video conferencing), **Speaking:** Interview Skills, Mock Interviews, **Reading:** Reading job advert Semen's and the profile of the company concerned, **Writing:** Applying for a job; Writing a cover letter with Resume / CV

Text Books:

1. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Blackswan, 2013.
2. Raman, Meenakshi and Sangeeta Sharma. Technical Communication. Oxford University Press, 2015.
3. Thorpe, Edgar and Showick Thorpe. Objective English. Pearson Education, 2013.
4. Dixon, Robert J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd., 1988.
5. Turton, Nigel D. ABC of Common Errors. Mac Millan Publishers, 1995.
6. Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.

7. Kumar, E Suresh, J. Savitri and P Sreehari (ed). Effective English. Pearson Education, 2009.
8. Goodale, Malcolm. Professional Presentation. Cambridge University Press, 2013.

B18EC2070	Computer Aided Engineering Drawing (I)	L	T	P	C
Duration :14 Weeks		1	0	1	2

Prerequisites:

Basic Knowledge on geometry and their construction

Course Description:

Computer Aided engineering drawing is the primary medium for communicating engineering design. In this course, to begin with Students are trained on skills of Sketching, Scaling and Dimensioning. The students are introduced to orthographic projections and they are trained to draw orthographic projections of Points, Lines, Planes and Solids. They are further trained to draw Development of Lateral surfaces, Isometric Projections.

Course Objectives:

The objectives of this course are to:

1. Comprehend general projection theory, with emphasis on orthographic projection to represent in two-dimensional views.
2. Introduce dimension and annotation for two-dimensional engineering drawings.
3. Emphasize freehand sketching to aid in the visualization process to efficiently communicate ideas graphically and best practices applied in engineering graphics
4. Introduction of CAD software for the creation of 2D engineering drawings.

Course Outcomes:

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

1. Identify industry Drawings and able to develop independent thinking and problem solving capabilities
2. Express components descriptions as per the commonly practiced standards
3. Visualize 2D and simple 3D drawings of simple machine component.
4. Comprehend the computer aided drawing of simple objects/tools/instruments /elements/ structures belonging to the engineering field and industry specific drawings

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC2070	CO1	3	2	1		2								2	1	2
	CO2	3	2			1								1		2
	CO3	3	2	1		2								2		2
	CO4	3	3	2		3				2	1			3	2	3

Course Contents:

Unit – 1: Introduction to Drawing

[3L+7P]

Introduction to Engineering Drawing: Introduction, Drawing Instruments and their uses, BIS conventions, Drawing sheets, Dimensioning, regular polygons and their construction and brief introduction to solid edge software.

Projection of points: Points in different quadrants.

Projection of Straight Lines (First-angle Projection only): Parallel to one or both planes – Perpendicular to one plane and parallel to other plane, Inclined to one plane and parallel to the other, Inclined to both planes.

Projection of Planes: Types of Planes, Projection of Planes, perpendicular to VP and inclined to HP – Inclined to both the planes.

Unit – 2: Projection of Prisms

[4L+7P]

Square, pentagonal and hexagonal prisms, cylinder, Solids in simple position (only resting on HP on one of the base corner or base edge of solid), Axis parallel to VP plane and inclined to HP, Axis inclined to both plane (only change of position method).

Unit – 3: Projection of Pyramids

[3L+7P]

Square, pentagonal and hexagonal pyramids, cone, Solids in simple position (only resting on HP on one of the base corner or base edge of solid), Axis parallel to VP p and inclined to HP, Axis inclined to both plane (only change of position method).

Unit - 4: Development of Lateral surfaces of solids

[4L+7P]

Regular prisms and pyramids only.

Isometric Projection: Isometric axes, Lines and Planes, Isometric Scale, Isometric Projection of Planes, Prisms, Pyramids, Cylinders, Cone and Sphere, Combination of Solids (Maximum Two solids).

Text Books:

1. Dr. K S Narayanswamy and Prof.Mahesh L, “Text Book on Engineering Drawing”, REVA University, WILEY Publishers 2017.
2. N.D.Bhatt and V.M. Panchal “Engineering Drawing “, Charotar Publishing, 48th Edition, 2005.
3. K.R. Gopalakrishna “Engineering Graphics”, Subhas Publishers, 32nd Edition, 2005.

Reference Books:

1. P. S. Gill “Engineering Drawing”, S. K. Kataria& Sons, 11th Edition, 2001.
2. K L Narayan and P Kannaiah, “Engineering Drawing”, Scitech Publications, 2015.

B18EC2080	Analog Electronics Lab	L	T	P	C
Duration: 14 Weeks		0	0	2	2

Prerequisites:

Course Description:

Analog Electronics lab is first step in the design of Amplifiers for the ECE students. The practical design aspects of various amplifiers is introduced and measurements are taken. Power amplifiers are designed and the efficiency is measured. The concepts of positive feedback amplifiers is also introduced by designing various oscillators. The students also design the circuits using simulators.

Course Objectives:

The objectives of this course are to:

1. Understand and estimate the gain and input/output resistances of single and two-stage amplifiers.
2. Perform DC and AC analysis of the BJT amplifier and understand the bode plots.
3. Learn different biasing techniques and behavior of BJT amplifiers, at low and high frequencies.
4. Understand the principle of operation of different oscillator circuits.
5. Simulation and design of electronic circuits using SPICE or other analog simulator.

Course Outcomes:

On completion of this course the student will be able to:

1. Design different BJT negative and positive feedback amplifiers.
2. Design and Assess the amplifier parameters like gain, BW, Zin and Zout, efficiency, etc.
3. Compile the experiment's procedures and results by writing a formal report.
4. Analyze all the above experiments using suitable simulation software.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC20 80	CO1	3	2	1		3								1	2	1
	CO2				1					3					2	1
	CO3					3				3	3	1		2		1
	CO4	2	2	1		3										1

Lab Experiments

1. Design a Single stage BJT CE Amplifier and obtain frequency response curve and find Bandwidth, Input & Output Impedances.
Challenging Experiment: Connect above amplifier to Analog Discovery Module & find frequency response curve.
2. Design a Two stage voltage series BJT Amplifier and Obtain frequency response curve, also find Bandwidth, Input & Output Impedances
3. Design a CE mode Cascode amplifier and plot frequency response. Also find Gain & Bandwidth.
4. Design a Class - C tuned Amplifier & find its Efficiency.
Challenging Experiment: Find Frequency response of Class - C tuned Amplifier by using Analog Discovery Module.

5. Design a BJT Darlington emitter follower and find Gain, Input & Output Impedances.
6. Rig-up an R-C Phase Shift oscillator for $f_o \leq 10$ KHz & Crystal oscillator for $f_o > 1$ MHz.
7. Design a BJT Hartley & Colpitt's Oscillators for frequency ≥ 100 kHz & simulate the circuit in Multisim.
8. Demonstrate the working of Class-B push pull power amplifier using transistors find its Efficiency & also simulate the same in Multisim.
9. Design an OPAMP Inverting & Non Inverting Amplifier.

Challenging Experiment: Conduct the Experiment by using Analog Discovery Module.

10. Mini Project.

B18EC2090	Chemistry Lab	L	T	P	C
Duration : 14 WKS		0	0	2	2

Prerequisites:

Students taking this course shall have the knowledge of the following:

Handling glassware, apparatus, Acids, Bases toxic chemicals and safety precautions in the laboratory. Chemical awareness and basic chemical reactions.

Course Description:

Engineering chemistry lab provides the very basic knowledge required for engineering students to understand its importance in technology and practical life. It provides the knowledge of quantum mechanics, battery technology its importance and applications. It also provides knowledge about corrosion science, construction of PCB's and engineering materials, testing the chemicals in laboratory etc.

Course Objectives:

The course objectives are to:

1. Distinguish qualitative and quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence
2. Analyze different instrumental and titrimetric methods for estimation of the samples

Course Outcomes:

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

1. Analyze the amount of material present in the sample by different instrumental methods.
2. Evaluate the amount of oxygen demand, alkalinity, and hardness of the different water samples.
3. Estimate impurities in water.
4. Test the ions present in unknown substance/ores using titrimetric and instrumental metals

Mapping of Course Outcomes with Program Outcomes

Course Code	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

B18EC209 0	CO1	1	1	1	1		2					1	1		
	CO2	1		1			2	2				1			
	CO3	1	1				2	2				1			1
	CO4	1	2	1			1	1				1			1

List of Experiments	
1.	Potentiometric Estimation of Mohrs salt.
2.	Colorimetric estimation of copper.
3.	Conductometric estimation of acid mixture using standard NaOH.
4.	Determination of pKa of given weak acid using pH meter.
5.	Determination of viscosity co-efficient of a given organic Liquid.
6.	Determination of total hardness of the given water sample.
7.	Determination of calcium oxide in the given cement sample.
8.	Determination of COD of the given waste water sample.
9.	Determination of percentage of copper in the given brass sample.
10	Determination of iron in the given sample of Haematite ore using Potassium dicromate.
11	Estimation of Alkalinity of the given water sample using standard HCl solution
12	Flame photometric estimation of sodium in the given water sample.
13	Electroplating of Copper and Nickel.
14	Determination of Calcium in a milk sample.

Text Books:

1. P.W. Atkins, "Physical Chemistry". Oxford University press, UK, 2018.

2. S. Agarwal, "Engineering Chemistry: Fundamentals and Applications". Cambridge University Press, UK, 2015.

Reference books:

1. S.S. Dara , "A text book on experiments and calculation in Engineering". S. Chand and company Pvt Ltd, 2008.
2. Gurdeep Chatwal, Sham Anand, "Instrumental methods of chemical analysis" , Himalaya Publications, 1984.

DETAILED SYLLABUS

Semester III:

B18EC3010	Engineering Mathematics – III	L	T	P	C
Duration: 14 Weeks		2	1	0	3

Prerequisites:

Engineering Mathematics –I & II

Course Description:

Fourier series, Fourier transform, Z-transform and application of Z-transform are used to solve difference equations. This course is widely used in all streams of Engineering, particularly in the field of Electronics and Communication Engineering, for ex., Fourier series is used in transmission and processing of digital signals, it can transform time domain into frequency domain and this domain is used as a mathematical tool to analyze the signals, Z-transform is used to simulate the continuous system, etc.

Course Objectives:

The objectives of this course are to:

1. To apply the knowledge of Fourier series and few of its applications.
2. To apply Fourier transform and Z-transform concepts to solve various engineering problems related to time domain.
3. Study the elements of complex variables and fundamental concepts such as analytic functions, complex integrals, Taylor series and Laurent series.
4. To apply the knowledge of Vector spaces, Basis and dimension.

Course Outcomes:

After the completion of the course the student will be able

1. To apply the knowledge of Fourier series and few of its application.
2. To apply Fourier transform and Z-transform concepts to solve various engineering problems related to time domain.
3. To demonstrate knowledge of integration in the complex plane, use the Cauchy integral theorem and Cauchy integral formula, manipulate and use power series, understand residues and their use in integration.
4. To apply the knowledge of vector spaces in the field electronics engineering.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COs	PO 1	Po 2	PO 3	PO 4	PO 5	PO 6	Po 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
B18EC3010	CO1	3	3	2	1					3			3	3	2	1
	CO2	3	3	3	1					3			3	3	2	1
	CO3	3	3	3	1					3			3	3	2	1
	CO4	3	3	3	1					3			3	3	2	1

Course Contents:

Unit-1 Fourier series

[7L+7T Hrs]

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-2: Fourier Transform and Z -Transform

[7L+7T Hrs]

Infinite Fourier Transform, Fourier sine and cosine transforms, properties, inverse transforms and evaluation of integrals. 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.

Unit-3: Complex Analysis

[7L+7T Hrs]

Function of a complex variable, Analytic functions-Cauchy-Riemann equations in Cartesian and polar forms (no proof). Properties of analytic functions.

Complex line integrals-Cauchy's theorem, Cauchy's integral formula. Taylor's and Laurent's series. Poles and residues, residue theorem(no Proof) problems.

Unit-4 : Vector spaces

[7L+7T Hrs]

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.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd 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.

B18EC3020	Linear integrated circuits	L	T	P	C
Duration:14 Weeks		3	0	0	3

Prerequisites:

Basic Electronics, Analog Electronic Circuits, Basics of OP-AMP

Course description

This course is basically a study of the characteristics, operations, stabilization, testing, and feedback techniques of linear integrated circuits. The course includes applications in computation, measurements, instrumentation, and active filtering.

Course Objectives:

The objectives of this course are to:

1. Interpret and explain frequency response and compensation techniques of Operational amplifier.
2. Illustrate how operational amplifiers can be used in linear and nonlinear applications.
3. Introduce the concepts of waveform generation and introduce some special function ICs.
4. Explain and introduce the theory and applications of analog multipliers, PLL, voltage regulators, IC555 timer applications.
5. Introduce the basic building blocks of linear integrated circuits and explain System design.

Course Outcomes:

On completion of this course the student will be able to:

1. Examine the stability of an op-amp circuit using frequency compensation techniques.
2. Design and simulate op-amp circuits for linear and non-linear applications.
3. Apply experience in building and trouble-shooting simple electronic analog and digital circuits(PBL)
4. Analyze systems like PLL, counters , Converters, frequency synthesizers function generators for simple applications.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC3020	CO1	3	2	1		3								1	2	1
	CO2				1	3									2	1
	CO3					3				3	2	1		1		3
	CO4	2	2	1		1										1

Course Contents:

Unit -1: OP-AMPS Frequency Response, Compensation and applications

[11 Hrs]

Circuit stability, frequency and phase response, frequency compensating methods, bandwidth, and slew rate effects, Z_{in} mod compensation.

Linear Applications: Voltage sources, current sources and current sinks, Current amplifiers, Instrumentation amplifier, precision rectifiers,

Unit -2: Non-linear applications of ICs**[10 Hrs]**

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**[10 Hrs]**

Series op-amp regulator, IC voltage regulator, 723 general purpose regulators, 555 timer-basic timer circuit, 555 timer used as Astable and Monostable multivibrator, Basic block of PLL, Applications of PLL.

Unit-4: System design using ICs**[11 Hrs]**

System design Principles, Frequency counter, DACs and ADCs, Digital voltmeter, Digital programmable frequency generator, frequency synthesizer, function generator, Display system design, Traffic controller design.

Text Books:

1. D. Roy Choudhury and Shail B Jain, " Linear Integrated Circuits", New Age International, 2nd edition, 2006
2. David A Bell, "Operational amplifiers and Linear ICs", PHI/Pearson, 2nd edition, 2004
3. B. S. Sonde, " Introduction to System Design Using Integrated Circuits", New Age International, 1992,

Reference Books:

1. Thomas L. Floyd, David Buchla, "Basic Operational Amplifiers and Linear Integrated Circuits", Prentice Hall, 1999
2. Gayakwad, "Op-amp and linear Integrated circuits", , Pearson, 4th edition, 2004
3. Bruce Carter," Op Amps for Everyone", ISBN: 978-0-12-391495-8, Fourth Edition.
4. BIS, ISO standards and Datasheets

B18EC3030	Digital Electronics & VHDL	L	T	P	C
Duration :14Wks		3	1	0	4

Prerequisites:

Number system, Logic gates, Boolean algebra

Course Description

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.

Hardware Description Language (HDL) is a computer –Aided Design tool for modern design and synthesis of digital systems. Due to the complexity in design of digital systems, such systems cannot be realized using discrete integrated circuits. They are usually realized using high density, programmable chips, such as Field

programmable Gate Arrays (FPGAs). 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 using VHDL

Course Objectives:

The objectives of this course are to:

1. Provide the basics behind the digital circuit design in terms of all the necessary building blocks.
2. Illustrate Boolean laws and systematic techniques for minimization of expressions.
3. Introduce the Basic concepts of combinational and sequential logic.
4. Provide foundations of different styles of descriptions in HDLs.
5. Highlight the Design techniques of digital modules by using different styles of HDL descriptions.

Course Outcomes:

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

1. Design digital circuits using gates, encoders, decoders, multiplexers and de-multiplexers
2. Interpret the output and performance of given combinational and sequential circuits.
3. Summarize the different styles of VHDL programming and its applications.
4. Distinguish VHDL models for realizing combinational and sequential circuits

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC303 0	CO1	2	3	1							3			2		3
	CO2		2	3	1	3					3	3		2		3
	CO3	2	1		2	3					3			2		3
	CO4	1		2	3	2					3	3		2		3

Course Contents:

Unit -1: Principle and Minimization Techniques of combinational Circuits [10L+7T]

Introduction to combinational logic circuits, generation of switching equation from truth table. Minimization Techniques: Boolean algebra, expression minimization. Min-term, Max-term, Sum of Products (SOP), Product of Sums (POS), Karnaugh map, incompletely specified functions, Introduction to Digital Logic Families.

Analysis and Design of Combinational Circuits

Adder/Subtractor, Carry Look Ahead adder, BCD adder. Principle of Encoder and Decoder with cascading of decoders. Principle of Multiplexers and Demultiplexer with cascading of Mux and Boolean function implementation using Mux and decoders, Comparators.

Unit -2: Introduction to Sequential circuits [11L+7T]

Basic bi-stable element, S R Latch, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation. Registers, Shift Register, Counters: Binary Ripple Up/Down Counter, Design of synchronous Mod- n counter using flip-flop.

Design & Applications of Digital Circuits

Sequential Design: Introduction to Mealy and Moore Model circuits. State machine notation, Synchronous sequential circuit analysis and construction of state table and diagram. Case study: sequence generator.

Unit -3: VHDL Programming concepts

[10L+7T]

Structure of VHDL Program, Operators, Data types, Types of Descriptions: Data Flow description, Behavioral Description, Structural Description

Data Flow Description:

Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type –Vectors, Programs based on Data Flow Description.

Unit -4: Introduction to Behavioral Description

[11L+7T] Highlights of

Behavioral Description, Structure of HDL Behavioral Description, Introduction to The VHDL Variable–Assignment Statement and Introduction to formats of sequential statements with examples. Programs Based on Behavioral Description and Booth algorithm.

Structural Description: Highlights of Structural Description, Organization of the Structural Description,

Text Books:

1. John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 1st Edition, 2001.
2. Nazeih M Botros ,“HDL Programming : VHDL and Verilog” Dreamtech Press, 6th Edition 2006

Reference Books:

1. Samir Palnitkar “Verilog HDL”--Pearson Education
2. Douglas perry “VHDL”--Tata McGraw-Hill
3. J Bhaskar “A Verilog HDL Primer”-- BS Publications
4. Volnei A pedroni “Circuit Design with VHDL”--PHI
5. Donald D Givone, “Digital Principles and Design”, Tata McGraw-Hill 1st Edition, 2002.
6. D P Leach, A P Malvino, & Goutham Saha, “Digital Principles and applications”, Tata McGraw-Hill, 7th Edition, 2010.
7. Moshe Morris Mano, “Digital Design” Prentice Hall, 3rd Edition, 2008.
8. Chales H Roth, Jr., “Fundamentals of Logic Design”, Cengage learning, 5th Edition, 2004

B18EC3040	Signals and Systems (I)	L	T	P	C
Duration :14Wks		2	1	1	4

Prerequisites:

Differential and Integral Calculus, Geometric Series.

Course Description:

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 to:

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

Course Outcomes:

On completion of this course the student will be able to:

1. Illustrate the operations on Signals and summarize the properties of Systems.
2. Apply Convolution operation on an LTI System.
3. Represent continuous time periodic signals in frequency domain using Fourier technique.
4. Represent the discrete time signals in Z-domain and determine the behavior of Causal LTI system using properties of Z-Transform.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/COs	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
B18EC304 0	CO1	3	2	1	1					3	1				2	3
	CO2	3	3	2	1					3	1				2	
	CO3	3	2	1	1					3	1	1				3
	CO4	1	3	1						3	1	1			1	2

Course Contents:

Unit-1: Introduction to Signals and Systems

[7 L+7T+7P]

Definitions of a signal and system, Elementary signals, Basic operations on signals, Classification of signals.

Unit-2: Analysis of Linear Time Invariant System

[7 L+7T+7P]

Properties of systems. Time domain representation of LTI system: Impulse response representation, Convolution Sum, Convolution Integral.

Unit-3: Fourier Representation for Aperiodic signals

[7 L+7T+7P]

Fourier Representation of Periodic Signals: Introduction to CTFS and DTFS, definition.

FT representation of aperiodic CT signals – FT definition, FT of standard CT signals, Properties of FT, Inverse FT.

FT representation of aperiodic discrete signals-DTFT definition.

Application of FT: Solving differential equations, Sampling theorem and reconstruction of signals.

Unit-4: Z-Transforms

[7L+7T+7P]

Introduction, Z – transform, Properties of ROC, properties of Z – transforms, Inversion of Z – transforms, transform analysis of LTI Systems, Unilateral Z-Transform and its application to solve difference equations.

Text Book:

1. Simon Haykins, “Signals and Systems”, John Wiley, India Pvt Ltd, Second Edition, 2008.

Reference Books:

1. Michael Roberts, “Fundamentals of signals and systems”, TATA McGraw Hill, Second Edition ,2010
2. Allan V. Oppenheim, S. Wilsky and S. H. Nawab, “Signals and Systems”, Pearson Education, Second Edition, 1997.
3. D. Ganesh Rao and Satish Tunga, “Signals and Systems”, Pearson/Sanguine Technical Publishers, 2004
4. Uday Kumar S. “Signals and Systems”, Prism books Pvt. Ltd, 6th Edition 2015

Signals and Systems Lab Experiments

List of Experiments to be done using MATLAB/Octave/Scilab

Introduction to MATLAB/ Octave

1. a) Generation and Plotting of Sine Waves
b) Generation and Plotting of Elementary Signals
2. Perform Operations on Dependent Variable of a Signal.
3. Perform Operations on Independent Variable of a Signal.
4. To Calculate Signal Power and Signal Energy
5. To Compute the Linear Convolution of The Given Input Sequence $x(n)$ & The Impulse Response of The System $h(n)$. (Causal Sequences)
6. To Compute the Linear Convolution of The Given Input Sequence $x(n)$ & The Impulse Response of The System $h(n)$. (Non-Causal Sequences)

7. Solve Any Given Difference Equation of An LTI System Without Initial Conditions.
8. Solve Any Given Difference Equation of An LTI System with Initial Conditions.
9. Representation of LTI systems in MATLAB.
10. a) Fourier synthesis of square wave in MATLAB
b) Fourier synthesis of a triangular wave in MATLAB
11. Demonstration of Sampling Theorem

B18EC3050	Network Theory	L	T	P	C
Duration:14 Weeks		2	1	0	3

Prerequisites:

Ohm's Law, KVL, KCL, Calculus, Cramer's rule, Basic concepts on passive elements, Laplace transforms.

Course Description:

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.

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. Construct an analysis strategy to determine a particular transient response of an electrical network.
4. Analyse the excitation response of the electrical network and the techniques for characterizing the networks using network parameters.

Course Outcomes:

On completion of this course the student will be able to:

1. Evaluate the branch currents and node voltages of any given electrical circuit by the application of super-mesh, super-node and various network theorems.
2. Determine branch voltage and node current by drawing cut set schedule and tie set schedule of electrical circuit.
3. Analyse transient behaviour of electrical circuit by applying Laplace Transforms.
4. Determine the condition of resonance for series/parallel RLC circuits and to model the circuit as two port networks.

Mapping of Course Outcomes with Program Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC3050	CO1	3	3	3						3	1			1	1	2
	CO2	3	3	3						3	1			1	1	2
	CO3	3	3	3						3	1	1		1	1	2
	CO4	3	3	3						3	1	1		1	1	2

Course Contents:

Unit-1: Network Analysis Techniques

[8 L+ 7 T]

Concepts of super node and super mesh for ac and dc networks, Network Theorems: Superposition theorem, Thevenin's & Norton's theorem, Maximum power transfer theorem and Reciprocity theorem for ac and dc networks. Numerical examples on each topic. (Text 1: Ch 4 & 5)

Unit-2: Network Graph theory

[8 L+ 7 T]

Concept of network graph, Terminology used in network graph, relation between twigs and links, properties of tree in a graph, formation of incidence matrix, number of trees in a graph, cut-set matrix, tie-set matrix, Network equilibrium equations. Procedure to find branch voltages and branch currents, Principle of duality. Numerical examples on each topic. (Text 2: Ch16, Text 1: Ch17)

Unit- 3: Transient Analysis using Laplace transforms

[8 L+ 7 T]

A procedure for evaluating initial conditions, Initial & Final State of a network element, Transient response of passive circuits. Time-domain to s-domain transformation, Definition and properties of Laplace transform, Application of Laplace transform technique for analysis of R-L-C circuits, step response of series R-L & series R-C circuit, impulse response of series R-L & series R-C network. Numerical examples on each topic. (Text2: Ch 8 & 9)

Unit-4: Resonant Circuits and Two Port Networks

[8 L+ 7 T]

Resonance-Series R-L-C circuit (derivation of resonant frequency, bandwidth, quality factor, expression for upper and lower cut off frequencies, relation between Q, BW & f_r), Parallel resonance of R-L-C circuit (derivation of resonant frequency, bandwidth, quality factor, expression for upper and lower cut off frequencies), Condition for resonance of two branch parallel RC-RL circuit. Numerical examples on each topic. (Text 2: Ch 4) Two port network parameters: Definition of z, y, h and transmission parameters, and relationship between parameters. Numerical examples on each topic. (Text 1: Ch 17)

Text Books:

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

Reference Books:

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

B18EC3070	Linear Integrated Circuits Lab	L	T	P	C
Duration:14 Weeks		0	0	2	2

Prerequisites:

Electronic Circuits

Course Description:

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 to:

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:

On completion of this course the student will be able to:

1. Design and test amplifiers, precision rectifiers, filters and waveform generators.
2. Experiment with as part of a team effectively.
3. Compile the experiment's procedures and results by writing a formal report
4. Demonstrate linear and non linear applications using simulator tools.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC2070	CO1	3	2	1		3								1	2	1
	CO2				1					3					2	1
	CO3					3				3	3	1		2		1
	CO4	2	2	1		3										1

Lab Experiments

1. Study the characteristics of negative feedback amplifiers and design of Instrumentation amplifier.

2. Designing and testing of second order low pass filter and high pass filter
3. Design of second order band pass.
4. Designing and testing of Schmitt Trigger circuit for the given values of UTP and LTP
5. Designing and testing of Astable multi-vibrator circuits using IC 555 for given frequency and duty cycle
6. Designing and testing of PLL.
7. Design a function generator and convert it into VCO/FM generator.
8. Designing and testing of a rectangular and triangular wave generator.
9. Designing and testing of integrator and differentiator circuit.
10. Designing and testing of a voltage regulator circuit using op-Amp

B18EC3080	Digital Electronics and VHDL Lab	L	T	P	C
Duration :16Wks		0	0	2	2

Prerequisites:

Number system, Fundamentals of Digital Electronics, programming skills.

Course Description:

Electronics is classified based on the type of signal/information into 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 into Combinational Logic/Circuits and Sequential Logic/Circuits.

Hardware Description Language (HDL) is a computer-Aided Design tool for modern design and synthesis of digital systems. Due to the complexity in design of digital systems, such systems cannot be realized using discrete integrated circuits. They are usually realized using high density, programmable chips, such as Field programmable Gate Arrays (FPGAs).

The two widely used hardware description languages are VHDL and Verilog. 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 to:

1. Design, realization and verification of Boolean Theorems, logic expressions
2. Realize various arithmetic, data path modules, memory modules
3. Understand the FPGA design flow
4. Simulate, synthesize various digital blocks by using Verilog code

Course Outcomes:

On completion of this course the student will be able to:

Ref: RU/BoS/ECE/CEC/June-2018-6

1. Demonstrate circuits using combinational gates/MSI chips
2. Develop and debug the codes for various digital combinational and sequential blocks
3. Implement and analyze the digital blocks on the targeted FPGA device

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC308 0	CO1	2		1	3						3	3			1	2
	CO2	2		3	1	3					3	3			1	2
	CO3	1		2	3	3					3	3			1	2

Lab Experiments

1. Realization of parallel Adder and Subtractor.
2. Realization of 3 bit Binary to Grey code conversion and vice versa using basic/Universal gates.
3. Realization of 4:1 MUX and 1:4 DEMUX using basic/universal gates.
4. Arithmetic circuit realization (Half/Full, Adder/Subtractor) using MUX.
5. Construction and verification of JK master slave, T, D flip flop using logic gates.
6. Construction and realization of n- bit ripple up/down counter using IC 7476 and other logic gates.
7. Design and verification of n-bit synchronous counter using 7476 JK, T and D flip flops.
8. Write a VHDL program for the following modules.
 - a. Decoder
 - b. Encoder with and without priority
 - c. Multiplexer
 - d. De-multiplexer
 - e. Comparator
9. Write a VHDL code to describe function of full adder in data flow, behavioral and structural style
10. Write VHDL code for a 4-bit binary, BCD counters with synchronous and asynchronous reset
11. Write a HDL code to control speed and directions of a Stepper motor

Demo experiments

12. Write a HDL code to generate waveforms of different frequency and amplitude using a DAC.
13. Simulation of digital circuit

DETAILED SYLLABUS

Semester IV:

B18EC4010	Engineering Mathematics – IV	L	T	P	C
Duration: 14 Weeks		2	1	0	3

Prerequisites:

Engineering Mathematics : Fourier transform, Fourier Series, Z Transform

Course Description:

This course introduces probability, distributions and statistics with applications. Topics include: Mean, Median, Mode, Correlation, Curve fitting, Random variables, Probability distributions, Joint densities, Hypothesis testing. Probability theory deals with many real-life problems, which either inherently involves the chance phenomena or describing the behavior of the system explicitly with statistical properties. Interpretation of the system behavior in many engineering and computing sciences depends on concept probability and statistics that familiarize with the computational aspects. The course deals with basic properties of various distributions and other related things.

Course Objectives:

The objective of this course is to:

1. Solve algebraic and transcendental equation, interpolation, differentiation and integration using Numerical methods.
2. Solve the first order differential equations using different numerical techniques.
3. Expose the students to probability theory and random processes essential for their subsequent study of analog and digital communication.
4. Illustrate sampling distributions, test of hypothesis for means, Student's t-distribution and Chi-square distributions and joint probability distributions.

Course Outcomes:

After the completion of the course the student will be able

1. To apply the knowledge of finite differences in the fields of engineering
2. Solve the simultaneous 1st order ODE, 2nd order ODE and PDE using numerical Techniques.
3. To solve the problems of Probability and statistics.
4. To apply Sampling Theory and joint probability distributions concepts to solve various Engineering problems.

Mapping of Course Outcomes with Program Outcomes

Course Code	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	PSO 1	PSO2	PSO3
B18EC 4010	CO1	3	3	3	2					3			3	3	2	1
	CO2	3	3	3	1					3			3	3	2	1
	CO3	3	3	3	1					3			3	3	2	1
	CO4	3	2	3	2					3			3	3	2	1

Course Contents:

Unit -1: Numerical Methods –I

[6L+7T]

Solution of algebraic and Transcendental equation-Regula- falsi method, Newton -Raphson method. Finite differences and Interpolation :-Forward and Backward differences , Newton’s forward and Backward interpolation formulae, Divided differences-Newton’s divided difference formula, Lagrange’s Interpolation formula and Inverse Interpolation formula and Problems.

Numerical Differentiation:-Derivatives using Newton’s forward and backward difference formula.

Numerical Numerical Integration: Trapezoidal Rule, Simpson’s 1/3rd, 3/8th Rule, Weddle’s formula and Problems.

Unit -2: Numerical Methods –II

[6L+7T] Numerical

solutions to ODE: Solution of First order and first degree ODEs- Picards Method , Modified Euler’s method , Runge-Kutta method of fourth order, Milne’s Predictor-corrector method.

Numerical solution of simultaneous first order ODE: Picard’s and Runge-Kutta method of fourth order.

(ii) Numerical solution of second order ordinary differential equations, Picards method, Runge-Kutta method, Milne’s predictor-corrector method.

Unit-3: Probability and Statistics

[7L+7T]

Mean, Mode, Median and standard deviation. Correlation, Coefficient of correlation and lines of regression.

Random variables (discrete and continuous), Probability density function, probability distribution – Binomial, Poisson’s, Exponential and Normal distributions and problems.[without proof for mean & SD for all distributions]

Unit-4: Sampling theory & Joint Probability distribution

[7L+7T]

Sampling, Sampling distributions, standard error, test of hypothesis for means and confidence limits, Student’s t-distribution and Chi-square distributions.

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

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.

B18EC4020	Analog Communication	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

Fourier Transform, Gaussian Process, Correlation and Co-variance function.

Course Description:

This course provides the basics of analog communication systems such as amplitude modulation and demodulation, DSB-SC modulation and demodulation, SSB and VSB modulation and demodulation. Later, comparison of various modulation schemes is carried out to differentiate all amplitude modulation schemes. Frequency division multiplexing and frequency translation are demonstrated with block diagram. Angle modulation and demodulation techniques are illustrated to provide a better insight of the course. Finally, the course provides introduction to noise and analyze the receiver model in presence of the noise. This fundamental knowledge on analog communication helps to explore and apply the techniques in design of various analog communication systems.

Course Objectives:

The objectives of this course are to:

1. Introduce the various Analog modulation & demodulation schemes.
2. Sketch the time domain and frequency domain description of Analog modulation schemes.
3. Present the concept of Phase locked loop (PLL).
4. Introduce the fundamental concepts of noise in communication systems and demonstrate the receiver model in presence of noise.

Course Outcomes:

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

1. Apply Fourier analysis to communication signals.
2. Analyze and differentiate types of modulators Such as AM, DSBSC, SSB, VSB and FM.
3. Apply the concept of Phase locked loop in FM detection.
4. Compute PSD, SNR, Figure of Merit for different Modulation techniques.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO	PO	PO	PO	PO	PO	P	PO	PO	P	P	P	PSO	PSO	PSO
		1	2	3	4	5	6	O	8	9	O	O	O	1	2	3
B18EC4020	CO1	1			4									1		
	CO2		2	3											2	3
	CO3		2	3												3
	CO4	1	2											1		

Course Contents:

Unit -1: Amplitude Modulation

[10 Hrs]

Introduction, AM: Time-Domain Description, Frequency–Domain Description. Generation of AM Wave: Square Law Modulator, Detection of AM Waves: Envelope Detector. Double Side Band Suppressed Carrier Modulation (DSBSC): Time-Domain Description, Frequency-Domain Representation. Generation of DSBSC Waves: Balanced Modulator, Coherent Detection of DSBSC Modulated Waves, Costas Loop.

Unit -2: Single Side-Band Modulation (SSB) and Vestigial Side-Band Modulation (VSB) [11 Hrs]

Quadrature Carrier Multiplexing, Single Side-Band Modulation, Frequency-Domain Description of SSB Wave, Phase Discrimination Method for Generating an SSB Modulated Wave. Demodulation of SSB Waves, VSB: Frequency Domain Description, Generation of VSB Modulated Wave, Coherent detection of VSB, Comparison of Amplitude Modulation Techniques. Frequency Division Multiplexing, Superheterodyne Receiver.

Unit -3: Angle Modulation and Demodulation

[10 Hrs]

Basic Definitions, FM, PM, Narrow Band FM, Wide Band FM(with Bessel function), Transmission Bandwidth of FM Waves, Generation of FM Waves: Indirect FM And Direct FM. Demodulation of FM Wave- Balanced Frequency discriminator, Phase Locked Loop, 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 [11 Hrs]

Introduction, Autocorrelation and power spectral density, Mean, co-variance, 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 DSB-SC Receivers, Pre-Emphasis And De-Emphasis in FM.

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 Books:

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

B18EC4030	Electromagnetic Field Theory	L	T	P	C
Duration: 14 Wks		2	1	0	3

Prerequisites:

Knowledge of Vector algebra and calculus, Basics of physics on Electrostatics and Magnetism.

Course Description:

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.

Course Objectives:

The objectives of this course are to:

1. Explain different coordinate systems and apply them appropriately to study the laws of electromagnetics.
2. Solve boundary conditions and compute various circuit parameters.
3. Execute Maxwell's equations for various applications.
4. Demonstrate the idea of electromagnetic waves and their behavior in different medium and at plane boundaries.

Course Outcomes:

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

1. Explain the physical quantities of electromagnetic fields in different media using the fundamental laws.
2. Analyze and compute various circuit parameters at boundaries of various media.
3. Relate Maxwell's equations and justify the use of electromagnetic waves in various applications.
4. Examine and Compare the behavior of uniform plane waves in different mediums with planar boundaries.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC4030	CO1	3	3	2											2	
	CO2	3	3	2											2	3
	CO3	3	3	3	3						2				3	
	CO4	3	3		3						3				3	

Course Contents:

Unit-1: Static Electric Fields Gauss law and Divergence

[9L+7T]

Introduction to co-ordinate system, Rectangular Cylindrical and Spherical, The experimental law of Coulomb. Electric Field Intensity field of line charge, Electric flux density, Gauss Law, Applications of Gauss Law, Some symmetrical charge distributions, Differential volume element, Concept of divergence. Solve the relevant problems.

Unit-2: Energy Potential, Poisson's and Laplace's Equations**[5L+7T]**

Definition of Electric potential, work, Energy potential difference, Potential field of different types of charges, Potential gradient, Energy density in the electric field, Capacitance, Derive boundary conditions for electric field, Derivations of Poisson's and Laplace equation uniqueness theorem solutions of Laplace's and Poisson's equation.

Unit-3: Magnetic Fields and Maxwell's Equations**[9L+7T]**

Biot Savart Law, Ampere's circuital law, Curl, Stoke's Theorem, Magnetic flux and magnetic flux density, The scalar and vector magnetic potentials, Derive boundary conditions for magnetic field, Time varying fields and Maxwell's equations: Faradays law, displacement current, Maxwell's equations in point and integral forms, retarded potentials

Unit-4: Uniform Plane wave and Dispersive Media**[5L+7T]**

Wave propagation in free space and dielectrics, Poynting's theorem and wave power, propagation in good conductors, skin effect, reflection of uniform plane waves at normal incidence, SWR, Plane wave propagation in general direction.

Add on: Demonstrations using MATLAB for any topics of all units.

Text Book:

1. William H.Hayt, Jr and John A. Buck., "**Engineering Electromagnetics**", Tata McGraw-Hill Publishing Ltd, 8th edition, 2012.

Reference Books:

1. Edward Jordan and Balmain. K. G., "Electromagnetic Waves and Radiating Systems", Pearson Education, 2nd edition, 2001.
2. Matthew N. Sadiku. O, "Elements of Electromagnetics", Oxford University Press, 3rd Edition, First Indian edition, 2006.
3. John D. Kraus, "Electromagnetics", McGraw Hill book Company, New York, 4th edition, 1991.

B18EC4040	Microcontrollers and Applications	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Number system, combinational circuits, sequential circuits

Course Description:

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 Raspberry Pi, ATMEGA, TI and PIC that are used in industrial and automation applications.

Course Objectives:

Course objectives 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:

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

1. Describe the Architecture of 8051 microcontroller.
2. Describe Instruction Set of 8051
3. Calculate Program Execution Time
4. Write Assembly and C Programs for 8051.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC4040	CO1	3	2	1	1	3									2	1
	CO2				1	3									2	1
	CO3										2	1	2			
	CO4	2	1	3	3						2	3	1		1	2

Course Contents:

Unit -1: 8051 Architecture, Addressing Modes

[10 Hrs]

Introduction to Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von Neumann CPU architecture. The 8051 Architecture, Memory organization, Addressing Modes, Data transfer Instructions, Stack, Assembly language programs.

Unit -2: Instruction Set, Interrupts

[11 Hrs]

Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instruction. Assembler Directives. Instruction delay calculations.

Basics of interrupts, 8051 interrupt structure. Assembly and C programs.

Unit -3: Introduction to Timers/counters and Serial Communication.

[11 Hrs]

Introduction to Timers and Counters, Timer delay calculations,

Ref: RU/BoS/ECE/CEC/June-2018-6

Serial Communication: Data communication, connections to RS-232, UART. Timers/counters, Interrupts and Serial communication programming in Assembly and C.

Unit -4: Interfacing and Applications

[10 Hrs]

8051 Memory Interfacing, Interfacing 8051 to LCD, parallel and serial ADC0804, DAC, Stepper motor and DC Motor, Interfacing Programming in C.

Add on: Overview of microcontroller families and their applications

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.

Reference Books:

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

B18EC4050	Control Systems (I)	L	T	P	C
Duration :14 Wks		2	1	1	4

Prerequisites:

Knowledge of Network analysis, Integration and differentiation, Matrix equations, Laplace Transform.

Course Description:

In this course covers the transfer function modelling and state space modelling of electrical and mechanical system . The dynamic and steady state time domain response system is discussed. This course also covers stability criteria and stability analysis of system by root locus, RH criteria, Bode plot and Nyquist plot. The state space modelling methods in different canonical form and transformation from transfer function model to state space and vice versa and different methods of calculating state variable and calculating output variable is covered. The concept of controllability and observability and 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. Explain time response of first order and second order system and to find system response to test input signals.

3. Explain stability criteria requirement of system in Laplace domain and different stability analysis methods
4. Provide a detailed understanding of state space modelling, analysis and design of system.

Course Outcomes:

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

1. Apply the concept of mathematics, science, engineering fundamentals to formulate model of systems for simple mechanical and electrical system and analyze the model using simulation tools.
2. Apply the knowledge of mathematics, science, engineering fundamentals to 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.
3. Identify the stability of system by applying various stability analysis method and verify the result using simulation tools.
4. Apply the knowledge of mathematics to formulate and analyze state space model of system and design closed loop state model for given time domain specification and verify the result using simulation tools.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
B18EC 4050	CO1	3	3	2	2	3								2		2
	CO2	3	3	2	2	3								2		2
	CO3	2	3	2	3	3								2		2
	CO4	3	3	3	2	3								2		2

Course Contents:

Unit-1: Modeling of Systems

[7L+7T+7P]

Modeling and writing Transfer function (Both Electrical & Mechanical), Block Diagram reduction, Signal flow graph. **Case Study**

Unit-2: Time Domain Stability Analysis

[7L+7T+7P]

Performance of feedback control system, Test input signals, performance of first order, second order system (No derivation), S-plane Root location and Transfer function, steady state errors, PD, PI, PID controllers. Concept of stability, RH Criteria, Relative Stability.

Root locus: Introduction to root locus, Procedure and problems, Effect of addition of pole zero to open loop systems. Case study

Unit-3: Frequency Domain Stability Analysis

[7L+7T+7P]

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:**[7L+7T+7P]**

Introduction, concept of state variable and state model, state model for linear continuous time systems, state variable and linear discrete-time systems, Diagonalization, solution of state equation, concept of controllability and observability, pole placement by state feedback, problems.

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

Reference Books:

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 8th Edition, 2009.
4. Joseph J Distefano III et al., Schaum'sOutlines, "Feedback and Control System", TMH, 2nd Edition 2007.

Lab Experiments

1. Introduction to Control System
2. Time response of first order system
3. Time response of second order system
4. Steady-state Error
5. Stability of system based on pole position
6. Root Locus Analysis.
7. Stability analysis of a system based using Bode Plot
8. Time response of PID controller.
9. Stability analysis of a system using Nyquist Plot
10. Design of control system in state space using pole placement.

B18EC4070	Microcontrollers and Applications Lab	L	T	P	C
Duration :14 Wks		0	0	2	2

Prerequisites:

Number system, combinational circuits, sequential circuits, theory concepts of microcontroller

Course Description:

This course introduces 8051 microcontroller practical and programming aspects to provide basic understanding of architecture, instruction set, assembly level programming, interfacing to various sensors, relays, motors, actuators through various types of serial and parallel communication. Timers and interrupt functions are illustrated through the selection and control activities using suitable programming platforms such as Assemblers, C compilers, Kiel, , etc. This fundamental knowledge on microcontrollers lead to explore large

number of controller families like Raspberry Pi, ATMEGA, TI and PIC that are used in industrial and automation applications.

Course Objectives:

Course objectives are 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:

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

1. Analyze a given problem and design a suitable embedded system using microcontroller 8051.
2. Apply the knowledge of programming in assembly language and C language to receive data, process it and control the various actuators.
3. Summarize the embedded system design and operations using microcontroller 8051.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	CO1	3	2	1	1	3									2	1
	CO2				1	3									2	1
	CO3										2	1	2			

Lab Experiments

Section-A (Assembly Language Programming)

1. Data Transfer Instructions: Block Data Transfer and Exchange between internal and external Data memory with and without overlap, Sorting, largest and smallest number in an array.
2. Arithmetic Instructions: 32-bit multi-precision Addition, Subtraction, Multiplication of 2 16-bit numbers and Division (16-bit by 8 bit).
3. Logical Instructions: 8x8 multiplication using shift Add technique. ASCII to packed BCD and Vice versa, Code Conversions. Exchange Two numbers without the use of 3rd location. Implementation of Boolean expressions (Bit Manipulation).
4. Timers: Wave form generation with varying Duty Cycle using Interrupt and Polling Techniques.
5. Serial Communication: Serial data transmission with Polling and Interrupt technique (Regular and Look up table).

Section-B (Embedded C Programming)

1. Display the ASCII value of Key pressed on LCD.
2. Count the incoming pulses using counters.
3. DC Motor speed control using external interrupt.
4. Stepper motor interfacing by controlling the steps and direction.
5. Interfacing DAC to generate various waveforms with output voltage varying between -12V to 12V with Amplitude and Frequency control.

Case Studies on Arduino and RaspberryPi Microcontrollers

B18EC4080	Analog Communication Lab	L	T	P	C
Duration :14 Wks		0	0	2	2

Prerequisites:

Circuit theory, Amplifiers, 555 Timers, Communication basics.

Course Description:

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 to:

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

Course Outcomes:

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

1. Design an IF Amplifier to select a particular signal in super heterodyne Receiver
2. Design AM/FM Modulators and demodulators
3. Apply the concept of Pulse Width Modulation to control a speed of DC motor
4. Apply the concept of PLL to synthesize the frequency

Mapping of Course Outcomes with programme outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC 4080	CO1	1		3		5			3					2	1	
	CO2	1		3		5			3					2	1	
	CO3	1	2	3	3									1	2	
	CO4	1	2											2	1	

Lab Experiments

1. To Study the Frequency Characteristics of IF Amplifier
2. To Generate Amplitude Modulation and Demodulation.
3. AM-Double Sideband Suppressed Carrier (DSBSC) Generation and Detection
4. Design and test Pulse Amplitude Modulation and Demodulation circuits.
5. Design and test Pulse Width Modulation and Demodulation
6. Design and test Pulse Position Modulation and Demodulation
7. To Generate Frequency Modulated wave for suitable modulation index (β) and Demodulate the signal.
8. Frequency Synthesis using PLL.
9. Design of a Mixer circuit using BJT.
10. To Illustrate Pre-Emphasis and De-Emphasis of a given signal.

Demo experiment:

1. To Demonstrate Frequency Division Multiplexing of two Analog signals.

Challenge Experiments:

1. AM transmitter /Receiver Design and simulation
2. FM transmitter /Receiver Design and simulation

DETAILED SYLLABUS

Semester - V

B18EC5010	Digital Communication	L	T	P	C
Duration: 14Wks		2	1	0	3

Prerequisites:

Fundamentals of Communication, Probability and Random Process.

Course Description:

Digital communication has proliferated in a big way in previous and today's electronic and telecommunication industries. It allows devices to exchange information digitally while making the communication more clear and accurate without losses. In addition to changing our daily lives, the transformation in digital communications paves a way to many applications in fields such as signal processing, video compression, data compression, mobile technology, etc. This course helps students to get a good idea of how the signals are digitized and why digitization is needed. Various waveform coding techniques are discussed in detail. The clear intentions behind choosing an appropriate digital modulation scheme are taught. This course also covers different techniques to share a common channel among multiple devices for data transmission. Finally, it presents various methods of spread spectrum technology in pursuit of achieving secured communication.

Course Objectives:

The objectives of this course are to:

1. Provide the basics of digital Communication with respect to Sampling & Quantization.
2. Introduce the fundamentals of Pulse Code Modulation (PCM), Differential pulse code modulation (DPCM) and Delta Modulation (DM) and Adaptive DM methods.
3. Describe the optimum coherent receivers such as correlation receiver and matched filter receiver for AWGN channel.
4. Familiarize with several digital modulation methods like BPSK, BFSK, QPSK, M-ary QAM , M-ary PSK and DPSK schemes, draw constellation diagrams, and compute their probability of error.
5. Present baseband signal shaping.
6. Render the understanding of multiple access techniques.
7. Provide the notion of spread spectrum technique and familiarize the conceptual elements of spread spectrum.
8. Introduce the applications of spread spectrum.

Course Outcomes:

On completion of this course the student will be able to:

1. Describe the importance of sampling and quantization on signals.
2. Apply suitable coding and multiplexing techniques.
3. Illustrate the different digital modulation techniques with transmitter and receiver.
4. Compare multiple access and spread spectrum techniques.

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC5010	CO1	3	3	1	2								2	1	3	1
	CO2	1	3	1	2								2	1	2	1
	CO3	3	3	1	2								2	1	3	1
	CO4	3	2	1	1								3	1	2	1

Course Contents:

Unit -1: Digital Communication Fundamentals and Sampling Process

[7L+7T]

Digital communication System- Advantage, functionality of blocks, transmission medium, Sampling theorem, Natural sampling, Flat top sampling, sample and hold circuit, Quadrature sampling of band pass signal, Quantization noise and SNR ,Robust quantization, Pulse Code Modulation.

Unit -2: Waveform Coding Techniques

[7L+7T]

Time division multiplexing, Line coding, Differential pulse code modulation, Delta modulation, errors in delta modulation (Slope overload and granular), Adaptive delta modulation, Coding speech at low bit rate (Adaptive DPCM, Adaptive Sub-band coding).

Unit -3: Optimum Detection and Digital Modulation Techniques

[7L+7T]

Optimum Detection: AWGN Channel, Probability of Error, Correlation receiver, Matched Filter receiver, Detection of signals with unknown phase in noise,

Digital Modulation Techniques: Generation, Coherent Detection, Constellation and error probability of BPSK, BFSK, QPSK, M-ary QAM, M-ary PSK, Non-coherent binary modulation techniques-DPSK.

Unit -4: Baseband Shaping, Multiple Access and spread spectrum techniques

[7L+7T]

Synchronization, Inter symbol interference, Eye pattern.

Multiple access: TDMA, FDM/FDMA, CDMA, SDMA, OFDM/OFDMA

Spread spectrum –Pseudo noise sequence, Notion of spread spectrum, DSSS- Direct sequence spread spectrum, FHSS-Frequency Hop spread spectrum, application of spread spectrum, Applications of spread spectrum (CDMA and Multipath Suppression).

Text Book:

1. Simon Haykin, “Digital Communication Systems”, John Wiley publication, 3rd edition, 2008.

Reference Books:

1. Simon Haykin, “Digital Communication Systems”, John Wiley publication, 1st edition, 2014.

2. K. Sam Shanmugam, "An introduction to analog and digital Communication system", John Wiley publication, 3rd edition, 2008.
3. BernadSklar, "Digital Communication", Pearson education 2007.
4. T L Singal, "Digital Communication", McGraw Hill Education 2015.

B18EC5020	RF and Microwave Engineering	L	T	P	C
Duration 14 Wks		2	1	0	3

Prerequisites:

Fundamentals of Transmission lines, network theory micro wave frequency, solid state physics, wave theory and optics.

Course Description:

This Course introduces to understand the fundamental principles involved in design, analysis of RF and Microwave transmission lines , Wave guides, Microwave amplifiers Microwave monolithic integrated circuit (MMIC) and theory behind the working of Microwave passive components like Directional coupler, E plane Tee, H- plane Tee – Magic Tee, Circulators –Isolators, Attenuators, cavity resonator and its applications. This course gives perception of Microwave tubes and 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.

Course Objectives:

The Course Objectives are to

1. To understand the structure and the various electrical parameters related to Microwave transmission lines and Wave guides.
2. To apply the knowledge of microwave theory in distinguishing the applications of Microwave passive and active devices.
3. To understand the working of Microwave Amplifiers and Oscillators
4. To understand the various design parameters for Microwave matching networks and Microwave monolithic integrated circuit (MMIC).

Course Outcomes:

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

1. Analyze the various performance parameters related to Microwave transmission lines and waveguides.
2. Identify Microwave passive and active devices for several applications.
3. Classify Microwave amplifiers and Oscillators
4. Summarize MMIC-materials and fabrication techniques

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC50 20	CO1	3	2	2	2					2	3		2	3	1	
	CO2	3	3							2	3		2	2	1	
	CO3	3	2	2	2					2	3		2	2	1	
	CO4	3	3							2	3		2	1	1	

Course Contents:

Unit-1: Transmission Lines

[7L+7T]

Introduction, Transmission lines equations and solutions, reflection and transmission coefficients, standing waves and SWR, line impedance Characteristics of Transverse Electric Waves- Group velocity and phase velocity. Smith chart for impedance matching

Unit-2: Wave guides Microwave passive components

[7L+7T]

Rectangular wave guides: TE waves and TM waves in Rectangular waveguides, Dominant mode, cutoff frequency in wave guides. Introduction to circular waveguides.

S-parameters Microwave passive Components: Directional coupler, E plane Tee, H- plane Tee – Magic Tee, Circulators – Isolators, Attenuators, cavity resonator.

Unit-3: Microwave Semiconductors and tubes

[7L+7T]

Principles of tunnel diodes , Transferred Electron Devices, Gunn diode, Avalanche Transit time devices IMPATT and TRAPATT devices, parametric amplifiers High frequency limitations, principle of operation of Multicavity Klystron, Reflex Klystron, Traveling Wave Tube, Magnetron (Introduction).

Unit 4: RF-transistor Amplifier Design and Matching Networks

[7L+7T]

Amplifier power relation, stability considerations, gain considerations noise figure, impedance matching networks, frequency response, T and Π matching networks, microstripline matching networks. Microwave monolithic integrated circuit (MMIC) materials and fabrication techniques

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.

Reference Books:

1. Robert. E.Collin, "Foundation of Microwave Engg" Mc Graw Hill,2001.
2. Annapurna Das and Sisir K Das, "Microwave Engineering", Tata Mc Graw Hill Inc., 2004.
3. M.M.Radmanesh, "RF & Microwave Electronics Illustrated", Pearson Education, 2007.
4. D.M.Pozar, "Microwave Engineering.", John Wiley & sons, Inc., 2006.

B18EC5030	Digital Signal Processing (I)	L	T	P	C
Duration:14 Wks		2	1	1	4

Prerequisites:

Fourier Transform, Z-transform, LTI System Representation.

Course Description:

The signal for processing is mathematically modeled as a function or a sequence of numbers that represent the state or behavior of a physical system. The examples of the signals range from speech, audio, image and video in multimedia systems, electrocardiograms in medical systems, to electronic radar waveforms in military. Signal processing is concerned with the representation, transformation, and manipulation of signals and the information they contain. For example, we may wish to remove the noise in speech to make it clear, or to enhance an image to make it more natural. Signal processing is one of the fundamental theories and techniques to construct modern information systems. During the last half century, lots of theories and methods have been proposed and widely studied in digital signal processing. In this semester, we only study the Discrete Fourier Transform and Fast Fourier Transform and IIR and FIR filter designs.

Course Objectives:

The objectives of this course are to:

1. Explain the concept of DFT and FFT.
2. Apply the concept of FFT algorithms to compute DFT.
3. Design IIR filter using impulse invariant, bilinear transform.
4. Describe the concept of linear filtering Technique and to demonstrate FIR & IIR filters for digital filter structures.

Course Outcomes:

On completion of this course the student will be able to:

1. Apply the DFT for the analysis of digital signals
2. Explain the different properties of DFT and Compute DFT using FFT algorithms
3. Design and analyze DSP systems like IIR and FIR filters
4. Describe the significance of various filter structures.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC5030	CO1	3	2	1	1										2	3
	CO2	3	3	2	1										2	
	CO3	3	2	1	1											3
	CO4	1	3	1											1	2

Course Contents:

Unit 1: Discrete Fourier Transforms and its Properties

[10L+7T+7P]

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, Symmetry Properties, auto correlation, cross correlation, parseval's theorem.

Unit 2: Fast Fourier Transform Algorithms

[11L+7T+7P]

Circular Convolution Concept and Its DFT Property, Examples on Time and Frequency domain. A linear filtering approach to computation of the DFT using overlap - add method, efficient computation of the DFT: FFT algorithms, direct computation of the FFT. Radix-2 FFT algorithms.

Unit 3: Design of IIR Filters

[10L+7T+7P]

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.

Unit 4: Design of FIR Filters and Digital Filter Structures

[11L+7T+7P]

Design of FIR filters, Symmetric and Anti symmetric FIR Filter, Design of Linear phase FIR Filter using Windows (Rectangular, Hamming, & Kaiser Windows).

Implementation of Discrete Time System: Direct Form -I, Direct Form II structures, Cascade Form Structures, Parallel Form Structures for IIR systems, Structure for FIR systems: Direct Form, Cascade Form Structures.

Text Books:

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

Reference Books:

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

Lab Experiments

A. List of Experiments using MATLAB/Octave:

1. 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).
2. Obtain the Auto correlation of a given sequence and verify its properties.
3. Obtain the cross correlation of a given sequence
4. Verification of Sampling theorem.
5. Perform the Circular convolution of two given sequences in time domain.
6. Perform Circular convolution of any two given sequences in frequency domain by using DFT and IDFT.
7. Design of digital Low-pass and Butterworth IIR filter to meet the given specifications using Bilinear transformations and verification.
8. Design of digital Low-pass Chebyshev IIR filter to meet the given specifications using Bilinear transformations and verification.
9. Design of digital Low-pass FIR filter to meet the given specifications using windowing technique and verify using Simulink.

B. List of Experiments using DSP Processor and CCS Studio:

1. Computation of N-point DFT of a given sequence.
2. Solving a linear constant coefficient difference equation.
3. Circular convolution of two given sequences.
4. Design and Implementation of IIR digital filter for audio signals.
5. Design and Implementation of FIR digital filter for audio signals.

B18EC5040	Entrepreneurship and Innovator Skills	L	T	P	C
Duration :14Wks		2	0	0	2

Prerequisites:

No Pre-requisite required

Course Description:

Management and Entrepreneurship will teach you how to start your own business, grow a family business or innovate inside an existing organization. Studying this entrepreneurship will not only provide you with the management skills and entrepreneurial qualities, it will also offer you networking opportunities to enable you to start and run businesses effectively and imaginatively.

Course Objectives:

The objectives of this course are to:

1. Provides a platform to sensitize the hidden entrepreneurial traits of management students.
2. Expose students to the Entrepreneurial and project management concepts and processes used in practice.

Course Outcomes:

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

1. Explain the fundamental concepts and process of managing an Entrepreneurial project.
2. Demonstrate the skill of managing an Entrepreneurial project.
3. Identify & manage an Entrepreneurial project in practice.

Course Code	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
B18EC5030	CO1								2	3	3	2			2	3
	CO2								2	3	3	2			2	1
	CO3								2	3	3	2			1	3
	CO4								2	3	3	2			1	2

Course Contents:

Unit-1: Entrepreneurship

[7 Hrs]

Meaning, Evolution and Development; Functions of an Entrepreneur; Types of entrepreneur; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneur – an emerging class. Family Business History: Types and Importance of family business; Succession in family business; Pitfalls of the family business; Improving family business performance.

Unit-2: Creativity and Innovation

[7 Hrs]

Sources of New Ideas, Ideas into Opportunities; Creative problem solving: Heuristics, Brainstorming, Synaptic; Sources and Transfer of Innovation. International Entrepreneurship The nature, Importance & Opportunities; International versus domestic entrepreneurship; Entrepreneurship entry into international business, exporting, direct foreign investment, barriers to international trade. Managing growth and diversification: strategies; franchising, joint ventures, Acquisitions and mergers.

Unit-3: Institutions Supporting Entrepreneurs

[7 Hrs]

A brief overview of financial institutions in India Central level and state level institutions; SIDBI, NABARD, IDBI, SIDO, Indian Institute of Entrepreneurship, DIC, Single window system; Latest Industrial policy of Government of India; FMME; Guidelines for starting new SMEs. Sources and ways of raising capital; Informal risk capital and venture capital; Business Planning Meaning and Business planning process.

Unit-4: Project Management

[7 Hrs]

Definition and Process; Project Management hierarchy programs, projects, processes, activities, tasks; Conceptual idea of the triple constraint: Time, cost, scope; Planning & scheduling Tools Brainstorming, Fishbone diagrams, Bar charts, Gantt Charts, WBS, Network diagrams CPM and PERT – Concept and applications; Accelerating projects “crashing”.

Text books:

1. Hisrich, Robert D. Peters, Michael P. Shepherd, Dean A , “Entrepreneurship”, Tata McGraw Hill, 9th Edition, 2014.
2. Vasant Desai, “The Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, 5th Edition, 2014.
3. Clements, James P. Gido, Jack., “Effective Project Management”, Cengage Learning, New Delhi, 2006.
4. Mantel, Samuel J. Meledith, Jack R. Shafer, Scott M , “Project Management : Core Text Book”, John Wiley & Sons, New Delhi, 8th Edition, 2012.

B18EC5080	RF and Microwave Lab	L	T	P	C
Duration :14 Wks		0	0	2	2

Prerequisites:

Circuit theory, Electromagnetic field theory and fundamentals of Microwave Engineering.

Course Description:

Microwave Laboratory is meant for experiments at the instructional level for undergraduate students. In this course students will conduct experiments to demonstrate the characteristics of Microwave generators like Klystron tube, GUNN diode and Voltage controlled oscillators. Determine the performance parameters for Directional couplers, Micro strip couplers, Ring resonators, H plane and E-plane Tees. These Experiments helps the students to correlate the concepts studied in theory and the results obtained from experiments.

Course Objectives:

The Course Objectives are to

1. Demonstrate the working of Microwave generators like Klystron Tube, GUNN diode and Voltage controlled Oscillators.
2. Understand the Experimental procedure to Determine the S parameters of Microwave passive components like Directional couplers, Power dividers, Magic tees
- 3 Understand the experimental procedure to determine the performance parameters of Microstrip power dividers , Phase shifters and circulators.

Course Outcomes:

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

1. Demonstrate the working of microwave bench to measure frequency, Wavelength, guided wavelength of Microwave oscillations.
2. Determine different parameters like Insertion loss, Coupling loss, Directivity of Directional Couplers, Power dividers, Phase shifters and Circulators as applicable to passive components.
3. Determine the S parameters of H-plane, E-plane and Magic Tees

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC5080	CO1	3	2	2	2					2	3		2	3	1	
	CO2	3	3							2	3		2	2	1	
	CO3	3	2	2	2					2	3		2	2	1	

Lab Experiments

1. Identification and study Microwave Components in a microwave bench
2. Study the Characteristics of Klystron Tube
3. Study the characteristics of GUNN oscillator
4. Measurement of frequency of microwave source and demonstrate relationship among frequency, free space wave length and guided wave length.
5. Measurement of insertion loss and isolation loss of directional coupler
6. Measurement of scattering matrix of Magic Tee
7. Measurement of scattering matrix of E plane and H plane Tee
8. Measurement of insertion loss of various cables, microwave devices
9. Study of VCO characteristics like Tuning voltage Vs frequency, Frequency Vs power output up to 10GHz
10. Study of phase shifter and calculate the degree of phase shift
11. Determination of coupling and isolation characteristics of strip line directional coupler.
12. Measurement of resonance characteristics of micro strip ring resonator.
13. Measurement of power division and isolation characteristics of micro strip 3 dB power Divider

Challenging Experiments

1. Study of open source microwave software to design microwave experiments
2. Design of transmission line using software for a given parameter
3. Mini project on Microwave design.

B18EC5090	Digital Communications Lab	L	T	P	C
Duration :14 Wks		0	0	2	2

Prerequisites:

Fundamentals of communications

Course Description:

Digital communication has proliferated in a big way in previous and today's electronic and telecommunication industries. It allows devices to exchange information digitally while making the communication more clear and accurate without losses. In addition to changing our daily lives, the transformation in digital communications paves a way to many applications in fields such as signal processing, video compression, data compression,

mobile technology, etc. This course helps students to get a good idea of how the signals are digitized and why digitization is needed. Various waveform coding techniques are discussed in detail. The clear intentions behind choosing an appropriate digital modulation scheme are taught. This course also covers different techniques to share a common channel among multiple devices for data transmission. Finally, it presents various methods of spread spectrum technology in pursuit of achieving secured communication.

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:

On completion of this course the student will be able to

1. Develop ability to verify sampling theorem.
2. Demonstrate multiplexing of two signals.
3. Construct the circuits for various digital modulation techniques.
4. Develop ability to generate PCM signals.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC5090	CO1	1	2	3	3									1	2	1
	CO2	1	2	4	3									1	2	2
	CO3	1	2	2	3									1	2	3
	CO4	2	2	3	3									1	2	3

Lab Experiments

All Experiments can be conducted using discrete components after testing with available kits

1. Verification of Sampling Theorem
2. TDM of two band limited signals.
3. ASK generation and detection
4. FSK generation and detection.
5. PSK generation and detection.
6. DPSK generation and detection.
7. QPSK generation and detection.
8. PCM generation and detection using a CODEC Chip.
9. Optical Fiber (Attenuation loss, Bending loss, Numerical aperture).
10. Analog and digital (with TDM) communication link using OFC.
11. Delta Modulation.

12. Adaptive delta modulation.

13. Line coding and decoding

Challenge Experiments

14. Verification of Channel capacity theorem (MATLAB Simulation)

15. a. FSK generation and Detection(MATLAB Simulation)

b. Modify the above simulation to get BER < 10^{-6}

c. Demonstrate Constellation diagram

DETAILED SYLLABUS

Semester – VI

B18EC6010	Antenna and Wave Propagation	L	T	P	C
Duration :14 Wks		2	1	0	3

Prerequisites:

Basics of Electromagnetic field Theory, Vector Algebra, Transmission Lines, Microwave theory.

Course Description:

This course 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. Students can analyze the various losses in the signal flow in different propagation.

Course Objectives:

The Course Objectives are to

1. Understand the basic terminologies related to antenna in wireless communication applications.
2. Apply the knowledge of antenna arrays in designing and analyzing Broadside and End fire arrays.
3. Acquainted with design of Micro strip patch antennas and feeding mechanism.
4. Understand the basic concepts of Electromagnetic Wave propagation

Course Outcomes:

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

1. Analyze the various performance parameters related to antenna in wireless communication applications
2. Differentiate the types of antenna arrays and types of Antennas for RF and Microwave applications.
3. Analyze The Micro strip patch and antenna and feeding mechanism.
4. Summarize the characteristics of different types of Wave propagation

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6010	CO1	3	2	2	2					2	3		2	3	1	
	CO2	3	3		1					2	3		2	2	1	
	CO3	3	2	2	2					2	3		2	2	1	

	CO4	3	2		1					2	3		2	1	1	
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Course Contents:

Unit-1: Antenna Fundamentals

[7L+7T]

Introduction to antenna, advantages, Parameters of antenna: -Radiation Pattern, Radiation intensity, Solid angle, Beam width, directivity and gain, Relationship b/w directivity and beam area and effective aperture, Effective length, Bandwidth and polarization, efficiency and radiation, Antenna temperature and field zone, Friss free space equation.

Unit-2: Antenna Array and Point Source

[7L+7T]

Array of two isotropic point sources and its types, n-element broadside array and end fire array, short dipole (no field derivation required), radiation resistance of short dipole and half wave dipole with derivation, folded dipole, Slot antenna and its radiation phenomenon. Horn, Yagi-uda antenna, Parabolic and Helical antenna.

Unit-3: Microstrip antenna Design

[7L+7T]

Basic characteristics of patch antennas, feeding mechanism method of analysis, Rectangular patch antenna design using transmission model. Introduction to smart antennas

Unit-4: Wave Propagation

[7L+7T]

Ground wave propagation, free space propagation, ground reflection, multipath phenomenon, surface wave propagation, fading, diversity, tropospheric scatter, ionosphere propagation, electrical properties of ionosphere.

Text Books:

1. Constantine Balanis A., "Antenna Theory: Analysis and Design", John Wiley and Sons, 3rd Edition, 2012.
2. John d. Krauss, "Antennas and Wave propagation" McGraw-Hill International 4th Edition, 2010
3. Harish and Sachidananda." Antennas and Wave Propagation"., Oxford press.

Reference Book:

1. John d

Krauss, "Antennas and Wave propagation" McGraw-Hill International 4th Edition, 2010

B18EC6020	CMOS VLSI Circuits	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

Semiconductor Physics and devices, BJTs and FETs, Digital Electronics.

Course Description:

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 to:

- 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:

On

completion of this course the student will be able to:

- 1 Illustrate the engineering behind the design and analysis of integrated circuits with fabrication technology details.
- 2 Sketch the physical design/layouts in CMOS and nMOS technology
- 3 Contrast different flavors of CMOS technology.
- 4 Express the basic storage concept ,memory circuits and VLSI testing concepts

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6020	CO1	1	2	3		3				2	3			1	2	3
	CO2		2	3	1	2				2	3			1	2	3
	CO3	2	1		3					2	3			1	2	
	CO4	1			2	3				2	3			2	1	

Course Contents:

Unit 1: Basic MOS Technology

[11 Hrs]

Integrated circuits era. Moore's law and its implications. Classification of MOS transistors, Enhancement mode transistor action, depletion mode transistor action, NMOS IC fabrication. CMOS, N-well, P-well and Twin tub process details. Introduction to BiCMOS technology.

MOS Transistor Theory: Introduction, MOS Device Design Equations, second order effects, The Complementary CMOS Inverter – DC Voltage Transfer Characteristics, Noise margin. Static Load MOS Inverters. Pass transistors transmission Gate, problems on pass transistors and TGs, CMOS Tristate Inverter.

Unit 2: Circuit Design Process

[10 Hrs]

Stick Diagrams and Layout of Digital Circuits Stick diagram concept, examples for standard gates. Design Rules, Basic Physical Design/Layout of logic gates and logic functions.

Unit 3: CMOS Logic Structure

[11 Hrs]

Basic Circuit Concepts: MOS layers. Sheet resistance, Area capacitances, Capacitance calculation, Delay UNIT, Inverter delays, Problem of driving large capacitive loads.

CMOS Logic Structures CMOS Logic, Bi CMOS Logic, Pseudo-NMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic and Cascaded Voltage Switch Logic (CVSL)

Unit 4: Memories and Testing

[10 Hrs]

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.

Text Books:

1. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design- a circuits and systems perspective", 2th Edition, 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

Reference Books:

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, 2nd Edition, 1998.

B18EC6030	Computer Communication and Networks (I)	L	T	P	C
Duration:14 Wks		3	0	1	4

Prerequisites:

Digital Communication, C and C++.

Course Description:

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, routing protocols, the Internet Protocol, reliability, flow control, congestion control, and their embodiment in TCP and UDP. 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:

On completion of this course the student will be able to:

1. Explain the fundamental concepts of basic networking, Protocols, Standards and Layered models
2. Differentiate multiple access methods and LANs
3. Demonstrate the concepts of network layer and build sub-nets and routing mechanism.
4. Evaluate different transport layer protocols and application layer protocols

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6030	CO1	3	2	1											2	1
	CO2	3	2	1											2	1
	CO3	3	2	1		3								3	2	1
	CO4	3	2	1		3								3	2	1

Course Contents:

Unit-1: Introduction to Data Communication and Networking.

[11L+7P]

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.

[10L+7P]

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.

[11L+7P]

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.

[11L+7P]

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.

Lab Experiments

Part A (Programs on different Layers)

1. Write a program for bit stuffing & de-stuffing using HDLC.
2. Write a program for character stuffing & de-stuffing using HDLC.
3. Perform 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.
5. Write a program to implement the congestion control using the leaky bucket algorithm. Examine node transmitting/receiving packets to/from other nodes. Using a random function; vary the packet size.
6. Write a program for distance vector algorithm to find the shortest path for transmission.

Part B – Programs on Networking

1. 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)
2. Simulate a four node point-to-point network, and connect the links as follows: n_0-n_2 , n_1-n_2 and n_2-n_3 . Apply TCP agent between n_0-n_3 , n_1-n_3 . Apply relevant applications over TCP agents by changing the parameters and hence determine the number of packets transmitted.
3. Simulate a four node point-to-point network, and connect the links as follows: n_0-n_2 , n_1-n_2 and n_2-n_3 . Apply UDP agent between n_0-n_3 , n_1-n_3 . Apply relevant applications over UDP agents by changing the parameters and hence determine the number of packets transmitted.
4. 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.
5. 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.
6. Simulate a wireless network for n nodes. For a wireless network consisting of three mobile nodes (n_0-n_2), 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).

B18EC6070	Antenna Lab	L	T	P	C
Duration :14 Wks		0	0	2	2

Prerequisites:

Electromagnetic field theory Microwave and antenna concepts.

Course Description:

Antenna lab is meant for experiments at the instructional level for undergraduate students. In this course students will conduct experiments to plot the radiation patterns of Horn antenna, E-sectorial, H-sectorial ,

Dish antennas in X band, Micro strip Mono pole, Yagi antenna, Slotted array antennas in C band. These experiments will help in determining the Directivity, Gain and efficiency of tested antennas.

Course Objectives:

The course objectives are to:

1. Demonstrate the working Horn antenna, Sectorial and Dish antennas in X band range.
2. Understand the Experimental procedure to Determine Directivity, Gain and Efficiency of Microstrip patch antennas.
3. Understand the experimental procedure to find the VSWR for various types of loads connected to Rectangular Wave guide.

Course Outcomes:

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

1. Demonstrate the working of Horn, Sectorial, Dish antenna in X band to plot the radiation pattern.
2. Determine different parameters like Directivity, Gain and efficiency of Microstrip patch antennas.
3. Determine the VSWR for different loads connected to Microwave bench.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6070	CO1	3	2	2	2					2	3		2	3	1	
	CO2	3	3		1					2	3		2	2	1	
	CO3	3	2	2	2					2	3		2	2	1	

Lab Experiments

1. Measure the gain, directivity of Pyramidal Horn Antenna.
2. Measure Gain, Directivity of Parabolic Disc Antenna.
3. Plot Radiation Pattern of Horn Antenna, E Sectorial Horn Antenna, H Sectorial Antenna.
4. Study of various types of antennas with defective ground plane
5. Measure of Co Polarization and Cross Polarization level of an antenna.
6. Measure the variation of Field Strength/Inverse Square Law.
7. Plot Radiation of Array Antenna.
8. Impedance Measurement of various types of loads using smith chart.
9. Measure VSWR, Reflection Co-efficient of Given Antenna.
10. Plot Radiation Pattern of Wired Mono Pole Antenna, Slot patch Antenna, Antenna with Defective Ground Plane.
11. Study frequency scanning of an array antenna
12. Determine Gain, directivity, Band Width of a given Micro strip Patch Antenna

Challenge Experiments:

Design of micro-strip antenna using HFSS

B18EC6080	CMOS VLSI Circuits Lab	L	T	P	C
Duration:14 Wks		0	0	2	2

Prerequisites:

Digital Electronics, fundamentals of CMOS

Course Description:

The lab 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 course objectives are to:

1. Introduce the concepts and techniques of modern integrated circuit design and testing
2. Provide experience in designing integrated circuits using Computer Aided Design (CAD) Tools.
3. Be able to design CMOS combinational and sequential logic at the transistor level, with mask layout.

Course Outcomes:

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

1. Design and implement digital integrated circuits
2. Measure the performance parameters of digital integrated circuits & systems using CAD tools
3. Demonstrate and calculate device parameters & system aspects of analog IC design

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6080	CO1	2	3	1		1				1	2	3		1	2	2
	CO2		2	1	1	1				1	2	3		1	2	2
	CO3	2	1		1	1				1	2	3		1	2	2

Lab Experiments

Part A

Basic Digital Gates

Write Verilog Code for the following circuits 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.

1. CMOS Inverter
2. CMOS Buffer
3. Transmission Gate
4. Basic/universal gates

5. Flip flops - RS, D, JK, MS, T
6. Serial & Parallel adder
7. 4-bit counter [Synchronous and Asynchronous counter]
8. Adder circuits – full adder cascading to build 4-bit parallel adder (RCA)

Part B

Analog Circuits

1. 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

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

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

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

* An appropriate constraint should be given.

** Appropriate specification should be given.

*** Applicable Library should be added & information should be given to the Designer.

NOTE: The design handouts to be given to students wherever required

Ref: RU/BoS/ECE/CEC/June-2018-6

DETAILED SYLLABUS

Semester: VII

B18EC7010	Internet of Things & Cyber Physical Systems (I)	L	T	P	C
Duration:14 Wks		3	0	1	4

Prerequisites:

Embedded systems, Computer concept networking Course

Course Description:

IoT is the technology enabling the inter-connection of all types of devices through the internet to exchange data, optimize processes, monitor devices in order to generate benefits for the industry, the economy, and the end user. It is composed of network of sensors, actuators, and devices, forming new systems and services. Many protocols are used for faithful transmission data based on the applications. The Cyber Physical Systems (CPS) is an engineering discipline and specifies the integrations of and interaction between computation and physical processes. CPS integrates the dynamics of the physical processes with those of the communications, computation and networking, and analysis techniques for the integrated systems.

Course Objectives:

The objectives of this course are to:

1. Discuss the architecture of Internet of Things and connected world.
2. Contrast various hardware, communication and sensing technologies, cloud services to build IoT applications
3. Understand about modelling of cyber-physical systems
4. Describe the design of cyber physical system.

Course Outcomes:

On completion of this course the student will be able to:

1. Describe the IoT system architecture and system design.
2. Use protocols, cloud services and communication API's for developing Applications
3. Apply the core principles behind Cyber physical system
4. Discuss the abstraction in designing the cyber physical system

Mapping of Course Outcomes with Program Outcomes

Course Code	CO# / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC7010	CO1	3	2	3	2	3	2	2		1		1		3	2	3
	CO2	3		3		3								3	2	3
	CO3	3	2	3	2	3					2			3	3	3
	CO4	3	1				1							3	2	

Course Contents:

Unit -1: Introduction & Concepts of IoT [7L+7P]

IoT Definition & Characteristics of IoT, Physical Design of IoT: Thing in IoT, IoT Protocols, Logical Design of IoT: Function Block, Communication Models, Communication API, IoT Enabling Technologies: WSN, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded System, IoT Levels and Deployment Templates, Applications of IoT

Unit -2: IoT System Design

[7L+7P]

IoT Design methodology, IoT Protocol – MQTT, CoAP, Introduction to Cloud storage Models: WAMP, Xively Cloud for IoT, Python Web Application Framework-Django, Designing a RESTful based Web API. Data Analytics for IoT – Apache Hadoop, Apache Oozie. Case studies illustrating IoT design – Home Automation, Cities, Environment, Agriculture

Unit -3: Introduction & Modelling of Cyber Physical System

[7L+7P]

Definition & Example of CPS system, Design Process, Modelling Dynamic Behaviours – Continuous Dynamics: Newtonian Mechanics, Actor Model, Discrete Dynamics: Discrete Systems, Notion of State, Finite-State Machines, Extended State machines

Unit -4: Designing of Cyber Physical System

[7L+7P]

Embedded architecture: Types of processors, Parallelism, Pipelining, Multicore Architectures, Multitasking: Process, Process Management, States of Process, Process Schedulers, Process Control Block, Interrupts, Threads & its types. Scheduling: Levels, Different of Types, Different process scheduling algorithms.

Textbooks:

1. Arshdeep Bagha and Vijay Madiseti Internet of Things: A Hands-on Approach
2. Edward A. Lee and Sanjit A. Seshia, "Introduction to Embedded Systems, A Cyber-Physical Systems Approach", Second Edition, MIT Press

Reference Books:

1. Pethuru Raj and Anupama C. Raman (CRC Press), The Internet of Things: Enabling Technologies, Platforms and Use Cases
2. Adrian McEwen, Hakim Cassimally, 'Designing the Internet of Things', Wiley, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, 'The Internet of Things: Key Applications and Protocols', Wiley, 2015.
4. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press
5. Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic, "Cyber-Physical Systems: From Theory to Practice", CRC Press

Internet of Thing and Cyber Physical System lab**List of Experiments:**

1. To simulate an IoT based smart home wireless system using cisco packet tracer
2. To simulate an IoT based smart home wired system using cisco packet tracer
3. To simulate an IoT based automate web camera system using cisco packet tracer
4. To simulate an IoT based smart RFID system using cisco packet tracer
5. To simulate an IoT based automatic lawn sprinklers system using cisco packet tracer
6. To simulate an IoT based smoke detection with fire prevention system using cisco packet tracer
7. To simulate an IoT based humidity monitoring system through programming the MCU using cisco packet tracer
8. To simulate an IoT a smart streetlamp system by programming the MCU using cisco packet tracer
9. To simulate the working of IoT protocol (MQTT) using cisco packet tracer
10. To Simulate an IoT smart home system with has an internet service provider, cable model client & 3g/4g cell client using cisco packet tracer.

SC-1

B18EC3061	Instrumentation Engineering	L	T	P	C
Duration: 14Weeks		3	0	0	3

Prerequisites:

Engineering Physics, Principles of Electronics.

Course description:

Instrumentation Engineering refers to the study of all measuring instruments that are required for engineering the systems. This course deals with measuring equipments such as voltmeter, multimeter, signal generator, function generator, bridges and transducer. Principal and working of all the above equipments is dealt in detail. This course also covers measurement errors faced during engineering the systems.

Course Objectives:

The objectives of this course are to:

1. Illustrate various measurement errors.
2. Analyze the operation of different voltmeters and multimeters, signal generators.
3. Appraise different electronic component measuring methods.
4. Evaluate various transducers used in electronic applications.

Course Outcomes:

On completion of this course the student will be able to,

1. Identify various types of measurement errors in measuring instruments.
2. Evaluate the concepts of voltmeters, multimeters and function generators.
3. Analyze the circuits used for the measurement of Resistance, Capacitance, Inductance, and Frequency.
4. Demonstrate the application of different transducers.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC3061	CO1	3	3	1										3	3	3
	CO2	3	2	1										3	3	3
	CO3	3	2	1										3	3	3
	CO4	3	2	1										3	3	3

Course Contents:

Unit-1: Introduction

[10 Hrs]

Measurement Errors: Introduction, Significance of measurements, methods of Measurements, Gross errors and systematic errors, Absolute and relative errors, Accuracy, Precision, Resolution and Significant figures.

Oscilloscope: Principle of operation and specifications.

Unit-2: Voltmeters and Multimeters

[11 Hrs]

Introduction, Multirange voltmeter, extending voltmeter ranges, Loading, AC voltmeter using Rectifiers – Half wave and full wave, Peak responding and True RMS voltmeters

Digital Voltmeters: Introduction, RAMP technique, DVM's based on V-T, V-F and Successive approximation principles, $3\frac{1}{2}$ Digit, Resolution and sensitivity, Digital Multimeters, Digital frequency meters, Digital measurement of time: Time base selector, Time measurement.

Unit-3: Signal Generators

[10 Hrs]

Introduction, Fixed and variable AF oscillator, Standard signal generator, Laboratory type signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator, Sweep generator, Frequency synthesizer.

Unit-4: Bridges and Transducers

[11 Hrs]

Measurement of resistance, inductance and capacitance: Introduction, Wheatstone's bridge, Kelvin Bridge, AC bridges, Capacitance Comparison Bridge, Maxwell's bridge, Wien's bridge, Wagner's earth connection.

Transducers: Introduction, Electrical transducers, selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges: Resistance wire gauge, Inductive transducer, Differential output transducer and LVDT.

Text Books:

1. H. S. Kalsi, "Electronic Instrumentation", TMH, Third edition 2012
2. David A Bell, "Electronic Instrumentation and Measurements, Pearson Education, 2006.

Reference Books:

1. John P. Beatly, "Principles of measurement systems", 3rd Edition, Pearson Education, 2000
2. Cooper D & A D Helfrick, "Modern electronic instrumentation and measuring techniques", PHI, 1998.

B18EC3062	Computer Organization and Architecture	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Basic electronics, Numbering system, Digital fundamentals

Course Description:

The course covers the basic principles of computer organization, operation and performance and peripheral devices. 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. Detailed coverage of the use of pipelining and multiple function units in the design of high-performance processors.

Course Objectives:

Course objectives are to:

1. Illustrate the fundamental concepts of computer system architecture.
2. Interpret significance of interrupts.
3. Differentiate the various ways of communicating with I/O devices and standard I/O interfaces.
4. Examine the different hierarchical memory system including cache memories and virtual memory.

Course Outcomes:

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

1. Summarize the computer system organization and its operations
2. Appraise the concepts of hardware interface.
3. Interpret the various bus operations and protocols
4. Distinguish the different types of memories and their performance.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
B18EC3062	CO1	1						3			2	3	3	3		
	CO2	1	2					3		1	2	3	3	3		
	CO3	1	2	2			1	3		1	1		3	3	2	
	CO4	1	2	3			1	3				2	3			

Course Contents:

Unit-1: Basic Structure of Computers:

[11Hrs]

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 and Subroutines.

Unit-2: Basic Input/Output and Processing Unit

[10Hrs]

Accessing I/O Devices; Interrupts; enabling and disabling interrupts, Handling multiple devices, Device requests, Exceptions.

Basic processing unit: Instruction Execution, Load Instructions, Arithmetic and Logic Instructions, Store Instructions, Hardware Components, Register File, ALU, Datapath.

Unit-3: Input/output Organization

[10Hrs]

Direct Memory Access, Bus Operation: Synchronous Bus, Asynchronous Bus, Arbitration, Interface Circuits, Parallel Interface, Serial Interface, Interconnection Standards: Universal Serial Bus (USB), PCI Bus, SCSI Bus, UART.

Unit-4: Memory system

[11Hrs]

Basic Concepts, Semiconductor RAM Memories, Static Memories, Dynamic RAMs, Synchronous DRAMs, Read-only Memories, ROM, PROM, EPROM, EEPROM, Flash Memory, Memory Hierarchy, Cache Memories, Performance Considerations, Virtual Memory.

Text Book:

1. Carl Hamacher, Z Varnesic and S Zaky, "**Computer Organization**", Fifth Edition, McGraw Hill 2002.

Reference Books:

1. David A. Patterson and John L. Hennessey, "Computer Organization and Design", Fifth edition, Morgan Kauffman / Elsevier, 2014.

2. William Stallings “Computer Organization and Architecture”, Seventh Edition , Pearson Education, 2006.
3. Morris Mano, “Digital Logic and Computer Design”, Pearson Education Asia.
4. Morris Mano and Charles R Kime, “Logic and Computer Design Fundamentals”, Second Edition, Pearson Education Asia.

B18EC3063	Object oriented Programming using C++ (I)	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

Programming with C.

Course Description:

The purpose of this course is to provide the solid foundations in the basic concepts of C++ programming language. The 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, and exception handling, which are not present in C Programming Language. By studying this course, it will help students to get placed in IT Company.

Course Objectives:

The objectives of this course are to:

1. Discuss insights of object oriented programming (OOP) features and basics of C++ language.
2. Explain the syntax and Semantics of the C++ language as well as basic data types offered by the language.
3. Implement the fundamental OOP concepts like Classes, Objects, Inheritance and Polymorphism.
4. Discuss advanced C++ features file handling and exception handling.

Course Outcomes:

After completion of the course a student will be able to

1. Identify and classify C++ data types and operators.
2. Apply object-oriented features like classes and objects in C++ programs.
3. Demonstrate and use the concept of inheritance and polymorphism for code reusability.
4. Apply concepts like exception handling, threads, and files to write robust programs in C++.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC30 63	CO1	3	3	2		2				2			1	3	3	3
	CO2	3	3	3		3				2			1	3	3	3
	CO3	3	3	3		2				2			1	3	3	3
	CO4	3	3	3		3				2			1	3	3	3

Course Contents:

Unit-1: The Basic C++ Language

[11 Hrs]

The General Form of a C++ Program, Basic Datatypes: Literal, Variables, const-Qualifier, Pointer, Strings, Reference, Bool, Enumeration, Array types. Operators: Arithmetic Operators, Equality, Relational and Logical operators, Assignment operators, Increment and Decrement operator, Conditional Operator, Branching and Looping Statements.

Teaching is supported by programming examples

Unit-2: Classes and Objects

[10 Hrs]

Functions, Procedure Oriented vs Object-Oriented Programming, Features of Object-Oriented Programming, Class, Object, Data Member, Member Functions, Static Class Members, Constructors and its Types, Destructors, Friend Functions, Dynamic Memory allocation-New and Delete Keywords.

Teaching is supported by programming examples

Unit-3: Inheritance and Polymorphism

[11 Hrs]

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

Teaching is supported by programming examples

Unit-4: Files and Exception Handling

[10 Hrs]

Files and Streams: Opening a file, Closing a file, Writing to a file, Reading from a file, File Position Pointers. Exception Handling: Exception handling fundamentals, Throwing exceptions, Catching exceptions, Standard Exceptions, Defining a New Exception.

Teaching is supported by programming examples

Text Books:

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

Reference books:

1. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Pearson Education, 2003
2. R. G. Dromey, "How to Solve it by Computer", 2nd Edition, Prentice Hall International Series in Computer Science.

Supporting experimentation

1. a) Write a simple C++ program to read and display a student Name and SRN.
b) Write a C++ program using Pointers and References concept to solve theProgram-1a
c) Write a C++ program using arrays to read and display four student's SRN.
2. Write a C++ program to read 2 students 6 subject marks (out of 100), calculate the total marks of each student and display total marks of both students. Also find and display who has scored the highest total among the two students.
3. Write a C++ program to read 4 students 6 Subjects marks (out of 100) using any looping structure, calculate and display the total marks of each student?
4. Write a C++ program to create a Student class with two data members StudentName, SRN and member functions get_data, put_data to read and display the contents of the data members. Create two objects of Student class. Read and display the contents of the objects using member functions of the Student class.
5. Rewrite the code in Program 4 by using the concept of class constructor and destructor.
6. Rewrite the code in Program-4 by making use of dynamic memory allocation.
7. Write a C++ program to implement single inheritance. Create a base class Student with two data members SRN, Total Marks and with two member functions get_data, put_data to read and display information. Create a derived class EligibleStudent using public inheritance from base class. Create objects of base and derived classes and display information? (Note: class EligibleStudent should contain list of students those are eligible for final C3 exam).
8. Write a C++ program to implement exception handling mechanism?

SC-2

B18EC4061	Solid state Devices Theory (SSDT)	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Fundamentals of Physics

Course description:

This course is about basic semiconductor physics and the physics devices like PN junction, (BJT), and MOSFET. The course contents gives insight into basics of quantum mechanics and solid-state physics (energy bands, electrons and holes, the Fermi function), doping and carrier densities, carrier transport and generation-recombination, in addition the semiconductor equations, which provide a complete, semi-classical, mathematical description of electrons and holes in semiconductors, subject to some important simplifying assumptions. In addition the course applies these concepts to PN junction, (BJT), and MOSFET with their fabrication procedures.

Course Objectives:

The objectives of this course are to:

1. Present a brief idea about the Solid State Devices.
2. Describe various Fabrication Processes.
3. Understand the idea of Energy Band Diagrams.
4. Describe the construction and working of BJT and MOSFET.

Course Outcomes:

After the completion of the course, a student shall be able to:

1. Describe the operation of PN Junction Diode
2. Explain the various processes involved in an IC Fabrication
3. Compare the different configurations and operations of a Bipolar Transistor
4. Describe the construction and operation of a MOSFET

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC4061	CO1	1	2	2							3					
	CO2		2								3			2		
	CO3	2	1	2							3					2
	CO4	1		2	3	3					3			2	3	2

Course Contents:

Unit 1: The PN Junction Diode

[10 Hrs]

Introduction, Space Charge Region, Analytical relations at Equilibrium, Conditions in the diode with voltage applied, Currents in diode.

Unit 2: Fabrication Technology

[10 Hrs]

Introduction, Why Silicon, Purity of Silicon, Czochralski process, Fabrication process, Fabrication of resistors and capacitors

Unit 3: Bipolar Transistors

[11 Hrs]

Structure and Basic operation, Fabrication, Circuit arrangements, Currents in active region, BJT as a current amplifier, Transistor parameters, modes of operation.

Unit 4: Metal-Oxide-Silicon Systems

[11 Hrs]

Energy band diagrams, Band Bending and effect of Bias voltages, Analytical relations for charge densities, Construction and operation of MOSFET, Regions of operation, Secondary effects.

Text Book:

1. Kanaan Kano, "Semiconductor Devices", Pearson Education, 2004.

Reference Book:

1. Streetman, Banerjee, "Solid State Electronic Devices", PHI Learning, 2006.

B18EC4062	Data Structures Using C & C++	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

Programming language C++

Course Description:

This course covers the design, analysis, and implementation of basic data structures using C++. This course shall implement some of the data structures and basic aspects of C++ are also covered. A brief discussion of the C++ programming language is done. Survey of fundamental data structures (array, vector, lists, queue, stack, trees) and how to use them in C++. This course then delves deeper into the design, analysis and implementation of such data structures.

Course Objectives:

The objectives of this course are to:

1. Discuss insights into the basic concepts of data structures and algorithms.
2. Implement basic concepts about stacks, queues, lists, and Trees
3. Explain a concise about searching and sorting techniques.
4. Discuss insights into programming skills to implement data structures for real time applications.

Course Outcomes:

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

1. Identify and classify various types of data structures.
2. Write C++ programs to implement data structures like stack, queue, linked list, and tress.
3. Classify and describe various sorting and searching techniques.
4. Write C++ programs to implement sorting and searching techniques.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC406 2	CO1	2	1	2					2	3			3			
	CO2	2	3	3	3		2		3	2	1	2	3		2	3
	CO3	1	2	3					2	2			2		2	
	CO4	3	2	3			3		3		2		3	2	3	

Course Contents:

Unit-1: Introduction and Linear Data Structures: Stack & Queues

[11 Hrs]

Introduction to Data Structure: Types of Data Structure, Concept of Files; Stack: Concept, operations, Array Representation of Stack, Applications; Queues: Concept, Operations, Array Representation of Simple Queue, Circular Queue, Applications;

Unit-2: Linear Data Structure: Linked List

[10 Hrs]

Array Vs Linked List, Linked List concept, Operations on Linked List, Types of Linked List, Application of Linked List.

Unit-3: Non-Linear Data Structure: Trees

[11 Hrs]

Binary Tree Concept, Binary Tree representation, Operations on Binary Tree, Binary Tree traversal, Binary search tree implementation; The Huffman Algorithm.

Unit-4: Sorting and Searching Techniques

[10 Hrs]

Sorting: Concept, Insertion Sort, Quick Sort, and Heap Sort.

Ref: RU/BoS/ECE/CEC/June-2018-6

Searching: List Search, Linear Index Search, and Index Sequential Search

Text Books:

1. Langsam, Augenstein, Tenenbaum, "Data Structures Using C and C+", 2nd edition, Pearson Education India, 2015.
2. Seymour Lipschutz, "Data Structure with C", TMH.

Reference Books:

1. G. A. V. Pai, "Data Structures and Algorithms", TMH, 2008.
2. Debasis, Sarnanta, "Classic Data Structures", 2nd edition, PHI, 2009.

B18EC4063	Power Electronics	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Basic Electronics, Analog Electronic circuits.

Course Description:

In this course power, semiconductor devices control characteristics and 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 Course objectives are to:

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:

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

1. Identify suitable semiconductor device for a given application.
2. Apply knowledge of engineering fundamentals to analyze AC to DC and DC-DC, DC-AC and AC-AC converters for different load conditions.
3. Identify suitable converters for a given application.
4. Analyze and identify different types of modulation techniques used for control and conversion of power.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
B18EC40 63	CO1	3	3	1	1	2								3	3	3
	CO2	3	3	3	3	2								3	3	3
	CO3	3	3	2	1	2								3	3	2
	CO4	3	3	1										2	2	2

Course Contents:

Unit-1: Power semiconductor devices [11Hrs]

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 [10Hrs]

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 [11Hrs]

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 [10Hrs]

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.

B18EC4064	Probability and Random Processes	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Basic Mathematics, Calculus and fundamentals of probability.

Course Description:

This course introduces probability, distributions and statistics with applications. Topics include: Mean, Median, Mode, Correlation, Curve fitting, Random variables, Probability distributions, Joint densities, Hypothesis testing. Probability theory deals with many real-life problems, which either inherently involves the chance phenomena or describing the behavior of the system explicitly with statistical properties. Interpretation of the system behavior in many engineering and computing sciences depends on concept probability and statistics that familiarize with the computational aspects. The course deals with basic properties of various distributions and other related things.

Course Objectives:

The objectives of this course are:

1. Understand the basic concepts of probability theory and random variables
2. Operations one random variables. conditional probability and conditional expectation, joint distribution and independence, mean square estimation
3. Study and analyze random processes
4. Apply the concept of probability and random processes in engineering problems

Course Outcomes:

On completion of this course the student will be able to:

1. Concepts of probability theory and random variables.
2. Single and multiple Orandom variables. conditional probability and conditional expectation, joint distribution and independence, mean square estimation
3. Understand analyze random processes
4. Apply the concept of probability and random processes in engineering problems

Mapping of Course Outcomes with program Outcomes

Course Code	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
B20EC406 4	CO1	3	3	3	2					3			3	3	2	1
	CO2	3	3	3	1					3			3	3	2	1
	CO3	3	3	3	1					3			3	3	2	1
	CO4	3	2	3	2					3			3	3	2	1

Course Contents:

Unit 1: Probability Theory

[10 Hrs]

Introduction to probability theory: Experiments, Sample space, Events, Axioms, Assigning probabilities, Joint and conditional probabilities, Baye's theorem, Independence, Discrete random variables, Engineering examples.

Unit 2: Random Variables

[11 Hrs]

Random variables, Distributions, Density functions: CDF, PDF, Gaussian random variable, Uniform, Exponential, Laplace, Gamma, Erlang, Chi-square, Rayleigh, Rician and Cauchy types of random variables.

Operation on a single random variable: Expected value, EV of random variables, EV of functions of random variables, Central moments, Conditional expected values.

Unit 3: Functions

[10 Hrs]

Characteristics functions: Probability generating functions, Moment generating function, Engineering applications, Scalar quantization,
Pairs of random variables: Joint PDF, Joint probability mass functions, Conditional distribution, Density and mass functions,

Unit 4: Random Process

[11 Hrs]

Random process: Definition and characterization, Mathematical tools for studying random processes, Stationery and Ergodic random processes, Properties of ACF.

Example Processes: Markov processes, Gaussian processes, Poisson processes, engineering applications

Reference books:

1. S. L. Miller and D. C. Childers, "Probability and random processes: application to signal processing and communication", Academicpress/ Elsevier 2004, 2nd Edition.

2. A. Papoullis and S. U. Pillai, "Probability, random variables and stochastic processes", McGraw Hill 2002, 2nd Edition.
3. Peyton Z. Peebles, "Probability, Random variables and random signal principles", TMH, 4th edition, 2007, 3rd Edition.
4. H Stark and Woods, "Probability, random processes and application", PHI, 2001

SC-3

B18EC5051	Microelectronics	L	T	P	C
Duration: 14 Wks		3	0	0	3

Prerequisites:

Basic Electronic Circuits.

Course Description:

Microelectronics is the miniaturized electronic circuits that make up integrated circuits such as micro-controllers, micro- processors, FPGAs, operational amplifiers, analog-to-digital converters and many other functions. Microelectronics deals with the designing and manufacturing of very small electronic designs and components made up of semiconductor materials. The ability to use large number of components at relative low cost and the ability to match components accurately on-chip makes the design of integrated circuits and systems different from a similar design using discrete components.

Course Objectives:

The objectives of this course are to:

1. Understand the basic operation & design of single stage amplifiers.
2. Acquaint with frequency response of amplifier circuits.
3. Provide small signal analysis of amplifier with different loads.
4. Analyze the performance of digital logic circuits.

Course Outcomes:

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

1. Illustrate device structure and its physical operation, leading to a description of its terminal characteristics
2. Summarize operation of a transistor of either type as an amplifier, with emphasis on small-signal operation and modeling.
3. Compare the MOSFET and BJT characteristics

4. Produce delay model for digital circuits to analyze the propagation delay

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC50 51	CO1	1	3	2						3				1	2	
	CO2	2		1	3									1	2	
	CO3	2	1		3						3			1	2	
	CO4	3	2	1							3			2	1	

Course Contents:

Unit 1: MOSFETS [10 Hrs]

Device Structure and Physical Operation, Current –Voltage Characteristics, MOSFET Circuits at DC, MOSFET as an amplifier and as a switch, Examples using SPICE simulations.

Unit 2: Single Stage MOS Amplifiers [11 Hrs]

Biasing in MOS amplifier circuits, Small Signal operations & model, Single Stage MOS Amplifier, Introduction to High frequency MOSFET model, Examples using SPICE simulations.

Unit 3: Integrated Circuit Amplifiers [10 Hrs]

IC design philosophy, Comparison of MOSFET and BJT, IC biasing- Current sources, current mirrors, current steering circuits, High frequency response-general considerations, Miller’s Theorem and examples using theorem.

Unit 4: Digital CMOS Logic Circuits [11 Hrs]

Digital circuit design overview, Design and performance analysis of CMOS inverter, CMOS logic gate circuits, Pseudo NMOS logic circuits, Pass transistor logic circuits, Dynamic logic circuits.

Text Books:

1. Adel Sedra and K.C. Smith, “Microelectronic Circuits”, 5th Edition, Oxford University Press, Interantional Version, 2009.
2. Behzad Razavi, “Fundamentals of Microelectronics”, John Wiley India, Pvt. Ltd, 2008.
3. Sundaram Natarajan , “Microelectronics – Analysis and Design”, , Tata McGraw-Hill, 2007

B18EC5052	Java Programming	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Programming fundamentals, C, C++.

Course Description:

Java is among the most popular programming languages out there, mainly because of how versatile and compatible it is. Java can be used for a large number of things, including software development, mobile applications, and large systems development. Knowing Java opens a great deal of doors for you as a developer. Java is the one of the most popular programming languages in the world today. It works on any platform (Windows, Mac, Linux, etc), and is the core language used in developing Android apps.

Course Objectives:

The Objectives of this course are to:

1. Introduce difference data types, operators, and control flows in Java Programming
2. Provide strong foundation for “object Oriented Programming Language (OOPL)”
3. Demonstrate the proper code organization using packages, sub packages and interfaces
4. Provide insight into file handlings, exception handling, and multithreading.

Course Outcomes:

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

1. Identify different Java properties which are unique compared to C++ language
2. Use an appropriate programming environment to design, code, compile, run and debug object-oriented Java programs.
3. Demonstrate basic problem-solving skills: analyzing, modeling, creating, and implementing programs in an object-oriented language (using concepts like classes, objects, abstract classes, interfaces, inheritance, packages).
4. Apply concepts like exception handling, threads, and files to write robust programs in Java

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC5052	CO1	3	3	2		3				2			1	3	2	2
	CO2	3	3	3		3				2			1	3	3	3
	CO3	3	3	3		2				2			1	3	3	2
	CO4	3	3	3		2				2			1	3	3	3

Course Contents:

Unit-1: Java Revolution and Object-Oriented Fundamentals [10]

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.

Unit-2: Classes and Inheritance [11]

Object references, Instance variables, the new operator, The Dot operator, Method declaration, Method calling, this, Constructors, Method overloading; Inheritance: Super, Method Overriding, Dynamic method dispatch; final, finalize, static.

Unit-3: Packages, Interfaces and String Handling [10]

Abstract, Interfaces: The interface statement, The implement statement, Variables in interfaces; The package statement, Compiling classes in packages, the import statement, Access protection; String Handling: Constructors, Special String Syntax, Character Extraction, Comparison, String copy modification

Unit-4: Exception Handling, Threads, and Files [11]

Fundamentals, Exception types, try and catch, Multiple catch clauses, Nested try statements; Threads: Single threaded event loop, The java thread model, Thread, Runnable, Thread priorities; Input/output: Files, Input Stream, Output Stream, File streams

Text book:

1. Patrick Naughton, "The Java Handbook", Tata McGraw-Hill, 2006 (Chapters 1 to 11, 13)

Reference Books:

1. Herbert Schildt "The Complete Reference – Java 2", Fifth Edition, Tata McGraw-Hill 2002
2. Bruce Eckel, "Thinking in Java", III Edition, Pearson 2004.

B18EC5053	Optical Fibre Communication	L	T	P	C
Duration: 14 wks		3	0	0	3

Prerequisites:

Communication Basics, Analog and Digital Modulation schemes, EM waves, Physics Optics.

Course Description:

Optical Fiber communications is 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 fibre optics efficiently. The course treats important devices as optical fibres, 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:

1. Conceptualize and analyze mathematically propagation of optical signals over optical Fiber cables.
2. Conceptualize the degradation of signals during propagation of optical signals over optical fiber.
3. Explain the construction and characteristics of optical sources and detectors.
4. Analyze various techniques for coherent transmission and system performance factors in optical Communication system.

Course Outcomes:

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

1. Analyze the optical fiber communication link, structure, propagation, fiber configurations, and modes of transmission in fiber.
2. Estimate the signal degradation factors/losses associated with optical fibers and optical components in optical communication systems.
3. Analyze the characteristics of optical sources and photo detectors, and design short haul and long haul analog/digital optical fiber communication system
4. Analyze the performance of optical receiver based on receiver sensitivity/channel selectively, fiber optic link based on link budgets and power budgets and design a reliable/lossless optical fiber communication system

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC 5053	CO1	3	1								2					
	CO2	3	1	1							2				2	1
	CO3	3	1	1		1					2				2	1
	CO4	3	2		1						2	1	1		2	1

Course Contents:

Unit – 1: Overview to Optical Fiber Communication

[11Hrs]

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; Optical Fiber Modes and Configurations - Step-index and Graded-index fiber, Single mode and Multi-Mode fibers; Modal Concepts - V Number ; Single mode fibers - Cutoff wavelength , Mode Field Diameter, Fiber Birefringence; Average optical power; Fiber Materials.

Unit – 2: Signal Distortion in Optical Fibers

[10Hrs]

Attenuation; Scattering Losses - Concepts of Rayleigh, Mie, Brillouin and Raman Scattering; Fiber Bend Loss; Dispersion - Concepts of Modal Dispersion, Material Dispersion, Waveguide Dispersion, Polarization Mode Dispersion; Optical Amplifier EDFA Amplification Mechanism, EDFA Architecture, Basic parameters – PCE, QCE, Gain ; Fiber Alignment - Joint Loss, Fiber Couplers – FBT coupler, Star couplers , Practical parameters of Couplers; Fiber Connectors – Butt Joint Connector, Expanded Beam Connector; Fiber Splices - Fiber Splicing Techniques.

Unit – 3: Optical Transmitter and Receiver

[11hrs]

Optical sources – LED structures, Materials, 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 - Physical Principle of PIN and APD, Practical parameters - Quantum efficiency, Detector responsivity, Cutoff wavelength, Photo Detector Noise, Response Time; Optical Receiver – Fundamental Receiver Operation, Practical parameters - Receiver sensitivity, Quantum Limit, Eye diagrams, Concepts of Coherent detection.

Unit – 4: OFC System Design Considerations

[10 Hrs]

Analog Links – Overview of Analog Links, CNR, Multichannel Transmission Techniques, Link Parameters Definitions – Gain, Noise Figure, SFDR; Digital Links – Simplex Point to point link, System Considerations, Link Power Budget and Rise Time Budget with examples, Power Penalties, Modal noise, Mode-Partition Noise ,Reflection Noise, Chirping.

Text Books:

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

Reference Books:

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

B18EC5054	Research Methodology & IPR	L	T	P	C
Duration:14Wks		3	0	0	3

Prerequisites:

No Prerequisites

Course Description:

The course aims to give a broad understanding of research methodology, including qualitative and quantitative methods. The main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation are discussed. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choice. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments. Also IPR frameworks are discussed to give them insight into the patent drafting.

Course Objectives:

The objectives of this course are to:

1. Develop the most appropriate methodology for their research studies, irrespective of their discipline.
2. Explain the research skills and equip them to carry out individual or team research work according to scientific/technology requirements.
3. Illustrate different IPR Legislations and IPR filing procedures.

Course Outcomes:

On completion of this course the student will be able to:

1. Identify and describe researchable ideas, projects and themes.
2. Develop the thesis layout and document using the LATEX tool.
3. Identify different IPR Legislations.
4. Formulate IPR norms for different case studies.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC 5054	CO1	2	3	1	3				2	2	2				2	1
	CO2	1	3	2	2						2		1		2	1
	CO3	1	2	1	3						2	1	1		2	1
	CO4	2	2	1	1				3	2	3	2	2		2	1

Course Contents:

Unit-1: Research and Types of research

[11 Hrs]

Meaning of Research- Objectives of Research- Motivation in Research. Research methods v/s Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Research Process. Criteria of good Research. Defining the Research Problem - Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem, Technique Involved in Defining a Problem, Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design, Different Research Designs.

Unit-2: Thesis writing and Ethics.

[11 Hrs]

Structure and components of scientific reports - Types of report – Technical reports and thesis, Significance –Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication. **LATEX**: Introduction to LATEX and it's usage in documentation, preparation of thesis, technical papers and articles.

Unit- 3: Intellectual Property Rights

[10 Hrs]

Intellectual Property Rights: Introduction, Legislations covering IPR in INDIA; Patents: Conditions to be satisfied by an invention to be patentable, Patentable inventions under patent Act 1970, Types of patents which are not patentable in INDIA, Term of patent in INDIAN system, Essential patent documents to be submitted, Criteria for naming inventors in an application of patent, Where to apply ?How to apply?, Why provisional specification, Complete specification, Hierarchy of officers in patent office, Register of patents ,working of patents and company licensing, Revocation of patents, Term of patents, Patent of addition

Unit-4: Other Intellectual Property Rights**[10 Hrs]**

Copy Right; Trade Marks; Geographical Indications; Industrial Designs; Layout Design of Integrated designs; Plant variety; International Patenting; Case studies

Text Books:

1. Kothari, C. R. "Research methodology: Methods & techniques". New Delhi: New Age International (P) Ltd, 2nd Edition, 2004.

References:

1. "LATEX Documentation" available at <http://www.latex-project.org/>
2. "Patent Manual", available at http://www.bits-pilani.ac.in/uploads/Patent_ManualOct_25th_07.pdf

SC-4

B18EC5061	ARM Processors and Applications	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Familiarity with Digital Electronic Circuits, Hexadecimal Number System

Course Description:

Progress in the ARM microcontroller community since the publication of the first edition of this book has been impressive, significantly exceeding our expectations and it is no exaggeration to say that it is revolutionizing the world of Microcontroller Units (MCUs). There are many thousands of end users of ARM-powered MCUs, making it the fastest growing MCU technology on the market. As such, the second edition of Joseph's book is very timely and provides a good opportunity to present updated information on MCU technology.

Course Objectives:

Course objectives are to

1. Explain the architecture of ARM Cortex M3.
2. Demonstrate programming ARM Cortex M3.
3. Apply the knowledge of ARM Cortex M3 to design an embedded systems using various interfaces.
4. Summarize the embedded system design with the specified constraints using ARM Cortex M3.

Course Outcomes:

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

1. Analyze a given problem and design a suitable embedded system using ARM Cortex M3.
2. Apply the knowledge of programming in assembly language and C language to receive data, process it and control the various actuators.
3. Summarize the embedded system design and operations using ARM Cortex M3.

Mapping of Course Outcomes with programme Outcomes

POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3									2	1
CO2				1	3									2	1
CO3										2	1	2			

Course Contents:

Unit 1: ARM-32 bit Microcontroller.

[10]

Architecture of ARM Cortex M3, Various Units in the architecture, Debugging architecture. General Purpose Registers, Special Registers,

Unit 3: Instruction Sets.

[11]

Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming Time delay calculations,

Unit 3: Exceptions and Interrupts.

[10]

Exceptions, interrupts, stack operation, reset sequence, programming in Assembly and C

Unit 4: Programming.

[11]

Timers/counters, Serial Communication: Data communication, connections to RS-232 programming in Assembly and C.

Text book:

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

Laboratory experiments.

1. Data Transfer Instructions: Data Transfer between internal and external RAM with and without overlap, Sorting, largest and smallest number in an array and exchange.
2. Arithmetic Instructions: 32 bit multi-precision Addition, Subtraction, Multiplication of 2 numbers

3. Logical Instructions: 8x8 multiplication using shift Add technique. ASCII to packed BCD and vice versa.
4. Timers: Wave form generation with varying Duty Cycle using Interrupt and Polling Techniques.
5. Serial Communication: Serial data transmission with Polling and Interrupt technique (Regular and Look up table).
6. Serial Reception and Display the ASCII value.
7. Count the incoming pulses using counters.

B18EC5062	Theory of Algorithms	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Data structures and C or C++

Course Description:

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, you will be well-positioned to ace your 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:

Course objectives are to:

1. Provide an understanding of fundamentals of algorithms to solve Engineering challenges.
2. Provide an understanding of various aspects of analysis of the problem domain and arrive at a suitable algorithm.
3. Understanding of arriving at a Pseudo code level of any challenge.
4. Provide a comprehensive look at the challenges in engineering problems to provide an effective and efficient solution.

Course Outcomes:

At the end of this course, student will be able to:

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.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO 1	P O 2	PO 3	PO 4	PO 5	PO 6	P O 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
B18EC50 62	CO1	3	3	2	1								2	3	1	
	CO2	3	3		1								1	3		
	CO3	3	3	2	1								1	3	1	
	CO4	3	3	1	1								1	3		

Course Contents:

Unit 1: Introduction to algorithms

[10Hrs]

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.

Unit 2: Divide - Conquer and Decrease - Conquer Approach

[11Hrs]

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.

Unit 3: Dynamic Approach and Greedy technique

[10Hrs]

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

[11Hrs]

Limitations and Coping of Algorithmic Power: Lower-Bound Arguments, Decision Trees, P, NP, and NP-Complete Problems, Backtracking, Branch-and-Bound.

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.

B18EC5063	Biomedical Signal Processing	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Signals & Systems, Digital Signal Processing, Linear Algebra.

Course Description

This course presents the fundamentals of digital signal processing with particular emphasis on problems in biomedical research and clinical medicine. It covers principles and algorithms Nature of Biomedical Signals, Examples of Biomedical Signals (ENG, EMG, ECG, EEG, ERP, EGG, PCG, CP, VMG, VAG), Biomedical Signal Analysis and Computer aided Diagnosis. Topics include Basic Electrocardiography, ECG lead systems, ECG Signal characteristics, ECG QRS Detection, ECG Analysis Systems. The focus of the course is in Neurological Signal Processing, processing physiological data, with examples from cardiology, speech processing, and medical imaging. Lectures cover signal processing topics relevant to the Data Acquisition and Classification of sleep stages, The Markov Model and Markov Chains, Dynamics of Sleep-Wake Transitions, Hypnogram Model parameters, Event History Analysis for modeling Sleep.

Course Objectives:

The objectives of this course are to:

1. Identify the application of the main signal processing tools to the analysis of biomedical signals.
2. Describe how clinically relevant information can be extracted from these signals.
3. Relate advanced signal processing for uni and multi-modal medical signals.
4. Discuss advanced signal processing for multidimensional medical signals.
5. Interpret and analyse medical signals from a set of specific medical applications.
6. Describe and apply signal processing methods for removal of artefacts in medical signals.
7. Estimate unique segments or regions in medical signals and images using automatic signal processing methods for classification.

Course Outcomes:

At the end of this course, student will be able to:

1. Apply statistical and adaptive signal modelling for multidimensional medical signals.
2. List the various ECG systems.
3. Define and apply signal processing methods for removal of artefacts in medical signals

4. Illustrate unique segments or regions in medical signals and images using automatic signal processing methods for classification.
5. Explain Smear signal processing methods for characterization of physiological and pathological phenomena

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC506 3	CO1	2	2											2		
	CO2		2	2	3									2		2
	CO3		3	3	2								3	3		2
	CO4		2	3	4								3			3
	CO5		2	2	2											3

Course Contents:

Unit-1: Introduction to Biomedical Signals **[10 Hrs]**

Nature of Biomedical Signals, Examples of Biomedical Signals (ENG, EMG, ECG, EEG, ERP, EGG, PCG, CP, VMG, VAG), Objectives of Biomedical Signal Analysis, Difficulties in (this text can be removed) Biomedical Signal Analysis, Computer aided Diagnosis.

Unit-2: Electrocardiography **[11 Hrs]**

Basic Electrocardiography, ECG lead systems, ECG Signal characteristics, ECG QRS Detection, ECG Analysis Systems.

Unit-3: Neurological Signal Processing **[11 Hrs]**

The Brain and its potentials, The Electrophysiological Origin of Brain Waves, EEG signal and its characteristics, EEG Analysis, Linear Prediction Theory, The AR method, Recursive Estimation of AR Parameters.

Unit-4: Sleep EEG **[10 Hrs]**

Data Acquisition and Classification of sleep stages, The Markov Model and Markov Chains, Dynamics of Sleep-Wake Transitions, Hypnogram Model parameters, Event History Analysis for modeling Sleep.

Text Books:

1. Rangaraj M Rangayyan, "Biomedical Signal Analysis" A case study approach, John Wiley publications. Second Edition 2009
2. Willis J Tompkins, ED, "Biomedical Digital Signal Processing", Prentice-Hall of India, 1993.

3. DC Reddy, “Biomedical Signal Processing Principles and Techniques”, Tata McGraw-Hill, First Edition 2005.

B18EC5064	Automotive Electronics	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Microcontroller, Instrumentation and Transducers.

Course Description:

Electronics plays a major role in the current automobile industry. From a temperature sensor recording, the temperature outside the car to the Engine Control Unit (ECU), electronics has made driving relatively simpler and safer. It covers the topics on engine management systems, Sensors and actuating systems, Exhaust treatment systems, Automotive Diagnostics. It majorly concentrates on Communication Protocols used to communicate between different ECU’s and finally it describes Electronic systems for Passenger Safety and convenience systems

Course Objectives:

Course objectives 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), Design ACP based In-Vehicle Networks(IVNs), selection of ACPs for various application in Automotive
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:

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

1. Implement and Interface sensors for various automotive applications
2. Design and diagnose the faults in the systems Implement automotive fault diagnostics and faults.
3. Analyze on and off board diagnostics, diagnostics protocol
4. Explain the different types of ECUs

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC50 64	CO1		2	3		1								1	2	
	CO2							1		2	3				1	
	CO3				3			1	1							1
	CO4		2		2											1

Course Contents:

Unit-1: Automotive Industry and Modern Automotive Systems

[11 Hrs]

Vehicle classifications and specifications, need for electronics in automobiles, Automotive Fundamentals Overview – Four Stroke Cycle, Engine Control, Spark and Compression Ignition Engines, 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 instrumentation

[10 Hrs]

Sensors and actuators, Air/ Fuel Management Sensors – Oxygen (O₂/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor - Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle sensor

Sensors in Engine control, adaptive cruise control, braking control, traction control, steering, stability, Lighting, wipers, climate control, Sensors for occupant safety,

Sensor and actuator interfacing techniques and electronic displays.

Actuators – Fuel Metering Actuator, Fuel Injector, Ignition Actuator

Unit 3: Exhaust After-Treatment Systems

[11 Hrs]

Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR), Evaporative Emission Systems

Electronic Engine Control – Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle speed control, EGR Control

Communication – Serial Data, Communication Systems, Power windows, Remote keyless entry systems, GPS, **Automotive Communication Protocols**

Protection, Body and Chassis Electrical Systems, Remote Keyless Entry,

Vehicle Motion Control – Cruise Control, Chassis, , Power Brakes, antilock braking systems, Electronic stability and other technologies, Traction Control, Electronic Stability Control, Electronically controlled suspension

Fundamentals of electronically controlled steering system, Power Steering,

Unit 4: Electronics for Passenger Safety and Convenience

[10 Hrs]

Electronics for Passenger Safety and Convenience – SIR, Air bag and seat belt pretension systems, Tire pressure monitoring systems,

Automotive Instrumentation – Sampling, Measurement & Signal Conversion of various parameters

Integrated Body – Climate Control Systems, Electronic HVAC Systems,

Lighting, Entertainment Systems

Automotive Diagnostics – Timing Light, Engine Analyzer, Process of Automotive Fault Diagnostics, Fault Codes, On-board diagnostics, Off-board diagnostics, Expert Systems.

Future Automotive Electronic Systems – Alternative Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System, AFS.

Text Books:

1. Denton, “Automotive Electrical and Electronic Systems, Burlington”, MA 01803, Elsevier Butterworth-Heinemann, 2004.
2. Ronald K. Jurgen, “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill, 2007.
3. William B. Ribbens, “Understanding Automotive Electronics, 5th Edition, Newnes, 2006.
4. Robert Bosch GmbH, “Bosch Automotive Electrics & Electronics: Systems and Components, Networking and Hybrid Drive”, Robert Bosch GmbH, 3rd Edition, 1999.

SC-5

B18EC5071	System Verilog	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

Logic Design, Verilog, C++, Digital system.

Course Description:

This course aims to give an in-depth introduction to the System Verilog which is an enhancement to the Verilog hardware description language (HDL). It also discusses the benefits of the new features,

and demonstrates how design and verification can be more efficient and effective when using System Verilog constructs.

Course Objectives:

The objectives of this course are to:

1. Understand logic verification using Verilog simulation.
2. Learn the features of System Verilog,
3. SVA and basics of UVM for verification, and understand the improvements in verification efficiency.
4. Demonstrate the advanced verification features, such as the practical use of classes, randomization, checking, and coverage.
5. Illustrate the advanced coverage driven verification environments using advanced System Verilog features, SVA and UVM.

Course Outcomes:

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

1. Develop the test benches for digital systems.
2. Perform the functional coverage for a given digital circuit.
3. Apply the constrained random stimulus to a digital circuit.

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B20	CO1	3		3		2								2	3	1
EC	CO2	2		3	1									2	3	1
5071	CO3	2		3	1	3								2	3	1

Course Contents:

Unit 1: Verification guidelines and Introduction to data types [10]

The verification process, basic test bench functionality, directed testing, methodology basics, constrained random stimulus, randomization, functional coverage, test bench components.

Data Types: Built in Data types, fixed and dynamic arrays, Queues, associative arrays, linked lists, array methods, choosing a storage type, creating new types, creating user defined structures, Enumerated types, constants and strings, Expression width.

Unit 2: Procedural statements, routines & connecting the test bench and Design [11]

Procedural statements, Tasks, Functions and void functions, Task and function overview, Routine arguments, returning from a routine, local data storage, time values

Separating the test bench and design, the interface construct, Stimulus timing, Interface driving and sampling, System Verilog assertions.

Ref: RU/BoS/ECE/CEC/June-2018-6

Unit 3: Threads and Inter process Communication**[10]**

Working with threads, Disabling threads, Inter process communication, Events, Semaphores, Mailboxes, Building a test bench with threads and IPC.

Unit 4: Functional Coverage**[11]**

Coverage types, Coverage strategies, Simple coverage example, Anatomy of Cover group and Triggering a Cover group, Data sampling, Cross coverage, Generic Cover groups, Coverage options, Analyzing coverage data, measuring coverage statistics during simulation.

Text Books:

1. Chris Spear, "System Verilog for Verification – A guide to learning the Test bench language features", Springer Publications, 2nd Edition, 2010.

Reference Books:

1. Stuart Sutherland, Simon Davidmann, Peter Flake, "System Verilog for Design-A guide to using system verilog for Hardware design and modeling", Springer Publications, 2nd Edition, 2006.

B18EC5072	Relational Data Base Management Systems (RDBMS)	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

This subject requires the student to know about Basics of computer and fundamental concepts of set theory.

Course Description:

Database Management Systems (DBMS) are vital components of modern information systems. ... In the first half of the course the relational data model, relational query languages, relational database design and conceptual data modeling are reviewed. It then focuses on XML, RD, OWL, parallel, and noSQL databases.

Course Objectives

The course objectives are to:

1. Memorize the basics terminologies of Databases, Conceptual design using ERD.
2. Demonstrate the relational database system using relational algebra.
3. Apply to create the Relation or a Table in a DATABASE using SQL.
4. Analyse the Database applications for real world problems by using different Normalization techniques.

Course Outcomes

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

1. Define the basic terminologies of RDBMS.
2. Discuss the relational data model and relational algebra
3. Demonstrate the table or a relation in Database and ER Model.
4. Survey the different database applications for real word problems using normalization techniques.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC5072	CO1	3	1	2										2	3	1
	CO2	3	2	1										3	2	1
	CO3	3	1	2										2	3	1
	CO4	3	1	2										1	2	3

Course Contents:

Unit-1: Introduction to Databases and Conceptual Modelling

[11 Hrs]

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

[10 Hrs]

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

[11 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**[10 Hrs]**

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.

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

Reference Book:

1. Silberschatz, Korth and Sudharshan, "Database System Concepts", Fourth Edition, Mc-GrawHill, 2002

B18EC5073	Digital signal Processor Architecture (DSPA)	L	T	P	C
Duration 14 Weeks		3	0	0	3

Prerequisites:

Fourier Transform, Fast Fourier transform, Filter Design, Data structure, Behavior Modeling.

Course Description:

DSP Processor Architecture course provides an introduction on the industry-based DSP processor's architecture and their algorithms. Students will learn about the addressing modes, instruction set and memory allocation of the TMS320C67XX processor.

Course Objectives:

Course objectives are to:

1. Summarize the architecture, programming, and interfacing of commercially available programmable DSP devices and to use them effectively and optimally in system implementations.
2. Discuss the knowledge of basic DSP filter algorithms.
3. Introduce the concepts of digital signal processing techniques, implementation of DFT & FFT algorithms by programming the DSP TMS320C54XX Processor.
4. Analyze about interfacing of serial & parallel communication peripherals.

Course Outcomes:

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

1. Describe various issues that need to be addressed when implementing DSP algorithms.
2. Explain the architecture details and instruction sets of specific DSP Processors.
3. Illustrate the features of on-chip peripheral devices & its interfacing and pipeline operations along with its programming details.
4. Apply signal processing algorithms like DIT,DIF, IIR/FIR.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC507 3	CO1	3	2	1									1		2	1
	CO2	2	1	1	1	1	1						1		2	1
	CO3	3	1	1											2	1
	CO4	2	1	1	1								1		2	1

Course Contents:

Unit-1: Introduction to Digital Signal Processing and Architectures for Programmable Digital Signal Processors. [11hrs]

Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation, and Interpolation. Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing.

Unit-2: Programmable Digital Signal Processors [10hrs]

Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS320C54xx., Memory Space of TMS320C54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54xx Processors, Pipeline Operation of TMS320C54xx Processor.

Unit-3: Implementation of Basic DSP Algorithms and Implementation of FFT Algorithms [11hrs]

Introduction, the Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). Introduction, an FFT Algorithm for DFT Computation, Overflow and Scaling, Bit-Reversed Index Generation & Implementation on the TMS320C54xx.

Unit 4: Interfacing Memory and Parallel I/O Peripherals to DSP Devices and Interfacing and Applications' Of DSP Processor. [10hrs]

Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I / O Direct Memory Access (DMA). Introduction, Synchronous Serial Interface, A CODEC Interface Circuit. DSP Based Bio-Telemetry Receiver, A Speech Processing System, An Image Processing System.

Text Books:

1. Avatar Singh and S. Srinivasan, "Digital Signal Processing", Thomson Learning 2004.
2. Venkataramani and M. Bhaskar, "Digital Signal Processors", TMH, 2002

Reference Books:

1. Ifeachor E. C., Jervis B. W, "Digital Signal Processing: A practical approach", Pearson-Education, PHI 2002
2. Peter Pirsch, "Architectures for Digital Signal Processing", John Weily, 2007

B18EC5074	Mechatronics	L	T	P	C
Duration: 14 Wks		3	0	0	3

Prerequisites:

Knowledge of elements of mechanical engineering, digital electronics and Microprocessor.

Course Description:

This course is an introduction to Mechatronic systems, which require integration of the mechanical and electronics engineering disciplines within a unified framework. Topics covered in the course include: Sensors, Transducers, elements of electrical actuation systems and signal conditioning circuits. It also describes the different concepts of system models and controllers. Finally, it covers the concept of programming logic controllers.

Course Objectives:

The objectives of this course are to:

1. Understand the requirements of Mechatronics systems and recognize its various elements.
2. Understand the actuation systems and signal conditioning circuits.
3. Understand the concepts of system models and controllers
4. Understand the implementation of programmable logic controllers for Mechanical drives.

Course Outcomes:

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

1. Define Mechatronics systems and recognize its various elements.
2. Compile the key elements of electrical actuation systems and signal conditioning circuits.
3. Demonstrate the concepts of system models and controllers.
4. Understand the concepts of programming logic controllers.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC5074	CO1	2	3												2	
	CO2				3			2						2		1
	CO3		1	2		3								2	1	
	CO4		2	3			1								2	

Course Contents:

Unit-1: Sensors and Transducers

[11 Hrs]

Introduction to Mechatronics Systems, Measurement Systems, control Systems, Microprocessor based Controllers. Sensors and Transducers , Performance Terminology , Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors Selection of Sensors.

Unit-2: Actuation Systems

[10 Hrs]

Rotary Actuators, Mechanical Actuation Systems, Cams, Gear Trains, Ratchet and pawl Belt and Chain Drives, Bearings. Electrical Actuation Systems, Mechanical Switches Solid State Switches , Solenoids Construction and working principle of DC and AC Motors speed control of AC and DC drives, Stepper Motor switching circuitries for stepper motor, AC & DC Servo motors.

Unit-3: System Models and Controllers

[11 Hrs]

Building blocks of Mechanical, Electrical, Fluid and Thermal systems, Rotational, Translation systems, electromechanical systems, Hydraulic Mechanical Systems. Continuous and discrete process Controllers, Control Mode, Step mode, Proportional Mode, Derivative Mode, Integral Mode, PID Controllers, Digital Controllers, Velocity Control, Adaptive Control, Digital logic control, Microprocessors control.

Unit-4: Programming Logic Controllers**[10 Hrs]**

Programmable Logic Controllers, Basic Structure , Input / Output Processing ,Programming ,Mnemonics , Timers, Internal relays and counters , Shift Registers , Master and Jump Controls , Data Handling , Analogs Input / Output, Selection of a PLC.

Text Books:

1. W. Bolton, Longman ,”Mechatronics”-, 2nd Pearson Publications, 2007
2. R.S. Ganokar ,”Microprocessor Architecture, programming and applications with 8085.8085A”-, Wiley Eastern.

Reference Books:

1. Godfrey C. Canwerbolu, Butterworth- Heinemann ,”Mechatronics Principles & applications” 2006.
2. DanNecsulescu ,”Mechatronics”-, Pearson Publication, 2007
3. David. G. Aliciatore& Michael B. Bihistand ,”Introduction Mechatronics & Measurement systems” , , tata McGraw Hill, 2000.
4. Sabricentinkunt ,”Mechatronics” , John wiley& sons Inc. 2007

SC-6

B18EC6041	Embedded Systems	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Microcontroller, Operating Systems.

Course Description:

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.

Unit1 gives an introduction to the basic elements of embedded system such as sensors, interfaces, firmware etc.

Unit2 discusses about the various aspects of hardware software co design.

Unit3 covers the complete aspects on real time embedded system design.

Unit4 briefly covers the various topics on embedded integrated development environment.

Course Objectives:

Course objectives are to:

1. Give a brief idea about the embedded system components, memory, communication interfaces and other firmware components.
2. Understand the Quality attributes, hardware and Software co-design, Computational models in embedded systems, Unified Modelling languages etc.
3. Understand the firmware system development and firmware development languages.
4. Give a brief description of RTOS, Integrated Development Environment, Simulators and Emulators.
5. Understand the trends in embedded system development.

Course Outcomes:

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

1. Design a module of embedded system
2. Elaborate the quality attributes, hardware-software co-design in embedded systems.
3. Develop a firmware module.
4. Analyze the various tools in RTOS.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC60 41	CO1	3	2		1	3	1				2	1	2		1	1
	CO2	3	2	2	1	3									1	1
	CO3						1				2	1	2			
	CO4	3	2	2	1	3									1	1

Course Contents:

Unit-1: Typical Embedded System

[10 Hrs]

Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components.

Unit-2: Characteristics and Quality Attributes of Embedded Systems

[11 Hrs]

Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language (**Self Study/Case Study**), Hardware Software Trade-offs

Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages

Unit-3: Real-Time Operating System (RTOS) based Embedded System Design [10Hrs]

Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS (**Self Study/Case Study**).

Unit-4: The Embedded System Development Environment [11 Hrs]

The Integrated Development Environment (IDE) (**Self Study/Case Study**), Types of Files Generated on Cross-compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.

Trends in the Embedded Industry: (Self Study/Case Study), Processor Trends in Embedded Systems, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks.

Text Books:

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009
2. James K Peckol , "Embedded Systems – A contemporary Design Tool", John Weily, 2008.

B18EC6042	Data Mining	L	T	P	C
Duration :14 Weeks		3	0	0	3

Prerequisites:

Probability and statistics, Database Management Systems

Course Description:

In this course the fundamental knowledge of extract usable data from a larger set of any raw data. It implies analysing data patterns in large batches of data using one or more software. The major techniques of data mining is concentrated and numerical problem to achieve the desired result is concentrated upon the course covers the detail description about various algorithms, learning of predictive and descriptive models.

Course Objectives

To introduce DM as a cutting edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modeling, and identifying new trends and behaviors.

The course objectives are to:

1. Learning how to gather and analyze large sets of data to gain useful business understanding.

2. Learning how to produce a quantitative analysis report/memo with the necessary information to make decisions.
3. Describing and demonstrating basic data mining algorithms, methods, and tools
4. Identifying business applications of data mining
5. Overview of the developing areas - web mining, text mining, and ethical aspects of data mining.
6. encourage students to develop and apply critical thinking, problem-solving, and decision-making skills, and apply enthusiasm for learning. Class participation is encouraged in this course.

Course Outcomes

On completion of this course the students will be able to:

1. Define knowledge discovery and data mining ,recognize the key areas and issues in data mining.
2. Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.
3. Determine the real world problem and apply evaluation metrics to select data mining techniques.
4. Apply clustering technique for data mining problems.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC6042	CO1	2					2	1					2			1
	CO2		2	1		2				2				1		
	CO3	2	3		3	2						1	1			2
	CO4	2	3		3	2						1	1			2

Course Contents

Unit-1

[11hrs]

Introduction to Data Mining and Preprocessing Techniques: What is Data Mining, Motivating Challenges, The Origins of Data Mining, Data Mining Tasks, Types of Data, Data Preprocessing techniques, Measures of Similarity: Similarity Measures for binary data, Jaccard Coefficient, and Cosine similarity, Applications of DM.

Unit-2

[10hrs]

Association Analysis: Basic Concepts and Algorithms-Basic Concepts and Algorithms: Problem Definition, Frequent Item set Generation: The Apriori principle, frequent Item set generation in the Apriori algorithm, Rule Generation, Alternative methods for generating Frequent Item sets, FP GROWTH Algorithm: FP Tree representation, Frequent Items et generation in FP Growth Algorithm.

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Unit-3**[11 hrs]**

Classification: Basic Concepts, Decision Trees-Basics concepts, General Approach to solve classification problem, Decision Tree Induction: How a decision tree works, How to build decision tree and Hunt's algorithm.

Classification: Alternative Techniques-Rule Based Classifiers: sequential covering algorithm. The Nearest Neighbor Classifiers, Bayesian Classifiers: Bayes theorem, using the Bayes theorem for classification, Naïve Bayes Classifier.

Unit-4**[10 hrs]**

Clustering Analysis: Basic Concepts and Algorithms-Overview, What is Cluster Analysis, Different types of clustering, and Different types of clusters. The Basic K-means algorithm, Basic Agglomerative hierarchical clustering, The DBSCAN algorithm. Graph Based Clustering, Scalable Clustering Algorithms.

Text Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2005.
2. G.K. Gupta, "Introduction to Data Mining with Case Studies", 3rd Edition, PHI, New Delhi, 2009.

Reference Books:

1. Jiawei Han and MichelineKamber , "Data Mining – Concepts and Techniques", 2nd Edition, Morgan Kaufmann Publisher, 2006
2. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining and OPAL", Computing McGraw Hill Publisher, 1997.
3. EthemAlpaydam, "Introduction to Machine Learning", PHI Publication, 2006
4. Arun K. Pujari, "Data Mining Techniques", 2nd Edition, Universities Press, 2009.

B18EC6043	Image Processing	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites

Signals & Systems, Digital Signal Processing, Linear Algebra

Course Description

This course covers the investigation, creation and manipulation of digital images by computer. The course consists of theoretical material introducing the mathematics of images and imaging. Topics include representation of two-dimensional data, time and frequency domain representations,

filtering and enhancement, , convolution, color images, compression and segmentation. This course found wide applications not only in the space program, but also in the areas such as medicine, biology, industrial automation, astronomy, defense and intelligence.

Course Objectives:

The course objectives are to:

1. Study the image fundamentals and mathematical transforms necessary for image processing.
2. Study the image enhancement techniques
3. Study image restoration procedures.
4. Study the image compression procedures.

Course Outcomes

On completion of this course the student shall be able to

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms and evaluate the techniques for image enhancement
3. Analyze image restoration techniques and Categorize various compression techniques.
4. Design image segmentation techniques

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC60 43	CO1	3	3	2			1	1			3	3	2	1	1	1
	CO2	3	3	3	2			1		3	3	2	2	2	2	3
	CO3	3	3	3	2			1		3	3	2	2	2	2	3
	CO4	3	3	3	2			1		3	3	2	2	2	2	3

Course Contents:

Unit-1: Introduction

[11]

Image Sampling, Quantization, Resolution, Classification of Digital Images, Image Types, Image File Formats, 2D signals, Separable Sequence, Periodic Sequence, 2D convolution, 2D Convolution using graphical Method, Circular and linear Convolution Through matrix Analysis and its applications, 2D Auto correlation, cross correlation. Light and color, Color Formation, Human Perception of color, color Model, The chromaticity Diagram.

Unit-2: Image Transforms

[10]

2D Discrete Fourier Transform, Properties of 2D-DFT, DCT , properties ,Haar Transform, properties, Hadamard transform, properties, slant transform ,properties. Image Enhancement in spatial Domain, Enhancement through point operation, Types of Point operation, Histogram Equalization (problems), Linear and Non Linear Grey-level Transformation, Median Filter.

Unit-3: Image Restoration and De-noising**[10]**

Image Degradation, Types of Image Blur, Classification of Image Restoration Techniques, Image restoration model, Linear Image restoration techniques and non-linear Image restoration techniques, Wiener filter, Inverse filter, Blind Deconvolution and classification, Image Denoising.

Unit 4: Image Segmentation and Compression**[11]**

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

Text Books:

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

Reference Books:

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

B18EC6044	Machine Learning and Deep Learning	L	T	P	C
Duration:14 Weeks		3	0	0	3

Prerequisites:

Statistics, Linear Algebra, Probability, calculus

Course Description:

The Course introduces to the world of machine learning with various aspects involved, types of learning like supervised, unsupervised and reinforcement learning. It includes concepts from design of learning systems, neural networks, different aspects involved in neural networks, their activation function, back propagation algorithm etc. It describes algorithms like Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Gibbs Algorithm, Naïve Bayes Classifier and Decision tree. The course also focusses on fundamentals of deep learning and Reinforcement learning.

Course Objectives:

The objectives of this course are to:

1. Introduce some concepts and techniques that are core to Machine Learning.
2. Introduce concepts of learning and decision tree.
3. Provide knowledge of neural networks, reinforced learning and Bayesian techniques.
4. provide insights into deep learning fundamentals

Course Outcomes:

On completion of this course the student will be able to:

1. Design mathematical models used across Machine Learning algorithms.
2. Apply paradigms of supervised and un-supervised learning.
3. Identify a real world problem and apply the learned techniques of Machine Learning to solve the problem.
4. Explain the basics of Deep learning concepts.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	P S O 2	P S O 3
B18E C6 044	CO1	2	3	2										3	2	3
	CO2	2	3	1										3	2	3
	CO3	2	3	2	2									3	2	3
	CO4	2	1	1										3	2	3

Course Contents:

Unit 1: Introduction to Machine Learning

[11 Hrs]

Designing Learning systems, Perspectives and Issues, Types of machine learning algorithms- Supervised Learning, Unsupervised Learning, Semi-supervised and Reinforcement Learning.

Concept Learning and the General-to-Specific Ordering: A Concept Learning Task, Concept Learning as Search, FIND-S, Version Spaces and Candidate Elimination Algorithm, Inductive bias

Unit 2: Bayesian and Decision Tree

[11 Hrs]

Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier.

Decision Tree: Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree.

Unit 3: ANN and Reinforcement Learning

[10 Hrs]

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Artificial Neural Networks: Introduction, Neural Network Representations, Perceptrons, Multilayer Networks and the Backpropagation Algorithm. Reinforcement Learning: Introduction, Learning task, Q-learning.

Unit 4: Deep Learning

[10 Hrs]

Introduction, Modern Practices-Example: Learning XOR, Gradient based Learning, Hidden Units, Architectural design, back-propagation Algorithm.

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education, (INDIAN EDITION), 2013.
- 2, Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", An MIT Press book

Reference Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013

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B18EC6051	Real Time Systems	L	T	P	C
Duration 14 Weeks		3	0	0	3

Prerequisites:

Basics of Embedded Systems, Structure of Embedded System, Programming assembly Language in C.

Course Description:

This course is intended to provide the understanding of hard and soft real-time systems. This is a course on the design and applications of all real time aspects of various system components, like OS, memory, communication, quality of service system principles, resource management and focus on their functionality and implementation platforms. A range of methodologies for specifying and designing hardware and software components of the real time systems is discussed. It also explains about the programming knowledge required to code the real time systems.

Course Objectives:

The objectives of this course are to:

1. Illustrate the basic concepts of real-time systems and their important hardware building blocks for computer used for control.
2. Summarize the concepts of RTOS, tasks scheduling, resource management and task communication.

3. Define specific language features desirable in real-time system and identify widely used programming languages in real-time system design.
4. Understand the methodologies to help in the specification, design and construction of real-time software and real-time systems.

Course Outcomes:

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

1. Describe the characteristics of Real-Time Systems and identify the hardware building blocks for Real-Time Systems.
2. Design and analyze various task scheduling and management mechanisms.
3. Categorize programming languages for different real-time systems.
4. Apply the different methodologies for designing and developing Real-Time Systems.

Mapping of Course Outcomes with Program Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC6051	CO1	3	3	1						3	3	2	1	3	3	3
	CO2	3	3	3	2	3				3	3	2	1	3	3	3
	CO3	3	2	3	1	3				3	3	2	3	3	3	3
	CO4	3	3	3	1	3				3	3	3	3	3	3	3

Course Contents:

Unit 1: Introduction to Real-Time Systems

[11 Hrs]

Real Time Systems- Definition, Classification of Real-Time Systems, Time Constraints, Classification of Programs.

Advanced Hardware Fundamentals: Microprocessors, Buses, Direct Memory Access, Interrupts, Other Common Parts, Built-Ins on the Microprocessor, Conventions Used on Schematics. Interrupts-Basics, The Shared-Data Problem, Interrupt Latency.

Unit 2: Operating Systems

[11 Hrs]

Introduction, Real-Time Multi-Tasking OS, Scheduling Strategies, Priority Structures, Task Management, Scheduler and Real-Time Clock Interrupt Handler, Memory Management, Code Sharing, Resource Control, Task Co-Operation and Communication, Mutual Exclusion.

Unit 3: Programming Languages for Real-Time Systems

[10 Hrs]

Coding of Real-Time Software, Assembly Language, Procedural Languages, Object-Oriented Languages, Overview of Programming Languages, Automatic Code Generation, Compiler Optimizations of Code.

Unit 4: Design of RTS

[10 Hrs]

General Introduction: Introduction, Specification Document, Preliminary Design, Single-Program Approach, Foreground/Background System.

RTS Development Methodologies: Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai Method.

Text Books:

1. Stuart Bennett, "Real-Time Computer Control", Pearson, Second Edition, 1994.
2. David E. Simon, "An Embedded Software Primer", Pearson Education, 1999.
3. Phillip A. Laplante, Seppo J. Ovaska, " Real-Time System Design and Analysis: Tool for the Practitioner", Wiley, Fourth Edition, 2012.

References:

1. C.M. Krishna and Kang G. Shin, "Real Time Systems", MGH, 1997.
2. Jane W. S. Liu, "Real Time Systems," Pearson Education, 2000.
3. Raj Kamal , "Embedded Systems Architecture, Programming and Design," Second Edition, TMH, 2003

B18EC6052	UNIX Fundamentals	L	T	P	C
Duration:14 Weeks		3	0	0	3

Prerequisites:

Basic computer skills, Working knowledge of UNIX, Administering the various services of UNIX environment.

Course Description:

The course is aims to present the UNIX environment and to provide the most basic commands to students with UNIX knowledge. The course covers UNIX system and use different commands, UNIX directories and files, File attributes and permissions, changing file permissions. Course also provides basic knowledge about Vi editor-Input mode commands. Command mode commands, the ex-mode commands, Use of editors and regular expressions, Filters, File links – hard and soft links, the shells interpretive cycle and illustrating the mechanism of process creation. After studying this course, students will be able to Explain UNIX system and use different commands, Compile certain functions on different subsystems and demonstrate use of editors and its usage in UNIX environment.

Course Objectives:

This course will enable the students to:

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1. Illustrate the UNIX system architecture and use of basic Commands.
2. Use of editors and networking commands.
3. Recognize the services of Unix and manage the services
4. Categorize, compare and make use of UNIX system calls

Course Outcomes:

After studying this course, students will be able to:

1. Explain UNIX system and use different commands.
2. Understand the UNIX directories and files.
3. Demonstrate use of editors and regular expressions
4. Illustrating the mechanism of process creation.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC605 2	CO1	3	3	2										3	2	1
	CO2	3	2	1										2	1	3
	CO3	3	1	2										3	2	1
	CO4	3	2	1										3	2	1

Course Contents:

Unit-1: Introduction to Linux:

[10]

Introduction, Brief history. UNIX Components/Architecture. Features of UNIX. Posix and Single Unix specification. Open source licensing - History of Linux - Unix Vs Linux - Flavors of Linux - Benefits and characteristics of Linux The login prompt. General features of Linux commands/ command structure. Command arguments and options. Understanding of some basic commands such as echo, printf, ls, who, date, passwd, cal, combining commands. Meaning of Internal and external commands. The type command: knowing the type of a command and locating it. Man command.

Unit –2: Directories and files:

[11]

Files, Naming files, Basic file types/categories. Organization of files. Hidden files. Standard directories. Parent child relationship. The home directory and the HOME variable. Reaching required files- the PATH variable, manipulating the PATH, Relative and absolute pathnames. Directory commands, pwd, cd, mkdir, rmdir commands. The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative path names. File related commands – cat, mv, rm, cp, wc and od commands. File attributes and permissions and knowing them. The ls

command with options. Changing file permissions: the relative and absolute permissions changing methods. Recursively changing file permissions. Directory permissions.

Unit-3: The Vi editor

[10]

The vi editor, Basics, Different modes of vi. Input mode commands. Command mode commands. The ex-mode commands. Illustrative examples Navigation commands. Repeat command. Pattern searching. The search and replace command. The set, map and abbr commands. Simple examples using these commands. The shells interpretive cycle: Wild cards. Removing the special meanings of wild cards. Three standard files and redirection.

Unit-4: Regular Expressions, Filters, Process

[11]

Basic and Extended Regular Expressions: The grep, egrep. Typical examples involving different regular expressions. File inodes and the inode structure. File links – hard and soft links. Filters. Head and tail commands. Cut and paste commands. The sort command and its usage with different options. Meaning of a process. Mechanism of process creation. Parent and child process. The ps command with its options. Executing a command at a specified point of time: at command. Background processes. The bg and fg command. The kill command. The find command with illustrative examples.

Text books:

1. Sumitabha Das., “UNIX Concepts and Applications”, 4th Edition. Tata McGraw Hill
2. Behrouz A. Forouzan, Richard F. Gilberg: “UNIX and Shell Programming”, - Cengage Learning – India Edition. 2009.

Reference books:

1. Orsaria Jang, “RHCSA/RHCE Red Hat Linux Certification Study Guide Exams Ex200 & EX300”, McGraw-Hill Education, July 2017
2. M.G. Venkatesh Murthy: “UNIX & Shell Programming”, Pearson Education.
3. Richard Blum, Christine Bresnahan : “Linux Command Line and Shell Scripting Bible”, 2nd Edition , Wiley,2014.

B18EC6053	Adaptive Filters	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Course Description:

The course covers structures, algorithms and convergence properties for adaptive filters, with emphasis on applications in communications and signal processing.

The term adaptive filter implies changing the characteristic of a filter in some automated fashion to obtain the best possible signal quality in spite of changing signal/system conditions. Adaptive filters are usually associated with the broader topic of statistical signal processing.

The operation of signal filtering implies extracting the desired signal from a signal containing both desired and undesired components.

An optimum linear filter in the minimum mean square sense can be designed to extract a signal from noise by minimizing the error signal formed by subtracting the filtered signal from the desired signal. For noisy signals with time varying statistics, this minimization process is often done using an adaptive filter.

Course Objectives:

The course objectives are to:

1. Provide a significant understanding of adaptive filters in signal processing.
2. Introduce the mathematical framework necessary in understanding the adaptive filtering process.
2. Present the perspectives of adaptive filters towards present day communication systems.
3. Study the differences between algorithms adopted in adaptive filtering.
4. Know the performance measures used in comparing different adaptive filtering algorithms.

Course Outcomes:

On completion of this course the student will be able to:

1. Define adaptive linear combiner, performance function-gradient, minimum mean square error, and filtering, smoothing, Prediction and performance surface.
2. Summarize the adaptive Searching performance surface stability and rate of convergence.
3. Appraise the LMS algorithm convergence of weight vector.
4. Illustrate the Applications of adaptive filters.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6053	CO1	2	2											2		
	CO2		2	2	3									2		2

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

Course Contents:

Unit-1: Adaptive systems

[11hrs]

Definitions and characteristics, applications, properties and examples of adaptive linear combiner. Definitions of input signal and weight vectors, performance function-gradient and minimum mean square error, introduction to filtering, smoothing and prediction, performance surface.

Unit-2: Searching performance surface stability and rate of convergence

[10hrs]

Learning curve, gradient search - Newton's method and method of steepest descent, comparison, gradient estimation, performance penalty: variance, excess MSE and time constants, mis-adjustments.

Unit- 3 LMS algorithm convergence of weight vector:

[10hrs]

LMS/Newton algorithm, properties, sequential regression algorithm, comparisons

Unit-4 Applications of adaptive filters:

[11hrs]

Multipath communication channel, geophysical exploration, FIR digital filter synthesis, inverse adaptive modeling, equalization, and deconvolution, adaptive equalization of telephone channels- adapting poles and zeros for IIR digital filter synthesis.

Text Books:

1. Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Person Education, 2005.
2. Simon Haykin, "Adaptive Filter Theory", Pearson Education, 2003.

Reference Books:

1. John R. Treichler, C. Richard Johnson, Michael G. Larimore, "Theory and Design of adaptive Filters", Prentice-Hall of India, 2002.
2. S. Thomas Alexander, "Adaptive Signal Processing - Theory and Application", Springer-Verlag.
3. D. G. Manolokis, V. K. Ingle and S. M. Kogar, "Statistical and Adaptive Signal Processing", Mc Graw Hill International Edition, 2000.

B18EC6054	Project Management	L	T	P	C
Duration: 14 Wks		3	0	0	3

Prerequisites:

No Prerequisites

Course Descriptions:

Project management course provides concept of project management that is very much essential to handle projects efficiently. It covers the topics on phases of project life cycle, roles and responsibilities of leaders, Project management and estimation. It also covers the concepts of Project scheduling, coordination and control. Finally, it covers the concept of performance measure in Project management to estimate the quality of project management.

Course Objectives:

Course objectives are to:

1. Understand project management and methodology
2. Know the use of project management tools, techniques and skills.
3. Understand how to manage the project cost, quality and delivery.
4. Learn the skill of selection and initiation of individual projects and portfolios of projects In the enterprise.

Course Outcomes:

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

1. Identify specific management needs in the execution of projects at tactical and strategic level.
2. Analyze the project proposals for scope, time and cost to consider its feasibility.
3. Summarize the strategies to evolve suitable approach to accomplish the project with effective usage of the resources.
4. Interpret the team building and leadership skills in planning and implementation of the project.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC6054	CO1	3	3	2	3		2	2	3	1	2	3	2	3	2	1
	CO2	3	3	2	2						2	3	2	3		1
	CO3	3	3	2	3	3	2					3		3	2	
	CO4	3	3	2	3		2					3		3	2	1

Course Contents:

Unit 1: Concept of Project Management

[10Hrs]

Concept of Project Management: Concept of project, categories of projects, phase of project life cycle, roles and responsibility of a project leader, tools and technology for project management. Organizing and Staffing: Project leader: skills/abilities required for project manager, authorities and responsibilities of project manager, project organization, types of accountability in project execution and control

Unit 2: Project Planning and Estimation

[11Hrs]

Project Planning and Estimation: Feasibility study and report, phased planning, project planning steps: objectives and goals of the project, preparation of cost estimation, finalization of project implementation, evaluation of the project profitability. Project Procedure Manual: Contract management, configuration management, communication management, man management, time management, materials management, cost management, needs for flexibility.

Unit 3 Project Scheduling, Coordination and Control

[10 Hrs]

Project Scheduling, Coordination and Control: Project implementation, scheduling-different techniques GANTT charts: case study, bar charts for combined activities, Project direction, communication in a project, project coordination, project control, scope and progress control performance control, schedule control and cost control.

Unit 4: Performance Measures in Project Management

[11 Hrs]

Performance Measures in Project Management and Project Inventory Management: Performance indicators, nature of project inventory, supply and transportation of materials. Project Implementation: project work system design, work break down structure(WBS), project execution plan(PEP), closing a project.

Text Books:

1. Herold Kerzner: "Project Management, a system approach to planning, scheduling and controlling", CBS publishers and distributors, 2002
2. Meri Williams: "The Principles of Project Management", Sitepoint publishers, 2008

Reference Books:

1. Harvey Maylor: "Project Management", 3rd edition, Pearson, 2003.
2. Chaudhry S: "Project Management", McGraw Hill 2010

B18EC6055	Component Engineering	L	T	P	C
Duration: 14weeks		3	0	0	3

Prerequisites:

Basics of Physics, Electrical Components, Electro Mechanical Components.

Course Descriptions:

About course: Component engineering involves the selection, maintenance, design and construction of smaller components for larger machines. Component engineers are needed in all manufacturing industries, from the auto and space industries to defence. A degree in mechanical, electrical or metallurgical engineering may be required for those seeking a job in component engineering.

Course Objectives:

The objectives of this course are to:

1. Understand the students to ensure specific components used in manufactured products and systems to make reliable and effective.
2. Comprehend the knowledge in the field of design, assembly, and testing of components to meet the specifications for quality and performance.
3. Develop the knowledge about the basic manufacturing mechanical and electrical systems used in the industry

Course Outcomes:

On completion of this course the student will be able to:

1. Examine and Compare the applications of various types of cables, connectors and fuses.
2. Differentiate the various Switches and their usage.
3. Interpret the construction, working and applications of various types of relays.
4. Summarize the various types of heat sink and heat cooling process.
5. Appraise the reliability and maintainability in industries.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6055	CO1	3	3										3	3		
	CO2	3											3	2		
	CO3	3	2										3	2		

	CO4	3	2										3	2		
	CO5	3	3											3		2

Unit 1: Cables, Connectors and Fuses

[11 Hrs]

Cables: General specifications of cables- characteristic impedance, current carrying capacity, flexibility. Types of cables - construction and applications of coaxial cable, 600 E telephone cable- PASP, Alpth sheathed cable, FRC cable, twin core cable twisted & shielded type, optical fibre cable

Connectors: General specifications of connectors- contact resistance, breakdown voltage, insulation resistance, Constructional diagram, applications of BNC, D series, Audio, Video, printer, edge, FRC, RJ 45 connectors. Constructional diagram and applications of phone plug & jacks

Fuses: Glass, ceramic fuse, resettable fuse, shunt fuse- MOV, HRC fuse

Unit 2: Switches and Relays

[10 Hrs]

Switches: Switch specifications – voltage rating, contact current rating, contact resistance, characteristics of switch & relay – operating time, release time, bounce time, constructional diagram, application of toggle, rotary, push to on & push to off, rocker.

Relays: Construction, working and application of general-purpose relay, NO, NC contact, reed relays, solid state relays, difference between switch & relay.

Unit 3: Heat Management and parasitic electrical effects

[10 Hrs]

Heat Transfer, Thermal resistance, Heat sinking, Forced Cooling, advanced heat-removal techniques, parasitic circuit elements, Distributed parameter circuits, problems related to above topics.

Unit 4: Electromagnetic effects and Reliability and maintainability

[11 Hrs]

Electromagnetic interference, application studies, Failure, The “bathtub” curve, measures of reliability and maintainability, High reliability systems and Maintenance, problems.

Text Books:

1. Stephen Sangwine, “Electronic Components and Technology”, 3rd Edition, ISBN 9781315221779
2. Grover & Jamwal, “Electronic Components and Materials”, 2nd edition, New Delhi: Shroff Publishers and Distributors, ISBN 81-7366-549-4.
3. SK Bhattacharya, “Electrical and Electronic Engineering Materials”, Khanna Publishers, Delhi ISBN: 9788187394247
4. SK Sahdev, “Electrical Engineering Materials”, Unique International Publications, Pearson Education India, 2015, ISBN: 9332547114, 9789332547117
5. SM Dhir, “Electronic Components and Materials”, Tata Mc Graw Hill, New Delhi, 0074630822, 9780074630822

SC-8

B18EC6061	MEMS	L	T	P	C
Duration: 14 Wks		3	0	0	3

Prerequisites:

Engineering Physics, Upper Division standing in Engineering, Chemistry or Chemical Engineering and Material Science, VLSI Technology, Elements of Mechanical Engineering.

Course Description:

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 to:

1. Describe the various MEMS materials, devices and applications.
2. Demonstrate the three fundamental pillars of MEMS, i.e. design, fabrication and micromachining techniques.
3. Evaluate different packaging materials used for MEMS.
4. understand the unique demands, environments and applications of MEMS devices

Course Outcomes:

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

1. Demonstrate the application of scaling laws in the design of microsystems.
2. Describe the various steps involved in MEMS fabrication.
3. Evaluate among different packaging techniques.
4. Analyze the critical performance aspects of electromechanical transducers, including sensors and actuators.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC6061	CO1	1	2		3			2		3			3	1		2
	CO2	1	2	1	2	3		2		3		3		1		2
	CO3	3	2	1			1	3					3	1		2
	CO4	3	2	1	2	3	1				3		3	1		2

Course Contents:

Unit -1: Introduction to MEMS

[11 Hrs]

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 and Microsystems: Substrates and Wafers , Silicon as a Substrate Material, Silicon Compounds, Silicon piezoresistors Gallium Arsenide, Quartz, Piezoelectric Crystals, Polymers.

Unit -2: Microsystems Fabrication Process

[11 Hrs]

Lithography: Introduction, Photolithography, Ion-implantation, Diffusion, Oxidation, Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD) - Sputtering, Epitaxy: Introduction, Vapor-Phase Epitaxy, Molecular Beam Epitaxy: Overview of Micro Manufacturing: Introduction, Bulk micromachining, Surface Micromachining, LIGA process.

Unit -3: Microsystems Design and Microsystem Packaging

[10 Hrs]

Design Considerations, Process Design, Mechanical Design, Design of a Silicon Die for a Micropressure Sensor, Computer Aided Design, Overview of Mechanical Packaging of Microelectronics, Microsystem Packaging, Interfaces in Microsystem Packaging, Essential Packaging Technologies, Three Dimensional Packaging, Assembly of Microsystems, Selection of Packaging Materials, Signal Mapping and Transduction, Design Case: Pressure Sensor Packaging.

Unit – 4: Micro Sensors, Actuators, Systems and Smart Materials

[10 Hrs]

Case Studies – Silicon Capacitive Accelerometer, Piezo-resistive Pressure Sensor, Conduct Metric Gas Sensor, Fiber-Optic Sensors, Electrostatic Comb-Drive, Magnetic Microrelay, Microsystems at Radio Frequencies, Portable Blood Analyze, Piezoelectric Inkjet Print Head, Micromirror Array For Video Projection.

VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, CMOS IC Technology, MOS Memory IC Technology, Bipolar IC Technology, IC Fabrication.

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. Tai Ran Hsu, “MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering”, Wiley, 2008.
3. Chang Liu, “Foundation of MEMS” Pearson Education International, 2006.
4. S. M. Sze, “VLSI Technology”, McGraw-Hill, Second Edition.

5. Nadim Maluf, Kirt Williams “An Introduction to Microelectromechanical Systems Engineering”
Second addition.

B18EC6062	Web Programming	L	T	P	C
Duration :14 Weeks		3	0	0	3

Prerequisites

Basic programming knowledge, Object oriented concepts

Course Description:

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:

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

1. Adapt XHTML and CSS syntax and semantics to build web pages.
2. Identify tools and technologies for Web applications.
3. Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to Generate and display the contents dynamically.
4. Develop user-interfaces for Web applications and Web services.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC606 2	CO1	3	2	1										2	1	3
	CO2	4	2	1										3	1	2
	CO3	3	1	2										3	2	1
	CO4	3	2	1										2	3	1

Course Contents:

Unit-1

Fundamentals of Computers and Internet

[11]

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

[10]

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 and <div> tags.

Unit-3

[11]

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

[10]

Introduction, PHP Basics, General Syntactic characteristics, Control statements, Arrays, Functions, Pattern Matching, Files, Cookies, Session Tracking, Database Access with PHP and MySQL.

List of Experiments:

1. Create a XHTML form which includes Name, Address and Comment, Hyperlinks, Images Lists.
2. Validate the user input using JavaScript. (Ex: Validating the student SRN).
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.
4. PHP code to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page.
5. PHP code to store page views count in SESSION and to show the count on web page.

Text Books:

1. Robert W. Sebesta, "Programming the World Wide Web", 7th Edition. Addison-Wesley, 2012.
2. 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
3. Robin Nixon, "Learning PHP, MySQL & JavaScript with jQuery, CSS and HTML 5", 4th Edition, O'Reilly Publications, 2015.

Reference Books:

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

B18EC6063	Information Theory and Coding	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

Digital Communication, Fourier analysis, Probability Theory and Bayesian Inference.

Course Description:

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:

Upon completion of this course, students will be able to:

1. Solve the information content of dependent and independent sequences.
2. Illustrate the efficiency and redundancy of information using various source encoding methods.
3. Develop linear block codes and binary cyclic codes for error detection and correction.
4. Design convolution codes for encoding.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC6063	CO1	3	3	2										1	2	1
	CO2	2	3	3	1									1	2	2
	CO3	1	2	3	1									1	2	3
	CO4	2	3	3	2									1	2	3

Course Contents:

Unit-1: Fundamentals of Information Theory

[11 Hrs]

Introduction: Historical Background, The Communication Process,

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

[10 Hrs]

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

[11 Hrs]

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**[10 Hrs]**

Convolutional encoder, Time-Domain Approach, Transform-Domain approach, Code tree, State diagram, Trellis diagram. Special Codes: Cyclic Redundancy Check Codes, Golay codes, Bose-Chaudhuri-Hocquenghem (BCH) Codes, Reed-Solomon Codes Viterbi decoding.

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

B18EC6064	Alternate Engineering	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Basic Engineering Physics, Basic Electronics.

Course Description:

This course gives an overview of key aspects in solar energy, wind energy, biomass for bioenergy and all other renewable Energy Sources in engineering. A general insight to the fundamental disciplines such as wind measurements, biomass sources, processing systems, human health effects, pollution abatement, energy generating systems using renewable and non-renewable sources of energy on the population.

This course also provide an overview of the basic process, by which solar energy is collected and converted to biomass. Emphasis will be given on different strategies to convert biomass to biofuels, the review of the available technologies and how these could meet the growing demand for energy in the future.

Course Objectives:

The course objectives are to:

1. Identify the basic concepts, principles, potentials, efficiencies and limitations of various renewable energy sources.
2. Identify formulate and solve problems of renewable energy conversion and storage.
3. Explore society's present needs and future energy demands.

- Identify the new methodologies / technologies for effective utilization of renewable energy sources.

Course Outcomes:

Upon completion of this course, the students can able to

- Describe the challenges and problems associated with the use of the current energy sources and the potentials for having renewable energy.
- Convert units of energy in order to quantify energy demands and make comparisons among energy uses, resources, technologies, challenges, global warming and greenhouse effect.
- Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.
- Evaluate, compare and select energy systems based on economic and environmental considerations.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC60 64	CO1	3	1	3	1		3	3	3	3			3	1		2
	CO2	3	1	3	1		3	3	3	3			3	1		2
	CO3	3	1	3	1		3	3	3	3			3	1		2
	CO4	3	1	3	1		3	3	3	3			3	1		2

Course Contents:

Unit- 1: Solar Energy

[11 Hrs]

Solar Radiation – Measurements of Solar Radiation – Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation – Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

Unit-2: Wind Energy

[10 Hrs]

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects.

Unit-3: Bio – Energy

[11 Hrs]

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration – Biomass Applications.

Unit- 4: Other Renewable Energy Sources

[10 Hrs]

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage – Fuel Cell Systems – Hybrid Systems.

Text Books:

1. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.

References:

1. Sukhatme. S.P., "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996.
3. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling & Applications", Narosa Publishing House, New Delhi, 2002.
4. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
5. Johnson Gary, L. "Wind Energy Systems", Prentice Hall, New York, 1985
6. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA 2010
7. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.

SC-9

B18EC7021	Analog Mixed Mode VLSI	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

MOSFET, Transistor Level Circuit Design, Analog CMOS IC's,

Course Description:

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 subthreshold 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 to:

1. Introduce the concept of analog and digital discrete signals.

2. Provide specifications of data converters.
3. Calculate DAC & ADC parameters
4. Design R-2R Ladder for given parameter.
5. Introduce non linear analog circuits like comparators, and analog multipliers.
6. Demonstrate the sub micron CMOS process flow.
7. Present capacitors, resistors and switches using MOSFETs.

Course Outcomes:

On completion of this course the student will be able to:

1. Compare Analog and Digital Converters specifications
2. Design different types of ADCs and DACs
3. Analyze different types of Non linear analog circuits
4. Design switch, relay adder circuits using Submicron technology

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC7021	CO1	3	2	2		1					2		2	3	2	2
	CO2	3	2	2		1					2		2	3	2	2
	CO3	3	2	2		1					2		2	3	2	2
	CO4	3	2	2		1					2		2	3	2	2

Course Contents:

Unit-1: Data Converter Fundamentals

[11 Hrs]

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-2: Data Converter Architectures

[10 Hrs]

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-3: Non Linear Analog Circuits

[11 Hrs]

Basic CMOS Comparator Design, characterizing the comparator, Analog Multipliers, Multiplying Quad (excluding stimulation), Level Shifting (excluding input level shifting for multiplier).

Unit-4: Sub-Micron CMOS Circuit Design

[10 Hrs]

Process Flow, Introduction to triple gate MOSFETs, Capacitors and Resistors, MOSFET Switch &

Bidirectional Switches, Delay and adder Elements, Analog Circuits Design, MOSFET Biasing, Basic Op-Amp design.

Text Books:

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

Reference Books:

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

B18EC7022	Cloud Computing	L	T	P	C
Duration:14 Weeks		3	0	0	3

Prerequisites:

Computer Networks, Operating Systems.

Course Description:

The course introduces the cloud environment in detail and explains how to use cloud infrastructure in real time environment .Virtualization in Cloud Computing. Virtualization is the creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage device, an operating system or network resources. The fundamental knowledge about cloud and virtualisation technique is explained which helps in creating real time application connecting with IoT.

Course Objectives:

The objective of this course is to:

1. Provide knowledge in different layers of cloud computing, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS);
2. Illustrate the use of various cloud computing technologies, cloud deployment models.
3. Illustrate how to store the data in cloud storage.
4. Introduce Virtualization technologies: Hypervisor, emulation, and application VM; Platform virtualization, storage virtualization, and network virtualization;

Course Outcomes:

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

1. Explain virtualization and their role in elastic computing.
2. Characterize the distinctions between Infrastructure, Platform and Software as a Service (IaaS, PaaS, SaaS) abstractions.
3. Analyze the advantages and disadvantages of cloud deployment models.
4. Create and deploy various cloud applications, storage of data in cloud, accessing the resources

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC7022	CO1	2		1			2				2	3				1
	CO2		2	1		2		3			3		1			
	CO3	2	1		2		3		2			2		2		2
	CO4	1	2			3		1		3			2		3	

Course Contents:

Unit-1: Introduction to Cloud Computing Overview

[11 Hrs]

Cloud Computing Overview, Origins of Cloud computing, Cloud components, Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, Measured service. Cloud scenarios – Benefits: scalability, simplicity, vendors, security. Risks and Challenges.

Unit-2: Cloud architecture, Service & Deployment models

[10 Hrs]

SPI framework, SPI V/s traditional IT Model. Cloud Service Models: Software as a Service, Platform as a Service, Infrastructure as a service, SaaS service providers – Google App Engine, Salesforce.com and Google platform, Benefits, Evaluating SaaS. PaaS service providers – Right Scale and Salesforce.com, Benefits of PaaS. IaaS: IaaS service providers – Amazon EC2.

Cloud Deployment Models: Public clouds, Private clouds, Community clouds and Hybrid clouds, Advantages of Cloud computing.

Unit-3: Cloud Databases and File Systems in cloud

[11 Hrs]

Cloud database, Cloud file system, Cloud programming model. Cloud data security and existing solutions.

Cloud Middleware and Best Practices: Concept and need of Cloud middleware, QoS Issues in Middleware, Data migration and streaming in cloud, Best practices of Cloud computing.

Unit-4: Virtualization Techniques**[10 Hrs]**

Virtualization and cloud computing, Need of virtualization, Virtualization Technology, Overview of Virtualization, Types of virtualization: CPU virtualization, Memory virtualization, Device and I/O virtualization, OS Level virtualization, Network virtualization, Server virtualization, Desktop, Data, Storage and Application virtualization.

Text Books:

1. Anthony T.Velte , Toby J. Velte Robert Elsenpeter, “Cloud computing a practical approach”, TATA McGraw- Hill , New Delhi – 2010.
2. A. Srinivasan and J. Suresh. “Cloud Computing: A practical approach for learning and implementation”, Pearson publication, Second addition 2017.
3. Rishabh Sharma, “Cloud Computing: Fundamentals, Industry Approach and Trends”, Wiley Publications, First Edition 2015.

Reference Books:

1. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Que 2008.
2. Sandeep Gupta, Frank Adelstein, Golden Richard, Loren Schweibert. “Fundamentals of Mobile and Pervasive Computing”, McGraw Hill Publication 2004.

B18EC7023	Wireless Communication	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Computer Communication Networks, Analog-Digital Modulation techniques, Introduction to Antenna and wave propagation.

Course Description:

This course introduces students to wireless communication and networks and concentrates on building a firm foundation for understanding the concepts of Cellular communication, Wireless Network Architecture. This course also covers the cellular wireless technologies (Global System for Mobile communication and Coded Division Multiple Access). Students are also introduced to the modern digital modulation techniques and other encoding methods which are used to mitigate wireless propagation effects.

Course Objectives:

The objectives of this course are to:

1. Understand the evolution and various generations of wireless networks
2. Understand the needful concepts behind the wireless architecture and operation
3. Understand the system operation for GSM networks
4. Understand the various modulation and coding techniques.

Course Outcomes:

On completion of this course the student will be able to:

1. Categorize wireless telecommunication systems and networks
2. Review wireless network architecture and operation
3. Analyze global system for mobile communication
4. Compare wireless modulation-coding techniques

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC70 23	CO1	3	2	2							1		1	2	2	1
	CO2	3	2	2							1	2	1	2	2	1
	CO3	3	3	1				1			1	2	1	2	2	1
	CO4	3	3	1							1	2	1	2	1	1

Course Contents:

Unit- 1: Wireless Telecommunication Systems and Networks

[11 Hrs]

Introduction, History and Evolution, Different generations of wireless cellular networks 1G, 2G, 3G and 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

[10 Hrs]

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: Global System for Mobile Communication (GSM):

[11 Hrs]

Introduction, System operation, Traffic cases, Call handoff, Roaming, GSM protocol architecture.

TDMA systems. CDMA technology, CDMA overview, CDMA channel concept CDMA operations.

Unit- 4: Wireless Modulation-Coding Techniques

[10 Hrs]

Introduction, Air interface, Path loss models, Wireless coding techniques, Digital modulation techniques, OFDM, UWB radio techniques, Diversity techniques, Typical GSM Hardware.

Text Book:

1. Gary J Mullett, "Introduction to wireless Telecommunications Systems and Networks", Thomson/Cengage Learning, 2006.

Reference Books:

1. William C. Y. Lee, "Mobile Cellular Telecommunication", MGH, 2nd, 2009.
2. D P Agrawal, "Wireless communication" Thomson learning, 2nd Edition 2007.
3. David TSE, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge 2005.
4. S. S. Manvi, M. S. Kakkasageri, "Wireless and Mobile Network Concepts and Protocols", John Wiley India Pvt. Ltd, 1st edition, 2010.
5. T. S. Rappaport, "Wireless Communication – Principles & Practice", PHI, 3rd Edition, 2001.

B18EC7024	Robotics and Automation	L	T	P	C
Duration:14 Wks		3	0	0	3

Prerequisites:

Embedded System Design, Control systems, Programming skills

Course Description:

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:

Course objectives are:

1. Classify Robots and anatomy.
2. Understand Robot kinematics
3. Determine Sensors and vision systems used in robots.
4. Write Robot Program.

Course Outcomes:

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

1. Summarize the basic applications and advantages of using robots in the industry
2. Do the robot motion analysis
3. Relate mathematical modeling and trajectory planning scheme in robots
4. Recognize the different types of sensors and cameras used in the field of robotics

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC70 24	CO1	3			3		3	1		2	2		2	3	3	2
	CO2	3			3		3	1					2	3	3	2
	CO3	3			3		3	1		2			2	3	3	2
	CO4	3			3		3	1		2	2		2	3	3	2

Course Contents:

Unit -1: Introduction to robotics

[11 Hrs]

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

[10 Hrs]

Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composite rotation matrix, rotation matrix about an arbitrary axis, links, joints and their parameters, Denavit-Hartenberg (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

[11 Hrs]

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 Robot sensors and Machine Vision & Robot programming

[10 Hrs]

Machine vision, functions of machine vision system, sensing and digitizing, imaging devices, analog to digital signal conversion, quantization and encoding, simple numerical problems, image storage, image processing and analysis, image data reduction, segmentation, feature extraction, object recognition, robotic machine vision applications, inspection, identification, visual servoing and navigation.

Introduction to robot programming, robot cell layout, work cell control and interlocks, manual programming, lead through and walkthrough programming, off-line programming, VAL programming language, example, AML and VAL-II robot programming languages, examples, Programming with graphics, example.

Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey, " Industrial Robotics," McGraw-Hill Publications, International Edition, 2008.
2. James G. Keramas, " Robot Technology Fundamentals", Cengage Learning, International Edition 1999.

Reference Books:

1. Fu K. S., Gonzalez R. C., Lee C. S. G: Robotics, " Control, Sensing, Vision, Intelligence ", McGraw Hill Book Co., International edition, 2008.
2. Appu Kuttan K. K, " Robotics, International Publications", First Edition, 2007
3. R. K. Mittal, I. J. Nagrath, " Robotics and Control", Tata-McGraw-Hill Publications, 2007.

B18EC7025	Software Engineering	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

No need

Course Description:

The course Software engineering is important because specific software is needed in almost every industry, in every business, and for every function. It becomes more important as time goes on – if something breaks within your application portfolio, a quick, efficient, and effective fix needs to happen as soon as possible.

Course Objectives:

The course objectives are :

1. To impart the knowledge of basic SW engineering methods and practices, and their appropriate application;
2. To give an understanding of approaches to verification and validation including static analysis, and reviews.
3. To give an understanding of software testing approaches such as unit testing and integration testing.
4. To give an understanding of some ethical and professional issues those are Important for software engineers.

Course Outcomes:

On completion of this course the student will be able to:

1. Analyze the requirements of a software development project
2. Verify and validate a software development project.
3. Describe and manage the core ethical issues of software development process.
4. Develop a positive attitude towards the development of a software project in a team and develop skill to work as software designer.

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
B18EC7025	CO1	1		2	2		1			2			1			
	CO2		2		3	2		2			1			2		
	CO3			3		2	3		2			1			3	
	CO4		2		2		1		3			2				2

Course Contents:

Unit 1: Overview

[11hrs]

Introduction: FAQ's about software engineering, Professional and ethical responsibility. Software Processes: Software Processes: Models, Process iteration, Process activities; The Rational Unified Process; Computer-Aided Software Engineering.

Unit 2: Requirements

[10hrs]

Software Requirements: Functional and Non-functional requirements; User requirements; System requirements; Interface specification; the software requirements document.

Requirements Engineering Processes: Feasibility studies; Requirements elicitation and analysis; Requirements validation; Requirements management.

Unit 3: System Models, Software Design & Development

[11hrs]

System Models: Context models; Behavioral models; Data models; Object models; structured methods. Architectural Design: Architectural design decisions; System organization; An Object-Oriented design process; Design evolution. Rapid Software

Development: Agile methods; Extreme programming; Rapid application development. Software Evolution: Program evolution dynamics; Software maintenance; Evolution processes; Legacy system evolution.

Unit 4: Verification and Validation

[10hrs]

Planning; Software inspections; automated static analysis; Verification and formal methods. Software testing: System testing; Component testing; Test case design; Test automation. Project Management: Management activities; Project planning; Project scheduling; Risk management.

Text Books:

1. Ian Sommerville, "Software Engineering", Eighth Edition, Person Education, 2007.
2. Roger.S.Pressman, "Software Engineering -A Practitioners Approach", Seventh Edition, McGraw-Hill, 2007

Reference Books:

1. PankajJalote, "An Integrated Approach to Software Engineering", Wiley India, 2009.

SC-10

B18EC7031	ASIC Design	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Fundamentals of Digital Circuits & CMOS.

Course Description:

This course aims to provide a strong foundation for students in understanding the principle aspects of ASIC design. It helps the students in getting familiarized with the methodologies and tools used in designing ASIC chips. Helps in understanding the applying various floor planning, placement and routing aspects and methodologies in refining the ASIC designs.

Course Objectives:

The objectives of this course are to:

1. Present an idea about the flow and economics of ASIC design.
2. Understand the different design aspects and metrics of ASIC design.
3. Analyze the different methodologies and tools available for ASIC design.
4. Understand the role of floor planning, Placement and Routing in ASIC design.

Course Outcomes:

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

1. Describe the complete flow and economics involved in ASIC design
2. Design customized and library-based ASICs
3. Develop optimized ASIC designs with suitable methodologies and metrics
4. Evaluate various algorithms for floor planning, placement and routing in ASIC design.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/COs	PO 1	PO 2	PO 3	PO 3	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
B18EC7031	CO1	1		2		3		3						1		2
	CO2	1			2	3		3						1		2
	CO3	1		2		3	3							1		2
	CO4	1						2				3	3	1		2

Course Contents:

Unit 1: Introduction

[11 Hrs]

Full Custom ASICs, Standard Cell based ASICs, Gate array based ASICs, Channeled gate array, Channelless gate array, structured gate array, Programmable logic devices, FPGA, Design flow, Economics of ASICs, ASIC cell libraries, I/O cells, Cell Compilers.

Unit 2: ASIC Library Design and Design entry

[10 Hrs]

ASIC Library Design: Logical effort: predicting delay, logical area and logical efficiency, logical paths, multistage cells, optimum delay, optimum number of stages, library cell design. Low-Level Design Entry: Schematic Entry: Hierarchical design. The cell library, Names, Schematic, Icons & Symbols, Nets, schematic entry for ASIC'S, connections, vectored instances and buses, Edit in place, Attributes, Netlist screener, Back annotation.

Unit 3: ASIC Construction Floor Planning

[11 Hrs]

Physical Design, CAD Tools, System Partitioning, Estimating ASIC size, partitioning methods. Floor planning tools, I/O and power planning, clock planning

Unit 4: Placement and Routing

[10 Hrs]

Placement algorithms, iterative placement improvement, Time driven placement methods. Physical Design flow, global Routing, Detail Routing, Special Routing, Circuit Extraction and DRC.

Text Book:

1. M.J.S .Smith, "Application - Specific Integrated Circuits", Pearson Education, Edition 1, 2003.

Reference Books:

1. Jose.E.France, YannisTsvividis, "Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, Edition 1, 1994.
2. Malcolm. R. Haskard, Lan. C. May, "Analog VLSI Design – NMOS and CMOS", Prentice Hall, edition 1,1998.
3. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, edition 1, 1994.

B18EC7032	Big Data and Data Science	L	T	P	C
Duration :14 Weeks		3	0	0	3

Prerequisites:

Database Management Systems, Data Mining basics, Probability and Statistics.

Course Description:

In this course the fundamentals of large volume, variety and velocity of data is described in detail. Big data analytics is the process of extracting useful information by analysing different types of big data sets. Big data analytics is used to discover hidden patterns, market trends and consumer preferences, for the benefit of organizational decision making. In this, the map-reduce programming, components of hadoop, architecture of map- reduce is taught. It also covers the tools of big data like PIG and HIVE.

Course Objectives:

The objectives of this course are to

1. Explain Big data for business intelligence and the main trends of Big Data concepts.
2. Describe map-reduce analytics using hadoop and related tools.
3. Process large data sets using Hadoop to extract value.
4. Provide big data analytics using R programming.

Course Outcomes:

On completion of this course the student will be able to:

1. Explain Hadoop Architecture.
2. Write Simple MapReduce programs.
3. Implement best practices for Hadoop development.
4. To Write R programming for data science.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC703 2	CO1	2	1	2					2	3			2			
	CO2	2	3	3	3	1	2		3	2	1	2			2	3
	CO3	1	2	3					2	2					2	
	CO4	3	2	3			3		3		2			2	3	

Course Contents:

Unit-1: Introduction to Big Data

[10 Hrs]

Classification of digital data, characteristics of data, Evolution of big data, Challenges with big data, what is big data, traditional business intelligence (BI) versus big data, A typical data warehouse environment, A typical hadoop environment, Top challenges facing big data.

Unit-2: Introduction to Hadoop

[10 Hrs]

Hadoop Basics, why Hadoop, why not RDBMS, RDBMS versus Hadoop, HDFS, Processing data with

Hadoop, Features of Hadoop. NoSQL-Types of NoSQL Databases, Advantages of NoSQL, SQL versus NoSQL.

Unit-3: Map Reduce

[11 Hrs]

Anatomy of a MapReduce job run, Classic MapReduce, YARN, Job scheduling, Shuffle and Sort.

Hadoop Related Tools: Introduction to PIG, What is PIG, The anatomy of PIG, PIG on Hadoop, PIG Latin, Data types in PIG, running PIG, Execution modes, HDFS Commands, Relational operators.

Unit-4: Introduction to R Programming

[11 Hrs]

History and overview of R, What is R, Basic features of R, Design of the R system, Limitations of R, R nuts and bolts, Entering Input, Evaluation, R objects, Numbers, Attributes, Creating objects, Mixing objects, Explicit Coercion, Matrices, Lists, Factors, Missing values, Data frames, Names, Control Structures, Functions, Loop functions.

Text Books:

1. Seema Acharya, Subhashini Chellappan, "Big Data and Data Analytics", Wiley, First Edition, 2015.
2. Tom White, "Hadoop: The Definitive Guide", O'Reilley, Third Edition, 2012
3. Roger D. Peng "R Programming for Data Science", Leanpub, First Edition, 2015

Reference Books:

1. Vignesh Prajapati, "Big data analytics with R and Hadoop", Packt Publishing, 2013
2. Alan Gates, "Programming PIG", O'Reilley, 2011
3. Eric Sammer, "Hadoop Operations", O'Reilley, 2012

B18EC7033	Satellite Communication	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Knowledge of Basic Geometry, Insight of Geography, Fundamentals of Communication Systems and information coding.

Course Description:

The course introduces the students to the basic concept in the field of satellite communication. This will enable the students to know how to place a satellite in an orbit and about the earth & space segment. The satellite services like broadcasting are also studied thoroughly.

Course Objectives:

The objectives of this course are to:

1. Make the student understand the historical background, basic concepts and frequency allocations for satellite communication
2. Understand Earth and space component.
3. Knowledge of every aspects of satellite communication like satellite link design, earth station technology and different access system towards a satellite
4. Know application of satellite communication.

Course Outcomes:

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

1. Describe orbital mechanics and launch methodologies
2. Describe space segment and earth segment
3. Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.
4. Explain satellite access techniques and understand role of satellite in various applications

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC7033	CO1	3	1				2	1					2		2	1
	CO2	3	1					1		2			2		2	
	CO3	3	3	3	2	2		1	1			2	2	1	3	2
	CO4	3	2	1				1					2		2	1

Course Contents:

Unit-1: Satellite Systems and Orbits

[11 Hrs]

Overview of satellite systems: Introduction, Frequency allocations for satellite systems.

Orbits and launching methods: Kepler's three laws of planetary motion, terms used for earth orbiting satellites, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, standard time.

The Geostationary orbit: Introduction, antenna look angles, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite.

Unit-2: Space Segment & Earth Segment

[10 Hrs]

The Space segment: Introduction, power supply, attitude control, station keeping, thermal control, TT&C subsystem, transponders.

The Earth segment: Introduction, receive-only home TV systems, master antenna TV system, Community antenna TV system, transmit-receive earth station.

Unit-3: Communication Satellite and Satellite link Design**[10 Hrs]**

Communication Satellites- Satellite subsystem; Attitude control, station keeping, Thermal control , Telemetry, Tracking, Command and Monitoring (TTC&M); power systems, transponders, satellite wide band receiver.

Satellite link design and Satellite access: Atmospheric losses, Basic transmission theory, system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; communication link design procedure.

Unit-4: Satellite Access Techniques and Application**[11 Hrs]**

Satellite Access: SPADE system, satellite switched TDMA, CDMA.

Satellite Applications: Satellite Mobile Services, VSAT, Radarsat, GPS, Iridium.

Text books:

1. Dennis Roddy, "Satellite Communications", McGraw-Hill international, 4th Edition, 2006.

Reference Books:

1. Timothy Pratt, Charles Bostian, Jeremy Allnut. "Satellite Communications", John Wiley Pvt Ltd & Sons, 2nd Edition, 2008.
2. W. L. Pitchand, H. L. Suyderhoud, R.A. Nelson., "Satellite Communication system Engineering", Pearson Education, 2nd Edition 2007.
3. Raja Rao: "Fundamentals of Satellite communications", PHI Learning.
4. MonojitMitra: "Satellite Communication": PHI Learning

B18EC7034	Medical Electronics	L	T	P	C
Duration: 14 Weeks		3	0	0	3

Prerequisites:

Signals and Systems

Course Description:

Medical electronics is a branch of electronics that deals with design, implementation and use of electrical devices and equipment for medical purposes such as research, examination, diagnosis, treatment, assistance and care. Students will be introduced with concepts of medical diagnostics, anesthesia control, bio-potentials etc.

Course Objectives:

The objectives of this course are to:

1. Make students to understand the applications of electronics in diagnostic, anesthesia control, cardiac control, surgery and therapeutic area.
2. Know the various functional blocks present in bio-signal acquisition system so that the students are capable to design the data acquisition system.

Ref: RU/BoS/ECE/CEC/June-2018-6

3. Study the methods of recording various bio-potentials.
4. Understand the need and technique of electrical safety in Hospitals.

Course Outcomes:

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

1. Analyze and evaluate the effect of different diagnostic and therapeutic methods, their risk potential, physical principles, opportunities and possibilities for different medical procedures.
2. have a basic understanding of medical terminology, relevant for biomedical instrumentation.
3. Understand and describe the physical and medical principles used as a basis for biomedical instrumentation.
4. Understand the elements of risk for different instrumentation methods and basic electrical safety.

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
B18EC7034	CO1	3										1		1		
	CO2	3										1			3	2
	CO3	3	2									1				2
	CO4	3		2			2	2				1		1		2

Course Contents:

UNIT – 1: Fundamentals of Medical Instrumentation

[11 hrs]

Sources of Biomedical Signal, Basic Medical Instrumentation System and their Performance Requirements.

Classification of transducers, performance characteristics of transducers, displacement, positioning and motion transducers, pressure transducers, transducers for body temperature measurement, photoelectric transducers, optical fiber sensor, biosensor and smart sensor.

UNIT – 2: Biosignal Acquisition: Electrodes and Amplifiers

[10hrs]

Origin of Bioelectric signals, recording electrodes, Electrode Types – surface metal plate electrodes, Needle and wire electrodes, microelectrodes .

Basic Requirements of Biomedical Amplifiers, Differential Amplifiers, Carrier Amplifiers, Chopper Amplifiers.

UNIT – 3: Bio-Potential Recording

[10hrs]

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG),

PCG(Phonocardiography), Vector cardiograph(VCG), lead systems and recording methods, typical waveforms and signal characteristics.

UNIT – 4: Patient Monitoring Systems and Safety Aspects of Medical Instrument [11 Hrs]

Heart rate measurement, Pulse rate measurement, Respiration rate measurement, Blood pressure measurement, Principle of defibrillator and pace mark, use of Microprocessors in patient monitoring. Gross current shock, Micro current shock, Special design from safety considerations, Safety standards.

Text Books:

1. R.S. Khandpur “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 2nd Edition, 2003.
2. R.S. Khandpur, “Modern Electronics Equipment”, Tata McGraw Hill, New Delhi
3. C. Raja Rao, Sujoy K. Guha “Principles of Medical Electronics and Biomedical Instrumentation”, University Press.

Reference Books:

1. Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg “Biomedical Transducers and instruments” CRC Press, 1997.
2. Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, “Biomedical Instrumentation and Measurement”, Prentice-Hall India Pvt. Ltd.

SC-11

B18EC7041	SOC Design	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Basics of system architecture, Principles of memory design and cache architecture.

Course Description:

Moore's law has created an era where most electronic systems contain chips that integrate various components such as microprocessor, DSPs, dedicated hardware processing engines, memories, and interfaces to I/O devices and off-chip storage. Most electronic systems today - cell phones, iPods, set-top boxes, digital TVs, automobiles contain at least one such "System-on-chip". Designing System-on-chips is a highly complex process. This course will present students with an insight into

the earlier stages of the System-on-chip design process. In addition to the conceptual foundations, this course will also involve analysis of chip basics, understanding various parameters for the selection of SOC processors and memory design.

Course Objectives:

The objectives of this course are to:

1. Provide a comprehensive introduction to the SOC technology and network on chip technologies.
2. Relate the different parameters needed to assess the tradeoffs in the chip basics.
3. Give an overview to SOC design, its challenges and design flow by giving an emphasis to processor selection.
4. Illustrate the memory design concepts in processors for system on chip and board based systems.

Course Outcomes:

On completion of this course the students will be able to:

1. Differentiate the system architecture and various components of System on Chip and to illustrate network on chip technologies.
2. Summarize the relevance and impact of chip basics- Cycle time, power, area tradeoff and various design aspects.
3. Illustrate the selection of processor core for SOC and analyze the system performance.
4. Analyze the system on chip and board based systems with respect to various memory designs techniques.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 1	P O 1	P O 1	PSO 1	PSO 2	PSO 3
B20	CO1	2	2	2	1									2	1	2
EC	CO2	3	2	2	1							1		2	2	2
7041	CO3	2	3	3	2			1		2		2	1	2	3	3
	CO4	3	3	3	2			1		2		1	1	2	3	3

Course Contents:

Unit-1: System Approach and Interconnect

[10 Hrs]

System Architecture, Components of the System, Hardware and Software, An approach for SOC Design, System Architecture and Complexity.

Interconnect: Introduction, Interconnect architectures for SOC. Bus: Basic architecture. NOC standard buses, Analytic bus models, NOC with switch interconnects.

Unit-2: Chip Basics**[11 Hrs]**

Cycle Time, Die Area and Cost, Ideal and Practical Scaling, Power, Area–Time–Power Trade-Offs in Processor Design, Reliability, Configurability.

Unit-3: Processors**[10 Hrs]**

Processor Selection for SOC, Basic Concepts in Processor Architecture, Instruction Handling, and Buffers, Minimizing Pipeline Delays, Branches. Vector, Very Long Instruction Word (VLIW), and Superscalar with case studies.

Unit-4: Memory Design:**[11 Hrs]**

System-on-Chip and Board-Based Systems – Scratchpads and Cache Memory, Basic Notions, Cache Organization, Cache Data, Write Policies, Strategies for Line Replacement at Miss Time, Other Types of Cache, Split I- and D-Caches and the Effect of Code Density, Multilevel Caches, Virtual-to-Real Translation, SOC(On-Die) Memory Systems, Board-based (Off-Die) Memory Systems, Simple DRAM and the Memory Array, Models of Simple Processor–Memory Interaction.

Text book:

1. Michael J Flynn, Wayne Luk, “Computer System Design: System-on-Chip,” Wiley, First Edition, 2011.

Reference Books:

1. SudeepPasricha, Nikil Dutt, “On-Chip Communication Architectures: System on Chip Interconnect”, Morgan Kaufman 2008.
2. Rao R.Tummala, Madhavan Swaminathan, “Introduction to system on package SOP- Miniaturization of the entire system”, McGraw-Hill 2008.
3. Michael Keating, Pierre Bricaud, “Reuse Methodology Manual for System on Chip designs”, Kluwer Edition, 2008.

B18EC7042	Grid Computing	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Programming with C C++, JAVA, DBMS, OS

Course Description:

In this Course it is focused on grid computing in which each computer's resources are shared with every other computer in the system. Processing power, memory and data storage are all community resources that authorized users can tap into and leverage for specific tasks. The course describes Open Grid Services Architecture, a service-oriented architecture for a grid computing environment for business and scientific use. Globus grid software that addresses the most challenging problems in distributed resources sharing. The Globus Toolkit includes software services and libraries for distributed security, resource management, monitoring and discovery, and data management.

Course Objectives:

The objectives of this course are to:

1. Be providing with an overview of the basic concepts of Grid Computing.
2. Provide an understanding of the need for and evolution of Grids in the context of processor and data-intensive applications;
3. Become familiar with the fundamental components of Grid environments, such as authentication, authorization, resource access, and resource discovery.
4. Understand the software services and libraries for distributed security, resource management, monitoring and discovery, and data management

Course Outcomes:

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

1. Design and implement Grid computing applications using Globus or similar toolkits.
2. Justify the applicability, or non-applicability, of Grid technologies for a specific application.
3. Explain programming toolkits such as Parallel Virtual Machine and Message Passing.
4. Apply the Globus open source software for finding the solutions in Grid problems like resource management, monitoring and discovery, and data management.

Mapping of Course Outcomes with program Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 1	P O 1	P O 2	PSO 1	PSO 2	PSO 3
B18EC70 42	CO1		2			2		1	1		2		2			1
	CO2	1			1			2			2	1			2	
	CO3		2		3		2		1	2		1		2		
	CO4	2		2	1		1		2		2		1		3	

Course Contents:

Unit -1: Overview of Grid Computing

[11 Hrs]

Early Grid Activities, Current Grid Activities, An Overview of Grid Business Areas, Grid Applications, Grid Infrastructure, Organizations Developing Grid Standards and Best Practice Guidelines, Organizations Developing Grid Computing Toolkits and the Framework, Organizations Building and Using Grid-Based Solutions to Solve Computing, Data and Network Requirements, Commercial Organizations Building and Using Grid-Based Solutions, The Grid Problem. Anatomy Computing

Unit -2: The OGSA Platform Components, OGSi

[10 Hrs]

OGSA Architecture and Goals, Commercial Data Center (CDC), National Fusion Collaborator (NFS), Online Media and Entertainment, Native Platform Services and Transport Mechanisms, OGSA Hosting Environment, Core Networking Services Transport and Security, OGSA Infrastructure, OGSA Basic Services. Grid Services, A High-Level Introduction to OGSi (Open Grid Services Infrastructure).

Unit -3: OGSA Basic Services, Toolkit

[11 Hrs]

Common Management Model (CMM), Service Domains, Policy Architecture, Security Architecture, Metering and Accounting, Common Distributed Logging, Distributed Data Access and Replication. GLOBUS GT3 Toolkit Architecture.

Unit -4: Globus GT3 Toolkit: High Level Services

[10 Hrs]

Resource discovery and monitoring, information service, index service, resource information provider service, resource management service, data management services

Text Book:

1. Joshy Joseph and Craig Fellenstein, "Grid Computing," Pearson/PHI PTR, 2003.

Reference Books:

2. Ahmar Abbas, "Grid Computing: A Practical Guide to Technology and Applications," Charles River media, 2003.
2. J. Joseph, C. Fellenstein, "Grid Computing", Pearson Education, 2004.
3. V. Silva, "Grid Computing for Developers", Dreamtech Press, 2006.

B18EC7043	Multi Media Communication (MMC)	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Signal representation, Quantization techniques, Coding theory, and OSI Reference model.

Ref: RU/BoS/ECE/CEC/June-2018-6

Course Description

The course introduces fundamental technologies for video communications and networking. The primary goal of the course is the development of necessary video-audio skills and understandings need to create effective digital media messages. It includes the introduction to the video system and Fourier analysis with effective representation and processing of video signals. Also, few more concepts covered include properties of the human visual system, motion estimation, basic video compression techniques, video communication standards, and video transport over the Internet and wireless networks.

Course Objectives:

The objectives of this course are to:

1. Provide an understanding of impact of multimedia techniques in the day to day life.
2. Provide an understanding of various representations of graphics, image & video.
3. Provide an understanding of the total processing, storing and communication of multimedia data.
4. Provide a comprehensive understanding of multimedia communication over wireless networks.

Course Outcomes:

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

1. Understand the different representations of graphics, image and video data types in multimedia.
2. Compare the various industry standard compression techniques for digital audio.
3. Understand the processing and storage techniques for video.
4. Determine impact of multimedia communication techniques in the wireless networks.

Mapping of Course Outcomes with program Outcomes

Course Code	POs/COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC7043	CO1	3	2	1											2	1
	CO2	3	2	1	2									1	2	1
	CO3	3	2	1											2	1
	CO4	3	2	1											2	1

Course Contents:

Unit 1: Graphics, Image & Video Representation

[11 Hrs]

Graphics/Image data types, Popular file formats, Color science – camera systems, XYZ to RGB Transform, Color models in images, Color models in video, Fundamental concepts in video

Unit 2: Digital Audio & Compression Algorithms

[10 Hrs]

Digitization of sound, MIDI, Quantization & transmission of audio, Lossless compression: Basics of information theory, Run-Length Coding, Variable Length Coding – Shannon Fano Algorithm, Huffman

Coding, LZW, Arithmetic Coding, Lossy compression: Distortion measures, Rate-distortion theory, Quantization, Transform coding.

Unit 3: JPEG & MPEG

[11 Hrs]

The 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

[10 Hrs]

Quality of multimedia data transmission, Multimedia over IP, Media-on-Demand (MOD), Multimedia over Wireless Network, C-Bird - A Case Study.

Text Book:

1. Ze-Nian Li, Mark S. Drew, "Fundamentals of Multimedia", Pearson Education, 2008.

Reference Book:

1. Ralf Steinmetz, KlaraNahrstedt, "Multimedia – Computing, Communications & Applications", Pearson Education, 2004,

B18EC7044	Reliability Engineering	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Fundamentals of Analog and Digital Electronics, Fundamental Mathematics

Course Description:

In this course, the student shall learn the basic concepts of Reliability Engineering and apply them to constrain a design. Reliability Engineering is engineering that emphasizes dependability in the life cycle management of a product. The student shall be able to predict the ability of a product or system to perform its required functions without failure for a specified time period and when used under the specified conditions. Engineering and analysis techniques are used to improve the reliability or dependability of a product or system. Reliability engineering falls within the maintenance phase of the software development life cycle (SDLC). The overall aim of the SDLC is to make software and product more reliable.

Course Objectives:

- The objectives of this course are to:
1. Introduce the subject of reliability engineering and familiarize the basic mathematics of reliability.
 2. Predict the reliability of typical systems and familiarize the electronic systems with models.

3. Familiarize the concept of design for production, test and maintenance.
4. Introduce reliability of software, software errors and preventions, concepts of fault tolerance, software checking and testing and software reliability prediction.

Course Outcomes:

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

1. Understand principles of reliability engineering.
2. Predict and analyze the reliability of typical systems and Incorporate reliability in electronic systems.
3. Understand the concept of design for production, test and maintenance of systems
4. Familiarize and Understand the reliability of software , software errors, preventions and fault tolerance, software testing

Mapping of Course Outcomes with Program Outcomes

Course Code	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
B18EC7044	CO1	3	2	1	1	3							1	1	2	1
	CO2	1	3	2	3	3				1		1	1	1	2	2
	CO3	1	3	2	3	1				1	2	1	1	1	2	
	CO4	1	3	2	3	3				1	1	1	1	2	1	1

Course Contents:

Unit-1: Introduction to Reliability Engineering

[11 Hrs]

What is Reliability Engineering? , Reasons for failure, Probabilistic Reliability, Repairable and Non-Repairable Items, The Pattern of Failures with Time (Non-Repairable Items), The Pattern of Failures with Time (Repairable Items).

Reliability Mathematics: Rules of probability, summary of continuous statistical distributions, discrete variations, statistical confidence, hypothesis testing.

Unit-2: Reliability prediction and modelling

[10 Hrs]

Systems Reliability models, availability of repairable systems, modular design, block diagram analysis,

Unit-3: Electronic Systems Reliability

[10 Hrs]

Reliability of Electronic Components ,Component Types and Failure Mechanisms, Reliability in Electronic System Design , Parameter Variation and Tolerances , Design for Production, Test and

Maintenance

Unit-4: Software Reliability

[11 Hrs]

Introduction, Software in Engineering Systems ,Software Errors , Preventing Errors , Fault Tolerance , Software Checking , Software Testing ,Software Reliability Prediction and Measurement , Case study from industry.

Text Books:

1. Patrick D.T.O’Connor, “Practical Reliability Engineering”, Wiley India, 5th edition, 2011.

Reference Books:

1. V.N.A. Naikan ,”Reliability Engineering and Life Testing”, PHI Learning Private Limited, 2009.
2. Charles B. Ebeling, “An introduction to Reliability and Maintainability Engineering”, Waveland Pr Inc, 2005.
3. Michael R. Lyu ,”Handbook of Software Reliability Engineering”, IEEE Computer Society Press,McGraw Hill, 1996.

SC-12

B18EC8011	Low Power VLSI	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

1. Concepts of low power VLSI design and scaling technologies involved.
2. Knowledge on simulation programming with integrated circuits and probabilistic power analysis.
3. Basics of design parameters of low power circuits and low power architecture.
4. Knowledge on clock distribution and architectural level methodologies.

Course Description:

This course deals with issues and models to design low-power VLSI circuits, fundamentals of power dissipation in microelectronic devices, will be able to estimate power dissipation due to switching, short circuit. The architectural, algorithm power estimation and optimization techniques will be discussed.

Course Objectives:

The objectives of this course are to:

1. Understand different sources of power dissipation in CMOS & MIS structure.
2. Understand the different types of low power adders and multipliers.
3. Focus on synthesis of different level low power transforms.
4. Understand the various energy recovery techniques used in low power design.

Course Outcomes:

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

1. Analyze different source of power dissipation and the factors involved in VLSI Circuits.
2. Explore the different techniques to design low power arithmetic circuits.
3. Illustrate the impact of various low powers transformation techniques
4. Optimize the power at architectural and algorithmic level.

Mapping of Course Outcomes with Program Outcomes:

Course Code	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
B18EC8011	CO1	3	3		1	2				3	3	2				
	CO2	3	2	3	1	2				3	3	3		3		3
	CO3	3	3	1	2					3	2	3				
	CO4	3	3	2		1				2	1	3		3		

Course Contents:

Unit -1: Introduction

[10 Hrs]

Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Physics of power dissipation in CMOS devices.

Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

Unit -2: Power estimation, Simulation Power analysis

[11 Hrs]

SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.

Unit 3: Low Power Design Circuit level**[11 Hrs]**

Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.

Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction.

Unit 4: Low power Clock Distribution**[10 Hrs]**

Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network.

Algorithm & Architectural Level Methodologies: Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis.

Text Books:

1. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000.
2. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002.
3. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic, 1997.

B18EC8012	Parallel Processing	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Computer Basics

Course Description.

In this course Parallel processing is taught which is a method in computing of running two or more processors (CPUs) to handle separate parts of an overall task. These multi-core set-ups are similar to having multiple, separate processors installed in the same computer. The course focus on memory technology and optimization technique by understanding the different types of parallelism, the course concentrates on reviewing the memory hierarchu and cache performance in parallel processors.

Course Objectives:

The objectives of this course are to:

1. Present design of parallel programs and how to evaluate their execution
2. Give knowledge of the characteristics, the benefits and the limitations of parallel systems and distributed infrastructures

3. Analyze the parallel programs in different operating system and build the programming model.
4. Encourage students to build experience with interdisciplinary teamwork.

Course Outcomes:

On completion of this course the student will be able to:

1. Analyze the requirements for programming parallel and critically evaluate the strengths and weaknesses of parallel programming models and how they can be used to facilitate the programming of concurrent systems.
2. Interpret the difference between the major classes of Instruction set architecture
3. Design and implement a SIMD and MIMD parallel processing solution for problems.
4. Understand the performances of processors and solve the optimization problems.

Mapping of Course Outcomes with program Outcomes

Course Code	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
B20 EC 8012	CO1	1	2		2		3	1			1			2		
	CO2	2	1	2		1						2			1	
	CO3		2	1		2	2			3			2			2
	CO4		1		2		1		2	1		2			2	

Course Contents:

Unit -1: Introduction and Architecture

[10Hrs]

Classes of computers; Defining computer architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Measuring, reporting and summarizing Performance; Quantitative Principles of computer design

Unit -2: Memory Technology and Optimization

[11Hrs]

Introduction to parallelism, shared memory model, distributed memory model, what is instruction level parallelism: concepts and challenges, basic compiler techniques for exposing ILP , Reducing Branch costs with prediction; Overcoming Data hazards

Unit -3: Thread Level Parallelism: Introduction

[11Hrs]

Multiprocessor architecture: issues and approach, challenges of parallel processing, Symmetric shared-memory architectures; Performance of symmetric shared-memory multiprocessors; Distributed shared memory and directory-based coherence; Basics of synchronization; Models of Memory

Unit -4: Review of Memory Hierarchy**[10Hrs]**

Introduction: Cache performance, Cache Optimizations, Virtual memory, Advanced optimizations of Cache performance, Memory technology and optimizations, Protection: Virtual memory and virtual machines

Text Books:

1. John L. Hennessey and David A. Patterson, "Computer Architecture – A quantitative Approach", Morgan Kaufmann / Elsevier Publishers, 5thEdition, 2012.

Reference books:

1. Barry Wilkinson, Michael Allen, "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers", Prentice Hall; 2nd edition ; ISBN: 0131405632
2. Kai Hwang , "Advanced Computer Architecture Parallelism, Scalability , Programability", Tata Mc Grawhill, 2003.
3. David E. Culler, Jaswinder Pal Singh, Anoop Gupta:, Morgan Kaufman," Parallel Computer Architecture, A Hardware / Software Approach", –, 1999.

B18EC8013	Ad-Hoc Networks	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites:

Wireless Communication, Computer Communication Network.

Course Description:

This course is an advanced research-oriented course designed for graduate students with computer and wireless networks background. Through this course, students can learn the state of art of wireless ad hoc networks research, and enhance their potential to do research in this exciting area.

Course Objectives:

The objectives of this course are to:

1. Describe the issues and challenges of Wireless Ad hoc networks
2. Discuss the various concepts involved in designing the network layered protocols
3. Discuss the concepts involved in designing the transport layered protocols
4. Discuss the issues and challenges involved in providing QoS in Ad hoc wireless Networks.

Course Outcomes:

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

1. Illustrate the characteristics of Adhoc Networks and MAC protocols
2. Explain the concepts of Adhoc networks and network layered protocols
3. Illustrate issues involved in designing transport layered protocols for Adhoc networks
4. Classify issues and challenges involved in providing QoS for Ad hoc wireless Networks

Mapping of Course Outcomes with program Outcomes

Course Code	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
B18EC801 3	CO1	3	2	1											2	1
	CO2	3	2	1											2	1
	CO3	3	2	1		3								3	2	1
	CO4	3	2	1		3								3	2	1

Course Contents:

Unit-1: AD-HOC Networks & MAC Protocol

[11 Hrs]

Introduction, Issues, Ad-hoc wireless internet, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols. Contention - based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols.

Unit-2: Routing Protocols for AD HOC Wireless Networks

[10 Hrs]

Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table drive routing protocol, On-demand routing protocol. Hybrid routing protocol

Unit- 3: Transport Layer Protocols for AD HOC Wireless

[11 Hrs]

Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks.

Unit-4: Quality of Service In AD HOC Wireless Networks

[10 Hrs]

Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions.

Text Book:

1. C. Siva Ram Murthy & B. S. Manoj, "Ad hoc wireless Networks", Pearson Education, 2nd Edition, 2005.

Reference Books:

1. Ozan K. Tonguz and Gianguigi Ferrari, "Ad hoc wireless Networks" , John Wiley, 2007
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: "Ad hoc Wireless Networking", Kluwer Academic Publishers, 2004.

B18EC8014	Avionics	L	T	P	C
Duration 14 Weeks		3	0	0	3

Prerequisites:

Instrumentation systems, sensors, Mathematical modeling of System, Microwave signals, Radar systems, Modulation Techniques.

Course Description:

This course covers the different features of Display units, roles of Avionics. The curriculum for the programme is structured as per the requirements of the aviation industry. The field of activity of qualified personnel involves maintenance of various flying instruments in the realm of Avionics and Illustrate the Surveillance and Communications Systems in Avionics. Students are taught existing technology as well as advanced Multi-Functional Display Systems.

Course Objectives:

The objectives of this course are to:

1. Introduce the general topics of aircraft Electronics.
2. Summarize the advantages and disadvantages of various avionics system.
3. Understand the different avionics systems of aircraft like display system, navigation system.
4. Identify different aircraft cockpit fittings like display system.

Course Outcomes:

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

1. Describe the avionics environment.
2. Understand the importance of Aircraft Instruments.
3. Appraise the Navigation Systems and Flight Control in Avionics.
4. Illustrate the Surveillance and Communications Systems in Avionics.

Mapping of Course Outcomes with program Outcomes

Course Code	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
B18EC80 14	CO1	1	1	1	2								2	1	1	2
	CO2	1	1	1	1								2	1	1	2
	CO3	1	3	3	2								1	1	1	2
	CO4	1	2	2	2								1	1	1	2

Course Contents:

Unit -1: Introduction to Avionics & Display Systems

[11 Hrs]

Importance and role of avionics, avionic environment, Regulatory and advisory agencies -Displays and man-machine interaction: Active Matrix Liquid Crystal Display (AMLCD), Head Down Display (HDD), Head Up Display (HUD), Helmet Mounted Display (HMD), OLEDs, Night Vision Goggles, LASERS, Integrated Standby Instrument System (ISIS), data fusion, intelligent displays management, Displays technology, control and data entry, instrument placements.

Unit -2: Aircraft Instruments

[10 Hrs]

Inertial reference systems, attitude derivation. RMI, HSI, ADI Magnetic Heading Reference System (MHRS.); Outside world sensor systems: Radar systems - Radar Sensing - Radar Altimeter (RADALT), Doppler Radar, Weather Radar, RADOME.

Unit -3: Navigation Systems and Flight Control

[11 Hrs]

Principles of navigation, Automatic Direction Finding, Very High Frequency Omni-Range (VOR), Distance Measuring Equipment (DME), landing aids (ILS & MLS), Inertial Navigation, GPS-global positioning system. Fly by Wire Flight control features and advantages.

Unit -4: Surveillance & Communication Systems

[10 Hrs]

HF, VHF, UHF, Microwaves Signals and Noise, Modulation and demodulation, Antennas, propagation, data links, Telemetry, Transponders, Typical Systems in Aircrafts, ATC Electronic Warfare Basics.

Text Books:

1. Cary R. Spitzer, "Digital Avionics Handbook", CRC Press LLC, 3rd Edition, 2006.
2. Collinson, R.P.G, "Introduction to avionics", Springer, 3rd Edition, 2011
3. Ian Moir, Allan G. Seabridge, "Military Avionics Systems", John Wiley & Sons, Ltd, 2009

Reference Books:

1. Ian Moir, Allan G.Seabridge, "Aircraft Systems" Mechanical, Electrical, Avionics Subsystems Integration, ohn Wiley & Sons, 3rdEdition, Ltd 2008
2. Cary R. Spitzer, "Digital Avionics Handbook", , CRC Press LLC, 2nd Edition ,2007.
3. Brain Kendal, "Manual of Avionics", the English Book House, New Delhi, 3rd Edition, 1993.
4. Collinson RPG, "Introduction to Avionics", Kluwer Academic Publishers, Chapman & Hall, 2ndEdition, 2003.
5. Mauhamed Abdulla, "Avionics made simple", Available at http://drmoie.org/research/avionics_made_simple, 2005

SC-13

B18EC8021	Digital Testing and Testability	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

Digital Electronic Circuits, HDL and Basic C Language.

Course Description:

Introduction to the basic concepts in digital systems testing. Advanced topics in fault modeling and simulation, test pattern generation, and design for testability.

Course Objectives:

The objectives of this course are to:

1. Describe the understanding of threshold logic and digital testing.
2. Demonstrate the understanding of minimization of FSM.techniques.
3. Provide an in-depth uunderstanding of the testing in sequential machines.
4. Conduct fault detection experiments.

Course Outcomes:

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

1. Identify the various ways of designing digital circuits.
2. Understand a combinational circuit and identify the faults.
3. Analyse the given finite state machines.
4. Design various fault detection experiments.

Mapping of Course Outcomes with Program Outcomes

Course Code	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
BTEC15F8230	CO1	1	3	3		3	3		1			2		3	2	1
	CO2	2	3	2	3	3	1						2	3	2	1
	CO3	2	3		3	3							1	3	2	1
	CO4	1	3	3	3	3	2					1		3	2	1

Course Contents:

UNIT-1: Threshold Logic, Reliable Design and Fault Diagnosis [11 Hrs]

Threshold Logic: Introductory Concepts, Synthesis of Threshold Networks.

Reliable Design and Fault Diagnosis: Hazards, Fault Detection in Combinational Circuits, Fault-Location Experiments, Boolean Differences, Fault Detection by Path Sensitizing, Detection of Multiple Faults, Failure-Tolerant Design, Quadded Logic.

Unit-2: Capabilities, Minimization, and Transformation of Sequential Machines [10 Hrs] The

Finite-State Model- Further Definitions, Capabilities and Limitations of Finite – State Machines, State Equivalence and Machine Minimization, Simplification of Incompletely Specified Machines.

Unit-3: Structure of Sequential Machines [11 Hrs]

Introductory Example, State Assignments Using Partitions, The Lattice of closed Partitions, Reductions of the Output Dependency, Input Independence and Autonomous Clocks, Covers and Generation of closed Partitions by state splitting, Information Flow in Sequential Machines, Decompositions.

Unit-4: State—Identifications and Fault-Detection Experiments [10 Hrs]

Experiments, Homing Experiments, Distinguishing Experiments, Machine Identification, Fault-Detection Experiments.

Text book:

1. Zvi Kohavi, "Switching and Finite Automata Theory", Tata McGraw Hill Edition, 2nd Edition. 1978.

B18EC8022	Pervasive and Ubiquitous Computing	L	T	P	C
Duration :14Wks		3	0	0	3

Prerequisites:

OSI Layer, TCP/IP, Protocols, IoT Layers

Course Description:

Pervasive and Ubiquitous Computing discusses the importance of modern communication systems and evolution of computing networking into various new domains. It highlights the recent trends in Internet of Things and its importance in everyday life.

Course Objectives:

Course objectives are to:

1. Provide a sound conceptual foundation in the area of Pervasive Computing aspects;
2. Provide a balanced treatment of the mechanisms and environments of ubiquitous Computing.
3. Give an insight into successful mobile and pervasive computing applications and Services.
4. Introduce to the architectures of Intelligent Systems.

Course Outcomes:

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

1. Summarise about the Smart Device, Environment and Interfaces (DEI) model of Ubiquitous Computing Systems.
2. Apply usability of alternative design of interactions for specific ubiquitous computing systems and HCI.
3. Design and implement simple context aware applications, using standard sensor technology.
4. Compare various Intelligent System.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC8022	CO1	3	2				2	1					1	3	3	2
	CO2	3	2				2	1					1	3	3	2
	CO3	3	2				2	1					1	3	3	2
	CO4	3	2				2	1					1	3	3	2

Course Contents:

Unit-1: Ubiquitous Computing

[11 Hrs]

Basics and Vision - Living in a Digital World, Modelling the Key Ubiquitous Computing Properties, Architectural Design for UbiCom Systems: Smart DEI Model; Applications and Requirements - Example Early UbiCom Research Projects

Unit-2: Human Computer Interaction

[10 Hrs]

Introduction, User Interfaces and Interaction for Four Widely Used Devices, Hidden UI via Basic Smart Devices, Hidden UI Via Wearable and Implanted Devices, Human-Centred Design (HCD), User Models: Acquisition and Representation, iHCI Design

Unit-3: Tagging, Sensing and Controlling

[11 Hrs]

Introduction, Tagging the Physical World, Sensors and Sensor Networks, Micro Actuation and Sensing: MEMS, Embedded Systems and Real-Time Systems, Control Systems (for Physical World Tasks), Robots.

Unit-4: Intelligent Systems (IS)

[10 Hrs]

Introduction, Basic Concepts, IS Architectures; Ubiquitous Communication – Introduction, Audio Networks, Data Networks, Wireless Data Networks, Ubiquitous Networks, Service-Oriented Networks.

Text Books:

1. Stefan Poslad, "Ubiquitous Computing Smart Devices, Environments and Interactions", Wiley, 2009
2. Ed. John Krumm. Chapman, "Ubiquitous Computing Fundamentals" Hall/CRC 2009.

Reference Book:

1. Burkhardt, Henn, Hepper, Rintdorff, Schaeck. "Pervasive Computing", 2002, Addison Wesley.

B18EC8023	Network Security	L	T	P	C
Duration :14 Wks		3	0	0	3

Prerequisites

Basics of digital communication, computer communication

Course Discription

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

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

1. Illustrate different types of symmetrical encryption techniques.
2. Solve different types of public key cryptography.
3. Understand threats and security mechanisms of Hash function, MAC's and Digital signature.
4. Analyze the knowledge of key management and transport layer security.

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC8023	CO1	3	3	2	2									1	2	1
	CO2	2	3	3	2									1	2	2
	CO3	2	2	3	3									1	2	3
	CO4	2	3	3	2									1	2	3

Course Contents:

Unit-1: Encryption Techniques & DES

[11hrs]

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

[10hrs]

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.

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Unit-3: Hash Functions, MACs and Digital Signature**[11hrs]**

Cryptographic Hash Functions: Two Simple Hash Functions, Hash function based on cipher block chaining, 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**[10hrs]**

Key management: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, distribution of public keys.

Transport-layer security: Web Security Considerations, Secure Sockets Layer, TLS, HTTPS.

Text Book:

1. William Stallings, "Cryptography and Network Security, Principles and Practice", Pearson/Prentice Hall ,6th edition, , 2011.

Reference Books:

1. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill ,2nd edition, , 2007.
2. Eric Maiwald, "Fundamentals of Network Security", McGraw-Hill,1st edition , 2003.

B18EC8024	RADAR and Navigational Aids	L	T	P	C
Duration :16 Wks		3	0	0	3

Prerequisites:

Analog & Digital Communication Basics

Course Description

This Course introduces the fundamental concepts of RADAR (Radio Detection and Ranging) like MTI, Pulsed Radar, AMIT and Navigation aids. Introduces the students to different types of RADAR and Navigation systems like Navigational Systems, Aids to Approach and Landing, Doppler Navigation, Inertial Navigation, Satellite Navigation System and also make students learn modern radar and navigational techniques.

Course Objectives:

The course objectives are to:

1. Derive and discuss the Range equation and the nature of detection.
2. Apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars
3. Understand principles of navigation, in addition to approach and landing aids as related to navigation

4. Introduce the different navigation system

Course Outcomes:

On completion of this course the student will be able to:

1. Discuss on the RADAR range equation parameters.
2. Explain the operation of MTI and Pulse Doppler RADAR.
3. Describe the Navigational methods.
4. Compare the different Navigational System.

Mapping of Course Outcomes with programme Outcomes

Course Code	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	PSO 1	PSO 2	PSO 3
	CO1	3	2	2							2		2	3	2	1
	CO2	2	2	2							2		2	3	2	1
	CO3	3	2	2							2		2	2	2	2
	CO4		3	2							2		2	2	2	2

Course Contents:

Unit1: Introduction to RADAR

[10 Hrs]

Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies – Applications of Radar – The Origins of Radar The Radar Equation Introduction- Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters System losses – Other Radar Equation Considerations

Unit 2 : MTI and Pulse Doppler RADAR:

[11 Hrs]

Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) - Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing - Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics - Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT), Detection of Signals in Noise

Unit 3: Basics of Navigations:

[10 Hrs]

Introduction - Four methods of Navigation.

Radio Direction Finding - The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders - The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders

Radio Ranges - The LF/MF Four course Radio Range - VHF Omni Directional Range (VOR) - VOR Receiving Equipment - Range and Accuracy of VOR - Recent Developments.

Unit 4: Navigational Systems

[11 Hrs]

Aids to Approach and Landing, Doppler Navigation, Inertial Navigation, Satellite Navigation System - The Transit System - Navstar Global Positioning System (GPS).

Text Books:

1. Merrill I. Skolnik, "Introduction to Radar Systems", Tata McGraw-Hill, 3rd Edition, 2003.
2. N.S.Nagaraja, "Elements of Electronic Navigation Systems", Tata McGraw-Hill, 2nd Edition, ISBN: 9780074623015, 2000.

Reference Books:

1. Peyton Z. Peebles, "Radar Principles", John Wiley, 2004
2. J.C Toomay, "Principles of Radar", 2nd Edition –PHI, 2004

Open Elective

B18EC7051	Embedded Systems	L	T	P	C
Duration :14 Wks		4	0	0	4

Prerequisites:

Microcontroller, Operating Systems.

Course Description:

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.

Unit 1 gives an introduction to the basic elements of embedded system such as sensors, interfaces, firmware etc.

Unit 2 discusses about the various aspects of hardware software co design.

Unit 3 covers the complete aspects on real time embedded system design.

Unit 4 briefly covers the various topics on embedded integrated development environment.

Course Objectives:

Course objectives are to:

1. Give a brief idea about the embedded system components, memory, communication interfaces and other firmware components.
2. Understand the Quality attributes, hardware and Software co-design, Computational models in embedded systems, Unified Modelling languages etc.
3. Understand the firmware system development and firmware development languages.
4. Give a brief description of RTOS, Integrated Development Environment, Simulators and Emulators.
5. To understand the trends in embedded system development.

Course Outcomes:

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

1. Design a module of embedded system
2. Elaborate the quality attributes, hardware-software co-design in embedded systems.
3. Develop a firmware module.
4. Analyze the various tools in RTOS.

Mapping of Course Outcomes with program Outcomes

Course Code	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
B18EC6041	CO1	3	2		1	3	1				2	1	2		1	1
	CO2	3	2	2	1	3									1	1
	CO3						1				2	1	2			
	CO4	3	2	2	1	3									1	1

Course Contents:

Unit-1: Typical Embedded System

[14 Hrs]

Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components.

Unit-2: Characteristics and Quality Attributes of Embedded Systems**[14 Hrs]**

Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language (**Self Study/Case Study**), Hardware Software Trade-offs

Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages

Unit-3: Real-Time Operating System (RTOS) based Embedded System Design**[14Hrs]**

Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS (**Self Study/Case Study**).

Unit-4: The Embedded System Development Environment**[14 Hrs]**

The Integrated Development Environment (IDE) (**Self Study/Case Study**), Types of Files Generated on Cross-compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.

Trends in the Embedded Industry:(Self Study/Case Study), Processor Trends in Embedded Systems, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks.

Text books:

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009
2. James K Peckol , "Embedded Systems – A contemporary Design Tool", John Weily, 2008.

B18EC7052	Robotics and Automation	L	T	P	C
Duration: 14 Wks		4	0	0	4

Prerequisites:

Embedded System Design, Control systems, Programming skills

Course Description:

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

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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:

Course objectives are to:

1. Classify Robots and anatomy.
2. Understand Robot kinematics
3. Determine Sensors and vision systems used in robots.
4. Write Robot Program.

Course Outcomes:

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

1. Summarize the basic applications and advantages of using robots in the industry
2. Do the robot motion analysis
3. Relate mathematical modeling and trajectory planning scheme in robots
4. Recognize the different types of sensors and cameras used in the field of robotics

Mapping of Course Outcomes with programme Outcomes

Course Code	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
B18EC 7052	CO1	3			3		3	1		2	2		2	3	3	2
	CO2	3			3		3	1					2	3	3	2
	CO3	3			3		3	1		2			2	3	3	2
	CO4	3			3		3	1		2	2		2	3	3	2

Course Contents:

Unit -1: Introduction to robotics

[14 Hrs]

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**[14 Hrs]**

Direct kinematics and inverse kinematics, 3D homogeneous transformations, rotation, translation and displacement matrix, composite 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**[14 Hrs]**

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 Robot sensors and Machine Vision & Robot programming**[14 Hrs]**

Machine vision, functions of machine vision system, sensing and digitizing, imaging devices, analog to digital signal conversion, quantization and encoding, simple numerical problems, image storage, image processing and analysis, image data reduction, segmentation, feature extraction, object recognition, robotic machine vision applications, inspection, identification, visual servoing and navigation.

Introduction to robot programming, robot cell layout, work cell control and interlocks, manual programming, lead through and walkthrough programming, off-line programming, VAL programming language, example, AML and VAL-II robot programming languages, examples, Programming with graphics, example.

Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey, " Industrial Robotics," McGraw-Hill Publications, International Edition, 2008.
2. James G. Keramas, " Robot Technology Fundamentals", Cengage Learning, International Edition 1999.

Reference Books:

1. Fu K. S., Gonzalez R. C., Lee C. S. G: Robotics, " Control, Sensing, Vision, Intelligence ", McGraw Hill Book Co., International edition, 2008.
2. Appu Kuttan K. K, " Robotics, International Publications", First Edition, 2007

3. R. K. Mittal, I. J. Nagrath, "Robotics and Control", Tata-McGraw-Hill Publications, 2007

B18EC7053	IOT & Cyber physical system	L	T	P	C
Duration:14 Wks		4	0	0	4

Prerequisites:

Embedded systems, Computer concept networking Course

Course Description:

IoT is the technology enabling the inter-connection of all types of devices through the internet to exchange data, optimize processes, monitor devices in order to generate benefits for the industry, the economy, and the end user. It is composed of network of sensors, actuators, and devices, forming new systems and services. Many protocols are used for faithful transmission data based on the applications. The Cyber Physical Systems (CPS) is an engineering discipline and specifies the integrations of and interaction between computation and physical processes. CPS integrates the dynamics of the physical processes with those of the communications, computation and networking, and analysis techniques for the integrated systems.

Course Objectives:

The objectives of this course are to:

1. Discuss the architecture of Internet of Things and connected world.
2. Contrast various hardware, communication and sensing technologies, cloud services to build IoT applications
3. Understand about modelling of cyber-physical systems
4. Describe the design of cyber physical system.

Course Outcomes:

On completion of this course the student will be able to:

1. Describe the IoT system architecture and system design.
2. Use protocols, cloud services and communication API's for developing Applications
3. Apply the core principles behind Cyber physical system
4. Discuss the abstraction in designing the cyber physical system

Mapping of Course Outcomes with Program Outcomes

Course Code	CO# / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
B18EC7010	CO1	3	2	3	2	3	2	2		1		1		3	2	3
	CO2	3		3		3								3	2	3
	CO3	3	2	3	2	3					2			3	3	3
	CO4	3	1				1							3	2	

Course Contents:

Unit -1: Introduction & Concepts of IoT [10]

IoT Definition & Characteristics of IoT, Physical Design of IoT: Thing in IoT, IoT Protocols, Logical Design of IoT: Function Block, Communication Models, Communication API, IoT Enabling Technologies: WSN, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded System, IoT Levels and Deployment Templates, Applications of IoT

Unit -2: IoT System Design

[11]

IoT Design methodology, IoT Protocol – MQTT, CoAP, Introduction to Cloud storage Models: WAMP, Xively Cloud for IoT, Python Web Application Framework-Django, Designing a RESTful based Web API. Data Analytics for IoT – Apache Hadoop, Apache Oozie. Case studies illustrating IoT design – Home Automation, Cities, Environment, Agriculture

Unit -3: Introduction & Modelling of Cyber Physical System

[10]

Definition & Example of CPS system, Design Process, Modelling Dynamic Behaviours – Continuous Dynamics: Newtonian Mechanics, Actor Model, Discrete Dynamics: Discrete Systems, Notion of State, Finite-State Machines, Extended State machines

Unit -4: Designing of Cyber Physical System

[11]

Embedded architecture: Types of processors, Parallelism, Pipelining, Multicore Architectures, Multitasking: Process, Process Management, States of Process, Process Schedulers, Process Control Block, Interrupts, Threads & its types. Scheduling: Levels, Different of Types, Different process scheduling algorithms.

Textbooks:

1. Arshdeep Bagha and Vijay Madiseti Internet of Things: A Hands-on Approach

2. Edward A. Lee and Sanjit A. Seshia, "Introduction to Embedded Systems, A Cyber-Physical Systems Approach", Second Edition, MIT Press

Reference Books:

1. Pethuru Raj and Anupama C. Raman (CRC Press), The Internet of Things: Enabling Technologies, Platforms and Use Cases
2. Adrian McEwen, Hakim Cassimally, 'Designing the Internet of Things', Wiley, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, 'The Internet of Things: Key Applications and Protocols', Wiley, 2015.
4. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press
5. Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic, "Cyber-Physical Systems: From Theory to Practice", CRC Press

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