REVA UNIVERSITY

Bengaluru, India

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

B. TECH IN ELECTRICAL AND ELECTRONICS ENGINEERING

2018-22

Rukmini Educational Charitable Trust

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech (Electrical and Electronics Engineering) Program

HANDBOOK

2018-22

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

Rukmini Educational
Charitable Trust

www.reva.edu.in

Chancellor's Message

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

- Nelson Mandela.

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

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

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

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

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

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

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

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

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

aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

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

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

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

Welcome to the portals of REVA University!

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

MESSAGE FROM THE DIRECTOR

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

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

The program is thus designed to expose students to various subjects having applications in power sectors, and IT and electronics related industries through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. The curriculum caters to and has relevance to local, regional, national, global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

The curriculum caters to and has relevance to local, regional, national, global developmental needs.

Maximum number of courses are integrated with cross-cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

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

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

The benefits of choosing Electrical and Electronics Engineering are:

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

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

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

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RUKMINI EDUCATIONAL CHARITABLE TRUST

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

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

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 11,000 students study various courses across REVA's three

campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

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

The University is presently offering 24 Post Graduate Degree programs, 21 Degree and PG Degree programs in various branches of studies and has 14000+ students studying in various branches of knowledge at graduate and post graduate level and 410 Scholars pursuing research leading to PhD in 21 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

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

others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano-Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

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

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

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

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitate students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

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

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

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is **'Life Time Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The

first “REVA Life Time Achievement Award” for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced “**REVA Award of Excellence”** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

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

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honored with many more such honors and recognitions.

ABOUT SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

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

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

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

This is reflected in various core subjects offered within the program

Vision

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

Mission

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

Academic Objectives

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

ADVISORY BOARD

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

B Tech (Electrical & Electronics Engineering) Program

Programme Overview

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

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

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

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

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

The B. Tech., in Electrical and Electronics Engineering curriculum developed by the faculty at the **School of Electrical and Electronics Engineering**, is outcome based and it comprises required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, innovative, creative thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in interdisciplinary topics and attitudinal skills to enhance their scope. The above-mentioned features of the programme, advanced teaching and learning resources, and experience of the faculty members with their strong connections with power and energy sector makes this programme unique.

Programme Educational Objectives (PEOs)

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

The Programme Educational Objectives are to prepare the students to:

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

Programme Outcomes (POs)

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

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

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

Program Specific outcome

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

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

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

1. Title and Commencement:

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

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

2. The Programs:

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

B Tech in:

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

3. Definitions:

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

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

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

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

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

4. Courses of study and Credits

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

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

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

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

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

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

a. Core Course:

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

b. Foundation Course (FC):

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

c. Hard Core Course (HC):

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

d. Soft Core Course (SC):

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

e. O**pen Elective Course:**

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

f. Project Work / Dissertation:

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

5. Eligibility for Admission:

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

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

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

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

6. Scheme, Duration and Medium of Instructions:

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

6.2. The medium of instruction shall be English.

7. Credits and Credit Distribution

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

	Credits

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

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

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

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

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

8. Assessment

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

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

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

The details as given in the table

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

Note: IA or CIA includes C1,C2, C3

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

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

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

9. Setting question paper and evaluation of answer scripts.

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

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

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

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

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

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

[

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

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

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

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

a) Continuous Internal assessment (CIA) = 50 marks

b) Semester end practical examination (SEE) = 50 marks

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

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

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

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

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

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

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

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

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

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

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

11. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1,C2 and C3 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

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

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

12. Eligibility to Appear for Semester End Examination

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

12.2. Requirements to Pass a Course

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

12.3. Requirements to Pass the Semester

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

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

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

Examples:-

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

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

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

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

Semester courses to earn B Tech Degree.

13.1. Re-Registration and Re-Admission:

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

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

14. Attendance Requirement:

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

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

14.3. Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester (C4) examination and such student shall seek re-admission as provided in 7.8.4.

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

15. Absence during Mid Semester Examination:

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

16. Grade Card and Grade Point

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

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

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

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

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

Here, P is the percentage of marks (P=[C1+C2+C3+C4] secured by a candidate in a course which is **rounded to nearest integer**. v is the credit value of course. G is the grade and GP is the grade point.

16.3.1. Computation of SGPA and CGPA

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

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

SGPA (Si) = ∑(Ci x Gi) / ∑Ci where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

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

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

Thus, **SGPA = 188 ÷ 24 = 7.83**

Illustration No. 2

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

Thus, **SGPA = 175 ÷ 24 = 7.29**

Illustration No.3

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

Thus**, SGPA = 199 ÷ 24 = 8.29**

16.4. Cumulative Grade Point Average (CGPA):

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

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

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

Illustration:
CGPA after Final Semester

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

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

16.4.2. *CONVERSION OF GRADES INTO PERCENTAGE:*

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.10 x 10=81.0

16.5. Classification of Results

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

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

Overall percentage=10*CGPA

17. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the

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

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

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

B. Tech (Electrical & Electronics Engineering) Program

Scheme of Instructions

(Effective from Academic Year 2018 - 19)

I Semester Physics Cycle

SL	Course Code	Title of the Course	HC/SC/OE	Credit Pattern & Credit Value				CH	Teaching School/Dept.
				L	T	P	C		
1	B18EE1010	Engineering Mathematics – I	HC	4	0	0	4	4	Mathematics
2	B18EE1020	Engineering Physics	HC	2	1	0	3	4	Physics
3	B18EE1030	Engineering Mechanics	HC	2	1	0	3	4	Civil
4	B18EE1040	Elements of Mechanical Engineering	HC	2	1	0	3	4	Mechanical
5	B18EE1050	Basic Electrical & Electronics Engineering	HC	2	1	0	3	4	EEE/ECE
6	B18EE1060	Indian Constitution and Professional Ethics	FC	2	0	0	2	2	Law
7	B18EE1070	Technical English I	FC	0	0	2	2	4	A & H
8	B18EE1080	Physics Lab	HC	0	0	2	2	2	Physics
9	B18EE1090	Basic Electrical Engineering lab	HC	0	0	2	2	2	EEE
TOTAL CREDITS				**14**	**4**	**6**	**24**	**30**	

II Semester Chemistry Cycle

SL	Course Code	Title of the Course	HC/ SC/ OE	Credit Pattern & Credit Value				CH	Teaching School/Dept.
				L	T	P	C		
1	B18EE2010	Engineering Mathematics – II	HC	4	0	0	**4**	4	Mathematics
2	B18EE2020	Engineering Chemistry	HC	2	1	0	**3**	4	Chemistry
3	B18EE2030	Electrical Power Generation & Transmission	HC	2	1	0	**3**	4	EEE
4	B18EE2040	Computer Concepts & C++ Programming	HC	2	1	0	**3**	4	CSE
5	B18EE2050	Electrical &Electronic Instrumentation and Measurements	HC	2	1	0	**3**	4	EEE
6	B18EE2060	Environmental Sciences	FC	2	0	0	**2**	2	Chemistry
7	B18EE2070	Technical English II	FC	0	0	2	**2**	4	A & H
8	B18EE2080	Chemistry Laboratory	HC	0	0	2	**2**	2	EEE
9	B18EE2090	Computer programming (C++) Lab	HC	0	0	2	**2**	2	CSE
FINAL CREDITS				**14**	**4**	**6**	**24**	**30**	

III Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	L	T	P	C	CH	Teaching School/Dept.
1	B18EE3010	Engineering Mathematics–III	HC	4	0	0	**4**	4	Mathematics
2	B18EE3020	Electrical Circuit Theory	HC	3	1	0	**4**	5	EEE
3	B18EE3030	Electrical Machines I	HC	4	0	0	**4**	4	EEE
4	B18EE3040	Analog Electronic & Digital Electronic Circuit Design	HC	2	1	0	**3**	4	EEE
5	B18EE3050	Theory and Applications of Linear Integrated Circuits	HC	2	0	1	**3**	4	EEE
6	B18EE3060	Microcontrollers and Applications	HC	2	1	0	**3**	4	EEE
7	B18EE3070	Analog Electronic & Digital Circuit Design Laboratory	HC	0	0	2	**2**	3	EEE
8	B18EE3080	Electrical and Electronics Measurements Lab.	HC	0	0	2	**2**	3	EEE
9	B18EE3090	Soft Skill	RULO	1	0	1	**2**	2	T & P / EEE
		Mandatory total Credits		**18**	**3**	**6**	**27**	**33**	
10	B18EE3X10	Skill Development	RULO	0	0	2	**2**	2	EEE / Industry
FINAL CREDITS				**18**	**3**	**8**	**29**	**35**	

IV Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B18EE4010	Engineering Mathematics–IV	HC	4	0	0	**4**	4	Mathematics
2	B18EE4020	Electromagnetic Theory	HC	4	0	0	**4**	4	EEE
3	B18EE4030	Electrical Machines II	HC	4	0	0	**4**	4	EEE
4	B18EE4040	Power Electronics	HC	4	0	0	**4**	4	EEE
5	B18EE4051	Electrical Power Utilization	SC	4	0	0	**4**	4	EEE
	B18EE4052	Electric drives							EEE
	B18EE4053	Digital system design using VHDL							ECE/EEE
	B18EE4054	Data Base Management System							C&IT
6	B18EE4061	Management & Entrepreneurship	SC	4	0	0	**4**	4	EEE
	B18EE4062	Electricity Act							EEE
	B18EE4063	Programmable Logic Circuits							ECE/EEE
	B18EE4064	Data Structures using C++							C&IT
7	B18EE4070	Electrical Machines-I Laboratory	HC	0	0	2	**2**	2	EEE
8	B18EE4080	Microcontroller Laboratory	HC	0	0	2	**2**	2	EEE
9	B18EE4090	Soft Skill	SS	0	0	2	**2**	2	T & P / EEE
		Mandatory total Credits		**24**	**0**	**6**	**30**	**32**	
10	B18EE4X20	Yoga/Sports/Performing Arts/Meditation	SC	0	0	2	2	4	EEE
TOTAL CREDITS				**24**	**0**	**8**	**32**	**34**	

V Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B18EE5010	Power System Analysis	HC	3	0	0	**3**	4	EEE
2	B18EE5020	Switch Gear & Protection	HC	3	0	0	**3**	4	EEE
3	B18EE5030	High Voltage Engineering	HC	3	0	0	**3**	4	EEE
4	B18EE5041	Design of Electrical Machines	SC	3	0	0	**3**	4	EEE
	B18EE5042	Advanced Power Electronics							EEE
	B18EE5043	VLSI Circuits and Design							ECE/EEE
	B18EE5044	Python Programming							C&IT
5	B18EE5051	Operation & Research	SC	3	0	0	**3**	4	EEE
	B18EE5052	Electric & Hybrid Vehicles							EEE
	B18EE5053	Digital Image Processing							ECE/EEE
	B18EE5054	Web Programming							C&IT
6	B18EE5061	Electrical Power Quality	SC	3	0	0	**3**	4	EEE
	B18EE5062	Electrical Regulations & Safety							EEE
	B18EE5063	Embedded Systems & IOT							ECE/EEE
	B18EE5064	Artificial Intelligence							C&IT
7	B18EE5070	Power Electronics Laboratory	HC	0	0	2	**2**	3	EEE
8	B18EE5080	Electrical Machines Laboratory II	HC	0	0	2	**2**	3	EEE
9	B18EE5090	Soft Skill	RULO	0	0	2	**2**	2	T & P / EEE
		Mandatory total Credits		**18**	**0**	**6**	**24**	**32**	
10	B18EE5X10	Skill Development	RULO	1	0	1	**2**	2	EEE / Industry
TOTAL CREDITS				**19**	**0**	**7**	**26**	**34**	

VI Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B18EE6010	Computer Aided Power System Analysis and Stability	HC	3	0	0	3	4	EEE
2	B18EE6020	Signal Processing	HC	3	0	0	3	4	EEE
3	B18EE6030	Control Engineering	HC	3	0	0	3	4	EEE
4	B18EE6041	Testing and Commissioning of Electrical Equipment	SC	3	0	0	3	4	EEE
	B18EE6042	Energy storage systems							EEE
	B18EE6043	Electrical Engineering Materials							EEE
	B18EE6044	MEMS Technology							ECE/EEE
	B18EE6045	Big Data Analytics & Cloud Computing							C&IT
5	B18EE6051	Power System Planning and Reliability	SC	3	0	0	3	4	EEE
	B18EE6052	Modeling and Simulation of Electrical Machines							EEE
	B18EE6053	Industrial Instrumentation and Automation							ECE
	B18EE6054	Fundamentals of Robotics							ECE/EEE
	B18EE6055	JAVA Programming							C&IT
6	B18EE6061	Smart grid	SC	3	0	0	3	4	EEE
	B18EE6062	Reactive power management							EEE
	B18EE6063	Advanced Electrical Machines							EEE

	B18EE6064	Analog & Digital Communication Systems							EEE
	B18EE6065	Cryptography & Network Security							C&IT
7	B18EE6070	Power System Simulation Laboratory	HC	0	0	2	2	3	EEE
8	B18EE6080	Control System Laboratory	HC	0	0	2	2	3	EEE
9	B18EE6090	Soft Skill	SS	2	0	0	2	2	T & P / EEE
10	B18EE6X10	SWYAM/MOOC Course	RULO	2	0	0	2	2	EEE
11	B18EE6X20	Skill Development	RULO	1	0	1	2	2	EEE / Industry
FINAL CREDITS				**23**	**0**	**5**	**28**	**34**	

VII Semester

SL No.	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B18EE7010	Project Phase -1	HC	0	1	1	2	2	EEE
2	B18EE7020	Computer Aided Electrical Drawing	HC	2	0	1	3	5	EEE
3	B18EE7031	Advanced Control Engineering	SC	2	1	0	3	3	EEE
	B18EE7032	Electrical Energy Conservation							EEE
	B18EE7033	Computer Control of Electric drives							EEE
	B18EE7034	Advanced microcontrollers							ECE
	B18EE7035	Software Testing							C&IT
4	B18EE7041	HVDC	SC	2	1	0	3	3	EEE
	B18EE7042	Operation and Control of Power Systems							EEE
	B18EE7043	Non Conventional Energy Sources							EEE
	B18EE7044	Optic Fiber Communications							ECE/EEE
	B18EE7045	Computer Networks Concepts and Protocols							C&IT
5	B18EE7050	Open Elective subject offered by other school	OE	3	0	0	3	3	OTHER SCHOOLS
6	B18EE7060	Signal Processing Laboratory	HC	0	0	2	2	3	EEE
7	B18EE7070	High Voltage Engineering Lab	HC	0	0	2	2	3	EEE
TOTAL CREDITS				**13**	**0**	**5**	**18**	**22**	

VIII Semester

SL	Course Code	Title of the Course	HC/SC/OE	L	T	P	C	CH	Teaching School/Dept.
1	B18EE8010	Project work	HC	0	1	7	8	16	EEE/Industry
2	B18EE8021	Trouble Shooting of Common Electrical Equipments	SC	2	1	0	3	4	EEE
	B18EE8022	Introduction to Flexible AC transmission system							EEE
	B18EE8023	Wireless Communication							ECE/EEE
	B18EE8024	Machine Learning Techniques							C&IT
TOTAL CREDITS				**3**	**1**	**7**	**11**	**20**	

Credit Distribution

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

B. Tech (Electrical & Electronics Engineering) Program

Detailed Syllabus

(Effective from Academic Year 2018 - 19)

I Semester Physics Cycle

Sub Code: B18EE1010	**Engineering Mathematics – I**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		4	0	0	4	4
Prerequisites:	Knowledge of basics limits, continuity, differentiation, integration, matrices, determinants, and geometry.					
Course Objectives	1. To understand the concepts of differential calculus and its applications. 2. To familiarize with partial differentiation and its applications in various fields. 3. To familiarize with linear algebraic applications and different reduction techniques. 4. To familiarize with concept of vector calculus and its applications.					
Course Outcomes	After the completion of the course the student will be able to: 1. Apply the knowledge of differential calculus in the field of wave theory and communication systems. 2. Apply the knowledge of Differential Equations in the field of Engineering. 3. Analyze and implement the concepts of Divergence and curl of vectors which play significant roles in finding the Area and volume of the closed surfaces. 4. Apply the knowledge of convergence of the series, which help in forming JPEG image compression. 5. To determine whether a sequence or a series is convergent or divergent and evaluate the limit of a convergent sequence or the sum of a convergent series.					

Course Contents

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

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

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

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

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

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

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

UNIT-IV Integral Calculus **[12 Hrs]**

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

Text books:

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

Reference Books:

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

Sub Code: B18EE1020	**Engineering Physics**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	3	4
Prerequisites:	Basic knowledge of physics of pre-university					
Course Objectives	1. Learn fundamentals of Physics and make their basic foundation in engineering education very strong. 2. Expose the students of different branches of engineering with a theoretical and practical knowledge of Engineering Physics 3. To prepare students and make them ready to take up higher semester core engineering subjects by giving them strong physics background. 4. Gain knowledge of different physical systems, basic quantum mechanics and materials science etc.					

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

Course Contents

Unit I **[12 hrs]**

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

Wave function: properties of wave function and physical significance. Probability density and normalization of wave function, Schrodinger time- dependent and independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – energy Eigen values of a free particle, Particle in one dimensional infinite potential well.

Unit II **[12 hrs]**

Lasers: Lasers Interaction between radiation and matter, Expression for energy density at thermal equilibrium in terms of Einstein's coefficients. Characteristics of laser light, Conditions for laser operation, Requisites of laser system, Construction and working of Carbon Dioxide (CO2) laser, semiconductor laser, Holography, Applications of holography.

Optical fibers: Construction and light propagation mechanism in optical fibers, Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Types of optical fibers, Attenuation and reasons for attenuation, optical fiber communication using block diagram, Advantages and limitations

Unit III **[12 hrs]**

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

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

Unit IV **[12 hrs]**

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

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

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

Text books:

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

Reference Books:

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

Sub Code: B18EE1030	**Engineering Mechanics**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	3	4
Course Objectives	1. To enable students to establish a broad concept of engineering mechanics. 2. To enable students to understand the basics of composition of coplanar forces. 3. To enable students to understand the concept of equilibrium of coplanar forces. 4. To provide an overview of centroid of plane area & Moment of Inertia of plane area.					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the moment of force and couples and equivalent force-couple system. 2. Solve numerical problems on composition of coplanar concurrent and non-concurrent force system. 3. Solve numerical problems on equilibrium of coplanar force system. 4. Locate the centroid and moment of inertia of different geometry.					

Course Contents

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

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

Engineering mechanics

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

UNIT-II Analysis of Force Systems [12Hrs]

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

UNIT-III Equilibrium of coplanar forces [12 Hrs]

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

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

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

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE1040	Elements of Mechanical Engineering	L	T	P	C	CH
Duration : 14 Wks		2	1	0	3	4
Course Objectives	1. To develop the basic knowledge of working of various turbines and IC engines 2. To incorporate the concepts of metal joining process, their applications and power transmission modes like belt drives, gears and gear trains 3. To understand various machines and its operations in Mechanical Engineering. 4. To give exposure to basic power transmission elements.					
Course Outcomes	The student will be able to 1. Apply the concepts of working principle of turbines in the power plants and also of the IC engines in the basic design of the vehicles 2. Have a basic knowledge of metal joining and power transmission and apply them in some basic requirements 3. Gain the knowledge about machine tools, cutting operations; belt and gear drive power transmission. .					

Course Contents

UNIT - 1 **[10 Hrs]**

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

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

UNIT - 2 **[10 Hrs]**

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

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

UNIT - 3 **[10Hrs]**

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

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

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

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

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

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE1050	**Basic Electrical & Electronics Engineering**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 WEEKS		2	1	0	3	4
Course Objectives	1. To make students understand the basics of representation of electrical quantities and relationship among them 2. To make the students understand single phase and three phase AC circuits 3. To make students understand the semiconductors and working of diodes 4. To make students understand the transistor and its operating principle					
Course Outcomes	On completion of this course the student will be able to: 1. Apply fundamental laws to electrical circuits for analysis 2. Differentiate between single and three phase systems 3. Use diodes for various signal processing operations 4. Understand the principle of operation of a transistor					

Course Contents

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

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

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

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

A.C.Circuits: Analysis with phasor diagram, of circuits with R,L, C, R-L, RC, R-L-C for

series and parallel configurations. Real power, reactive power, apparent power and power factor. Illustrative Examples. Three-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of three phase power using two wattmeter method. Illustrative Examples.

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

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

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

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

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

Text Books:

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

Reference Books

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

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

Sub Code: B18EE1060	**Indian Constitution and Professional Ethics**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	0	0	2	4
Prerequisites	Pre-university level Constitution of India and Professional Ethics					
Course Objectives	1. To provide and gain knowledge on Constitution of India. 2. To know and understand about the Fundamental Rights, Duties and other Rights which is been given by our law. 2. To prepare students in the practicality of Constitution perspective and make them face the world as a bonafide citizen. 3. To attain knowledge about ethics and also know about professional ethics. 4. Explore ethical standards followed by different companies.					
Course Outcomes	On completion of this course the student will be able to:					

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

Course Contents

UNIT-I Constitution of India **[8 Hrs]**

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

UNIT-II Union and State: **[8 Hrs]**

Organs of the Government; Legislature, Executive and Judiciary. Union and State Executives: President, Vice President, Prime Minister, Supreme Court, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission. Right to Information (RTI), Consumer and Consumer Protection.

UNIT III Ethics: **[8 Hrs]**

Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

UNIT IV Engineering Ethics: **[8 Hrs]**

Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companiesin India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence.

Reference books:

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

Sub Code: B18EE1070	**Technical English I**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		0	0	2	2	4
Course Objectives	1. To develop basic communication skills in English in the learners. 2. To prioritize listening and reading skills among learners. 3. To simplify writing skills needed for academic as well as workplace context.					

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

Course Outline:

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

COURSE CONTENT/ SYLLABUS

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

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

References:

1. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
2. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
3. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
4. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. *Effective Technical Communication*. New Delhi: Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.

Sub Code: B18EE1080	**Physics Lab**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		**0**	**0**	**2**	**2**	**2**
Course Objectives	1. This course is to make the students to gain practical knowledge to co-relate with the theoretical studies. 2. To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipment. 3. Design of circuits using new technology and latest components and to develop practical applications of engineering materials and use of principle in the right way to implement the modern technology.					
Course Outcomes	At the end of the course a students are able to 1. Develop skills to apply practical knowledge of Physics in real time solution. 2. To understand and verify different laws of Physics using some simple experiments. 3. To design simple electrical circuits and analyze obtained result. 4. Ability to apply knowledge of basic electronics in making simple circuits using diodes and transistors and analyze the responses. 5. Ability to use the knowledge acquired for different applications and projects.					

Course Contents

List of Experiments

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

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

Recommended Learning Resources (Text books):

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

Recommended Learning Resources (Reference books):

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

Sub Code: B18EE1090	**Basic Electrical Engineering Lab**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		**0**	**0**	**2**	**2**	**2**
Course Objectives	1. To establish a broad concept of various types of electrical apparatus, tools and instrumentation. 2. To provide hands on experience with electrical apparatus and electrical safety norms. 3. To train students to read and understand schematics so as to make electrical connection for different appliances. 4. To train students in collecting and interpreting experimental data. 5. To enhance written skills of students.					
Course Outcomes	On completion of this course the students will be able to: 1. Use appropriate electrical tools for electrical connections and repair of electrical equipments. 2. Recognize various symbols in a schematic and make connection as per the schematic 3. Systematically follow various safety procedures. 4. Make use of various measuring instruments to collect experimental data 5. Relate experimental results with theoretical analysis.					

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

List of experiments

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

II Semester Chemistry Cycle

Sub Code: B18EE2010	Engineering Mathematics – II	L	T	P	C	CH
Duration : 14 Wks		4	0	0	**4**	4
Prerequisites	Knowledge of basics of derivatives, vectors, complex numbers					
Course Objectives	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.					

Course Contents

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

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

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

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

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

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

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

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

Curves in space, tangents and normal, Velocity and acceleration related problems, scalar and vector point functions-Gradient, Divergence and curl, directional derivatives. Solenoidal and irrotational vector fields. Vector identities-div($\emptyset A$), curl($\emptyset A$), curl(grad$\emptyset$), div(curl *A*).

Line integral-Circulation-work, Surface integral: Green's Theorem, Stokes Theorem.

Volume integral: Divergence theorem. (All theorems without proof, no verification, only evaluation).

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

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

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

Text books:

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

Reference Books:

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

Sub Code: B18EE2020	**Engineering Chemistry**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	**3**	4
Course Objectives	1. To understand basic principles of Cell and Batteries, types of electrodes and their importance in some applications 2. To study and understand the materials required for designing and proper functioning of batteries. 3. To understand the Corrosion and metal finishing that explains why and how materials corrode and their prevention. 4. To understand the properties of various polymeric materials and their commercial significance.					
Course Outcomes	After the completion of the course the student will be able to: 1. Know the importance of electrodes and materials in designing a battery 2. Apply the knowledge of Corrosion phenomenon and precautions to be taken in the selection of materials in controlling corrosion 3. Fabricate of PCB which is an important component for electronic industries 4. Apply the knowledge of Properties of polymers and their applications in various field, also that of composite materials in sports, aviation etc.,					

Course Contents

UNIT – I **[10 Hrs]**

ATOMIC, MOLECULAR STRUCTURE AND PERIODIC PROPERTIES

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

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

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

UNIT – II **[11 Hrs]**

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

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

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

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

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

Unit-III

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

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

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

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

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

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

Semiconducting and Super Conducting materials-Principle and some example.

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

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

Adhesives: properties, synthesis and applications of epoxy resin.

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

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

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

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

Recommended Learning Resources (Text books):

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

Recommended Learning Resources (Reference books):

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

Sub Code: B18EE2030	**Electrical Power Generation & Transmission**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		2	1	0	**3**	4
Course Objectives	1. To provide an awareness of various conventional and non-conventional energy resources and also of principle of their conversion process into electrical energy. 2. To provide fundamental concepts about Power plant structure, operation and control. 3. To equip the students with basic concepts of Substations, Grounding systems and economic aspects. 4. To provide basis for further study of both conventional and Non-Conventional Energy resources					
Course Outcomes	On completion of this course the students will be able to: 1. Compare the relative merits and limitations of available Energy Sources. 2. Interpret the values of various factors influencing the economic aspects of a power system 3. Recognize the role of Substation and the fundamentals of Grounding systems. 4. Estimate the energy cost from the given tariff.					

COURSE CONTENTS

UNIT- I

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

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

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

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

UNIT- II

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

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

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

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

UNIT- III **[12hrs]**

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

Overhead Transmission Lines:

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

UNIT- IV **[9hrs]**

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

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

Text Books Power Generation and Transmission:

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

Reference Books:

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

Sub Code: B18EE2040	**Computer Concepts and C++ Programming**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		2	1	0	**3**	4
Course Objectives	The objective of this course is to: 1. Introduce the fundamentals of computer System. 2. Provide an understanding of problem solving with computers. 3. Introduce C programming language. 4. Provide a familiarization with the UNIX programming environment. 5. Provide problem solving skills through executing C programs.					
Course Outcomes	1. A student who successfully completes the course will have the ability to: Explain the different UNIX commands, their usage and their syntax and fundamentals of computer. 2. Apply the C programming concepts like operators, data types, functions, arrays, strings and pointers to solve the given problem Apply the C language knowledge to solve variety of problems.					

Course Contents

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

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

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

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

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

Operators: Types of Operators, Expressions and Statements.

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

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

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

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

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

Functions: Inbuilt and User defined Functions, Parameter Passing mechanisms, Call by value and Call by address;
Strings: String Operations with and without using inbuilt String Functions;
Pointers: Introduction to Pointers.

Recommended Learning Resources:

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

Sub Code: B18EE2050	**Electrical & Electronic Instrumentation and Measurements**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		2	1	0	**3**	4
Course Objectives	1. To provide basic knowledge about measuring units of physical parameters. 2. To describe the principles of various measuring instruments 3. To equip students with basic concepts of different Electrical transducers used in process control. 4. To enable students with necessary mathematical skills for instruments' measurement range					
Course Outcomes	On completion of this course the students will be able to: 1. Adopt various measurement units associated with physical parameters 2. Select different instruments for measuring different electrical parameters in industries 3. Describe the operation of measuring instruments 4. Identify and use different type of transducers for various applications in industries.					

Course Content

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

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

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

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

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

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

Unit 4: Measurement of Power and Energy [10 hrs]

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

Text Books :

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

Reference Books:

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

Sub Code: B18EE2060	**Environmental Sciences**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		**2**	**0**	**0**	**2**	**2**
Course Objectives	1. Graduates will be familiar with current and emerging environmental engineering and global issues, and have an understanding of ethical and societal responsibilities. 2. Graduates will have the ability to obtain the knowledge, and will recognize the need for engaging in life-long learning. 3. Will find the need of various types of energy (conventional & non-conventional) resources and natural resources. 4. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem. 5. Acquiring knowledge about environmental pollution-sources, effects and control measures of environmental pollution, degradation and waste management. 6. Explore the ways for protecting the environment.					
Course Outcomes	On completion of this course the students will be able to: 1. Analyze the environmental conditions and protect it. 2. Will observe the role of individual, government and NGO in environmental protection. 3. Get motivate to find new renewable energy resources with high efficiency through active research. 4. Analyze the ecological imbalances and protect it. 5. List the causes of environmental pollution & find ways to overcome them.					

Course Contents

UNIT-1 **[6Hrs]**

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:

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

Environmental protection – Role of Government-Assignments of MOEF, Functions of central and state boards, Initiative and Role of Non-government organizations in India and world

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

UNIT-2 **[7 Hrs]**

Environmental pollution, degradation & Waste management:

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

Self study: Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes.

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

Solid Waste management – Municipal solid waste, Biomedical waste, Industrial solid waste and Electronic waste (E-Waste).

Self study: Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.

UNIT-3 **[7Hrs]**

Energy & Natural resources:

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

Self study: Remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster.

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

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

UNIT-4 **[6Hrs]**

Ecology and ecosystem:

Ecology-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem-Ecosystem Resilience, Ecological

succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity.
Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

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

Reference Books:

1. "Environmental Studies", by R.J. Ranjit Daniels and Jagadish Krishnaswamy, (2017), Wiley India Private Ltd., New Delhi, Co-authored & Customised by Dr.MS Reddy & Chandrashekar, REVA University.
2. "Environmental Studies", by R.J. Ranjit Daniels and Jagadish Krishnaswamy, (2009), Wiley India Private Ltd., New Delhi.
3. "Environmental Studies" by Benny Joseph, Tata McGraw – Hill Publishing Company Limited.
4. Environmental Studies by Dr. S.M. Prakash, Elite Publishers Mangalore, 2007
5. Rajagopalan R. 2005, "Environmental Studies – from Crisis to cure", Oxford University Press
6. Environmental Science by Arvind walia, Kalyani Publications, 2009.
7. Environmental Studies by Anilkumar Dey and Arnab Kumar Dey.

Sub Code: B18EE2070	**Technical English II**	**L**	**T**	**P**	**C**	**CH**
Duration : 14 Wks		**0**	**0**	**2**	**2**	**4**
Course Objectives	1. To utilize the ability of using language skills effectively in real-life scenarios. 2. To develop the learners' competence in employability skills. 3. To improve the habit of writing, leading to effective and efficient communication. 4. To prioritize specially on the development of technical reading and speaking skills among the learners.					
Course Outcomes	On completion of the course, learners will be able to: 1. Organize their opinions clearly and meaningfully. 2. Demonstrate the ability to speak appropriately in social and professional contexts. 3. Build inferences from the text. 4. Take part in interviews confidently. 5. Develop accurate writing skills using different components of academic writing.					

Course Contents

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

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

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

References:

1. Bansal, R.K. and J.B. Harrison. *Spoken English*. Orient Blackswan, 2013.
2. Raman, Meenakshi and Sangeeta Sharma. *Technical Communication*. Oxford University Press, 2015.
3. Thorpe, Edgar and Showick Thorpe. *Objective English*. Pearson Education, 2013.
4. Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt. Ltd., 1988.
5. Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.
6. Samson, T. (ed.) *Innovate with English.* Cambridge University Press, 2010.
7. Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.
8. Goodale, Malcolm. *Professional Presentation*. Cambridge University Press, 2013.

Sub Code: B18EE2080	Chemistry Laboratory	L	T	P	C	CH
Duration : 14 Wks		0	0	2	2	2
Course Objectives	To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence					
Course Outcomes	1. On completion of lab course students will have the knowledge in; 2. Handling different types of instruments for analysis of materials for better accuracy and precision 3. Carrying out different types of titrations for quantitative estimations of materials.					

Course contents

LAB EXERCISES

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

Sub Code: B18EE2090	Computer programming (C++) Lab	L	T	P	C	CH
Duration : 14 Wks		0	0	2	2	2
Course Objectives	1. Introduce the Basic Principles of Problem Solving using a Computer; 2. Present and Provide the Programming Constructs of 'C' Programming Language; 3. Provide the skills required to Design, Demonstrate and Implement Computable Problems / Mini-projects / Projects using 'C' Programming Language. 4. Provide the Arena for Development of Analytical, Reasoning and Programming Skills; 5. Set the Strong Foundation for Software Development in the field of Programming and hence to Create high quality 'C' Professionals.					
Course Outcomes	After completion of this course, the students would be able to: 1. Understand the Basic Principles of Problem Solving 2. Study, understand and identify the Representation of Numbers, Alphabets and other Characters in the memory of Computer System 3. Understand Analyze, Integrate, Apply and Demonstrate Software Development Tools; like Algorithms, Pseudo Codes and Programming Structures.					

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

Course contents

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

Recommended Learning Resources:

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

III Semester

Sub Code: B18EE3010	Engineering Mathematics – III	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	To study and understand the application approach of the concepts of Numerical methods, Probability, random variables and Sampling distributions in various fields of engineering.					
Course Outcomes	After the completion of the course the student will be able 1. To understand the basics of numerical methods and their applications. 2. To solve the problems of Probability and statistics in various engineering fields. 3. To apply the numerical methods and Sampling Theory concepts to solve various engineering problems					

COURSE CONTENTS

UNIT-I **[12 hrs]**

Numerical Method – I

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

Finite differences and Interpolation :-Forward and Backward differences , Newton's forward and Backward interpolation formulae, Divided differences-Newton's divided difference formula, Lagrange's Interpolation formula and Inverse Interpolation formula and Problems.

UNIT –II **[12 hrs]**

Numerical Method – II

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

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

UNIT-III **[12 hrs]**

Probability Theory – I

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

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

UNIT-IV **[12 hrs]**

Probability Theory – II

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

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

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

Text books:

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

Reference Books:

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

Sub Code: B18EE3020	**Electrical Circuit Theory**	**L**	**T**	**P**	**C**	**CH**
Duration:14Weeks		3	1	0	**4**	5
Course objectives	1. To enable students to apply network theorems for solving network problems 2. To describe the constituents of two port network 3. To discuss the concept of resonance and the associated terminologies for different configurations of the tank circuit 4. To enable the students evaluate the transient response of RLC networks 5. To enable the students to realize a network through different forms 6. To design attenuator networks 7. To solve a given network problem through state variable analysis					
Course Outcomes	After the completion of the course the student will be able to 1. Solve network problems using KCL, KVL, loop and mesh analysis 2. Represent the given network in terms of two-port network 3. Apply the concept of resonance in the design of filter and also to understand the principle behind ZVS and ZCS in a power electronic circuit 4. Calculate the initial and transient conditions in power electronic circuits 5. Develop network of immittance functions 6. Calculate parameters an attenuator for the given specifications and also to analyze attenuation of a probe 7. Develop to solve network problems using state variable concept and also to relate the concept with the state estimation technique in power system					

COURSE CONTENTS

UNIT- I **[12Hrs]**

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

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

UNIT- II **[12Hrs]**

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

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

UNIT- III **[12Hrs]**

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

UNIT-IV **[12Hrs]**

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

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

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE3030	Electrical Machines - I	L	T	P	C	CH
Duration :16 weeks		4	0	0	**4**	4
Course Objectives	1. To enable the students to familiarize with the theory, construction, classifications and working principle of transformers and Induction motors 2. To enable the students to learn the necessity of different tests conducted and the parallel operation on single phase transformers 3. To enable to study the Classification and different connections of three phase Transformers 4. To enable to draw equivalent circuit & circle diagram for the performance Analysis of three phase induction motor. 5. To enable to understand the necessity of starters & speed control for 3 phase IM					
Course outcomes	On the successful completion of this course, the student is expected to be able to: 1. Reveal their knowledge and understanding of electromechanical energy conversion in Transformers and Induction machines. 2. Analyze the concepts of fundamental torque equation and rotating fields 3. Analyze the fundamental characteristics of Transformers and Induction machines. 4. Interpret experimental results and correlate them with theoretical predictions.					

COURSE CONTENTS

UNIT – I **[11 hr]**

Transformers-I

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

UNIT – II **[10 hr]**

Transformers-2

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

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

UNIT – III **[10 hr]**

Induction machines

Introduction to three phase induction motor, constructional details, three phase rotating magnetic field. Exact and approximate per phase equivalent circuit; Phasor diagram. Power

flow diagram in a three phase induction machine, Torque-slip characteristics. Starting torque, breakdown slip and breakdown torque. Introduction to Induction Generators.

UNIT – IV **[11 hr]**

Testing of three phase induction machines

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

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

Text books:

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

References

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

Sub Code: B18EE3040	**Analog Electronic and Digital Electronic Circuit Design**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		2	1	0	**3**	4
Course Objectives:	1. To provide an insight into the modeling of bipolar junction transistors, biasing techniques. 2. To illustrate the application and its design of BJTs as amplifiers and oscillators. 3. Illustrate Boolean laws and minimization techniques for simplification of expressions like minterm, maxterm using K-Map and QMT 4. Introduce various application oriented circuits which can be implemented in real world examples for making the learners attuned to Logic concepts. 5. Introduce and differentiate between the Combinational and Sequential Circuits.					
Course outcomes	At the end of this course, student will be able to: 1. Describe the operation, applications and characteristics of devices BJT. 2. Analyze and design circuits such as amplifiers and oscillators using BJT. 3. Define a Boolean term, expression, SOP, POS, and construct the K-map/QMT Table for real time application implementation 4. Design arithmetic and combinational logic circuits using gates, encoders, decoders, multiplexers and de-multiplexers. 5. Design specified synchronous or asynchronous sequential logic circuits using appropriate flip flops.					

COURSE CONTENTS

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

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

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

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

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

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

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

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

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

Text Books:

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

Reference Books:

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

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

Sub Code: B18EE3050	**Theory and Applications of Linear Integrated Circuits**	**L**	**T**	**P**	**C**	**CH**
Duration:		2	0	1	**3**	4
Course Objectives	1. To introduce the basic building blocks of linear integrated circuits. 2. To outline the design procedure of applications using operational amplifiers, analog multipliers and PLL. 3. To study the operation of ADC and DAC 4. To introduce the concepts of waveform generation and introduce some special function ICs					
Course Outcomes	After completion of the course, the student can able to: 1. Describe the fabrication methods and characteristics of op-amp and Timer ICs 2. Design different applications using general purpose op- amp and application specific ICs. 3. Design multipliers and PLL, and design of applications using Timer IC					

COURSE CONTENTS

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

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

Unit 2: **[12hrs]**

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

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

Unit 3: **[14hrs]**

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

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

Unit 4: **[14hrs]**

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

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

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

Sub Code: B18EE3060	**Microcontrollers and Applications**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	**3**	4
Course Objectives	1. To describe the architecture of microcontroller and various features associated with different models of the microcontrollers. 2. To discuss various computations and accessing methods associated with the microcontrollers. 3. To develop the skill of programming microcontrollers in controlling different applications in real time. 4. To demonstrate the interfacing of various devices to the microcontroller.					
Course Outcomes	After the completion of the course the student will be able to: 1. To recognize the architecture of the 8051 and MSP430 microcontrollers. 2. To be adept at using various inbuilt features and external peripherals based on the requirement. 3. To program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled using the microcontroller. 4. To develop the ability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller.					

COURSE CONTENTS

UNIT-I: Fundamentals of 8051 [11hrs]

Fundamentals of 8051

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

UNIT-II: Features of 8051 [11hrs]

Instruction set of 8051 along with simple programs, Addressing modes, programming in C:

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

UNIT III: Communication and Interfacing [11hrs]

I/O port programming, serial communication.

Interfacing: ADC and DAC, LCD, DC motor, stepper motor, sensors (e.g.: temperature, pressure). Case studies/application notes.

UNIT-IV: MSP 430 Microcontroller [11 hrs]

MSP430 RISC CPU architecture, instruction set, addressing modes, on-chip peripherals of MSP430, Programming in ALP/C, case studies/application notes.

Text books:

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

Reference Books:

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

Sub Code:B18EE3070	**Analog Electronics & Digital Circuit Design Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		0	0	2	**2**	3
Course Objectives	1. To enable students to identify the various electronic components 2. To enable students to verify theoretical analysis with experimental results. 3. To enable students to conduct experiments, collect results, interpret results and analyze any discrepancies 4. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits. 5. To enable students to verify theoretical analysis with experimental results. 6. To To prepare students to perform the analysis and design of various digital electronic circuits.					
Course Outcomes	Students will be able to 1. Rig circuit as per the circuit and conduct experiments. 2. Demonstrate the ability to design circuits for a given specification and to choose appropriate instruments for measurements. 3. Analyze and design simple electronic circuits such as rectifiers, clippers, clampers, amplifiers and oscillators. 4. Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis. 5. Have a thorough understanding of the fundamental concepts					

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

COURSE CONTENTS

List of analog electronics experiments:

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

List of digital electronics experiments:

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

Sub Code: B18EE3080	Electrical & Electronics Measurement Lab	L	T	P	C	CH
Duration :14 Wks		0	0	2	**2**	3
Course Objectives	1. To understand the working of various electrical bridge 2. To understand the energy meter 3. To know the working of Op-amps					
Course Outcomes	On completion of this course the students will be able to: 1. Measure various parameters of given bridge 2. To apply the Op-amps in various signal processing circuits					

COURSE CONTENTS

List of lab experiments:

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

Course Code	Soft Skill	Course Type	L	T	P	C	Hrs./Wk.
B18EE3090		RULO	1	0	1	**2**	2

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

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

B18EE3X10	SKILL DEVELOPMENT	RULO	0	0	2	**2**	2

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

IV Semester

Sub Code: B18EE4010	**Engineering Mathematics –IV**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	To study and understand the application approach of the concepts of Numerical methods, Fourier transforms, Z-transforms and Complex variables.					
Course Outcomes	After the completion of the course the student will be able 1. To understand the basics of numerical methods and their applications. 2. To solve the problems of Probability and statistics in various engineering fields. 3. To apply the numerical methods and Sampling Theory concepts to solve various engineering problems.					

COURSE CONTENTS

Unit –I **[12 Hrs]**

Numerical Methods –III: (i) Numerical solution of simultaneous first order ODE: Picard's and Runge-Kutta method of fourth order.

(ii) Numerical solution of second order ordinary differential equations, Picards method, Runge-Kutta method and Milne's method

(iii) Numerical solutions of PDE: Finite difference approximations to derivatives, Numerical solution of two –dimensional Laplace equation, one-dimensional Heat and Wave Equations.

Unit –II **[12 Hrs]**

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

Infinite Fourier Transform, Fourier sine and cosine transforms, properties, inverse transforms.

Unit-III **[12 Hrs]**

Z-transforms and special functions: Z-Transforms- Definition, standard Z-transforms , damping rule, shifting rule , initial value and final value theorems , inverse Z-transform , application of Z-transform to solve difference equations.

Solution of Laplace equation in cylindrical and spherical systems leading Bessel's and Legendre's differential equations, Series solution of Bessel's differential equation leading to Bessel function of first kind, Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula.

Unit-IV **[12 Hrs]**

Complex variables –I & II

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

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

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

Text books:

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

Reference Books:

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

Sub Code: B18EE4020	**Electromagnetic theory**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To study the basic concepts of vector calculus and co-ordinate system. 2. To discuss the concept of potential and energy density in the case of static and time varying fields. 3. To discuss the concepts of Coulomb's law and Gauss law and their applications. 4. To study the concept of the steady magnetic field, magnetic materials and inductance calculation. 5. To provide the knowledge of time varying field and Maxwell's equations.					
Course Outcomes	After the completion of the course the student will be able to: 1. Able to understand the concepts of vector calculus and co-ordinate system. 2. Able to understand the concept of potential and energy density in the case of static and time varying fields. . Able Coulomb's law and Gauss law and their applications in real world applications. 3. Able to understand the steady magnetic field, magnetic materials and inductance calculation 4. Investigate the electromagnetic phenomenon in a time varying electric and magnetic fields.					

COURSE CONTENTS

UNIT-I **[12 Hrs]**

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

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

UNIT-II **[12 Hrs]**

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

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

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

UNIT-III **[12 Hrs]**

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

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

UNIT-IV **[12 Hrs]**

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

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

Text books:

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

Reference Books:

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

Sub Code: B18EE4030	Electrical Machines –II	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To equip the students with the knowledge electromechanical energy conversion. 2. To equip the students with physical concepts and operational features of DC and synchronous machines. 3. To equip the students with basic experimental skills 4. To provide basis for further study of Electrical Machines					
Course Outcomes	On completion of this course the students will be able to: 1. Understand the concept of electromechanical energy conversion in DC and synchronous machines 2. Analyze the concepts of fundamental torque equation and rotating fields 3. Analyze the fundamental characteristics of DC and synchronous machines 4. Interpret experimental results and correlate them with theoretical predictions 5. Describe the parallel operation of alternators.					

COURSE CONTENTS

Unit 1: DC Generators [10Hrs]

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

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

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

Unit-3: Synchronous Machine I [11 Hrs]

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

Unit 4: Synchronous Machine II [10Hrs]

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE4040	**Power Electronics**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To provide basic knowledge of power semiconductor devices. 2. To illustrate the students about concepts of Gate driver circuits, and need of isolation and protection circuits of various power semiconductor devices. 3. To enumerate operation of Phase controlled Rectifiers for various loads. 4. To inculcate the skills of analyzing the basic topologies of DC-DC converters, Inverters and AC voltage regulators for various loads. 5. To discuss the different modulation techniques for output voltage control of Inverters.					
Course Outcomes	After the completion of the course student will be able to: 1. Acquire a basic knowledge of solid state electronics devices including power diodes, power BJT, power MOSFETs, SCR, IGBT etc. 2. Analyze power electronic circuits such as control rectifiers, inverters, choppers & AC voltage regulators. 3. Describe the role of Power Electronics as an enabling technology in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc. 4. Apply engineering tools (MATLAB, PSIM) to solve electrical & electronics circuits.					

COURSE CONTENTS

Unit 1: Power Transistors [11Hrs]

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

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

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

Unit 3: **[11Hrs]**

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

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

Unit :4 **[10Hrs]**

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

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

Text Books:

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

References:

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

Sub Code: B18EE4051	Electrical Power Utilization	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	4	4
Course Objectives	1. To enable students to understand the advantages of utilization of electricity. 2. To give an insight into various industrial applications of electricity. 3. To illustrate electric traction and the speed time curves associated with it. 4. To compare the characteristics of various types of motors suitable for electric traction. 5. To introduce the basic knowledge of electric and hybrid vehicles.					
Course Outcomes	On completion of this course the students will be able to: 1. Identify the motors suitable for electric traction for various applications. 2. Analyze various electrolytic processes for different applications. 3. Interpret the type of illumination required for a given application. 4. Illustrate various industrial heating and welding techniques.					

COURSE CONTENTS

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

Introduction, requirements of an ideal traction, systems of traction, speed time curve, tractive effort, co-efficient of adhesion, selection of traction motors, method of speed control, energy

saving by series parallel control, ac traction equipment. AC series motor, characteristics, regenerative braking, linear induction motor and their use. AC traction, specific energy, factors affecting specific energy consumption.

Unit 2: **[12Hrs]**

Introduction to Electric and Hybrid Vehicles: Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.

Electrolytic Process: Fundamental principles, extraction, refining of metals and electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

Unit 3: Illumination **[12Hrs]**

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

Unit 4: Heating and Welding **[12Hrs]**

Advantages and methods of electric of heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building. Electric welding, resistance and arc welding, control devices and welding equipment.

Text Books:

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

Reference Books:

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

Sub Code: B18EE4052	**Electrical Drives**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To understand the basics of electrical drive system 2. To Describe the various braking methods of DC and Induction Motor Drives 3. To understand the control aspects of electrical drives using power electronics converters					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the structure of a drive system and their role in any application. 2. Analyze the given specifications and suggest a suitable motor for a particular application 3. Select a power electronic converter and decide its operational parameters for DC & AC motor drive system					

COURSE CONTENTS

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

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

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

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

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

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

Sub Code: B18EE4053	**Digital System Design Using VHDL**	**L**	**T**	**P**	**C**	**CH**
Duration: weeks		4	0	0	**4**	4
Course Objectives	1. To demonstrate an understanding of the fundamentals for an HDL. 2. To demonstrate an understanding of data flow descriptions. 3. To implement combinational and sequential circuits using VHDL. 4. To implement various digital circuits using Programmable Logic Devices. 5. Implement various logical circuits using CMOS circuits					

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

COURSE CONTENTS

Unit 1: **[10Hrs]**

Introduction: A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Comparison of VHDL and Verilog.

Data –Flow Descriptions: Data-Flow Description, Structure of Data-Flow Description, Data Type – Vectors.

Unit 2: **[10Hrs]**

Behavioral Modelling: Behavioral Description, structure of HDL behavioral Description, the VHDL variable –Assignment Statement, sequential statements.

Structural Modelling: Structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements.

Unit 3: **[10Hrs]**

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

Unit 4: **[12Hrs]**

Mixed –Type Descriptions:

Why Mixed-Type Description? VHDL User-Defined Types, VHDL Packages, Mixed-Type Description examples.

Digital CMOS circuits overview: Overview, Design and performance analysis of CMOS inverter, Logic gate circuits, Pass transistor logic, Dynamic logic circuits.

Text Books:

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

Reference Books:

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

Sub Code: B18EE4054	Database Management Systems	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. Understand the role of a database management system in an organization. 2. Understand basic database concepts, including the structure and operation of the relational data model. 3. Construct simple and moderately advanced database queries using Structured Query Language (SQL). 4. Understand and successfully apply logical database design 5. Principles, including E-R diagrams and database normalization. 6. Design and implement a small database project using Microsoft Access. 7. Understand the concept of a database transaction and related database facilities, including concurrency control. 8. Understand the role of the database administrator.					
Course Outcomes	On completion of this course the students will be able to: 1. Master the basic concepts and appreciate the applications of database systems. 2. Master the basics of SQL and construct queries using SQL. 3. Be familiar with a commercial relational database system (Oracle) by writing SQL using the system. 4. Be familiar with the relational database theory, and be able to write relational algebra expressions for queries 5. Be familiar with the basic issues of transaction processing and concurrency control.					

Course Contents

Unit-1

INTRODUCTION TO DATA BASE SYSTEMS [04 Hrs]

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

ENITTY – RELATIONSHIP MODEL [06 Hrs]

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

Unit-2

RELATIONAL MODEL AND RELATIONAL ALGEBRA [06 Hrs]

Relational model concepts, relational model constraints and relational database schemes, update operations and dealing with Constraint Violations, Unary relational Operations, SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations, JOIN and DIVISION, Additional Relational Operations, examples of Queries in Relational algebra, relational database design using ER-to-Relational mapping.

DATABASE SECURITY [**04 Hrs]**
Introduction, Access control, Discretionary Access, Mandatory Access Control

Unit-3
SQL –THE RELATIONAL DATABASE STANDARD [14 Hrs]
SQL Data definition and data types, specifying basic constraints in SQL, Schemes, Change statements in SQL, basic Queries in SQL, more complex SQL queries, Insert, Delete and update statements in SQL, additional features SQL, specifying general constraints as assertion, views (virtual tables) in SQL, database Programming, issues and Techniques, Embedded SQL, Dynamic SQL, more examples; PL/SQL.
NOTE: Lab sessions to be conducted for unit 3.

Unit-4
TRANSACTION MANAGEMENT [06 Hrs]
The ACID properties, transactions and schedules, concurrent execution of transactions, lock based concurrency control, performance of locking, transaction support in SQL. Introduction to lock management.

TEXT BOOKS

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

Sub Code: B18EE4061	**Management and Entrepreneurship**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To explain the basic concepts, principles, and processes of management. 2. To use the elements of effective decision making–research, assessment and consequence. 3. To develop the abilities to plan for effective communication – learn how to reflect, present and evaluate communication. 4. To Analyse organizational practices that facilitate creativity and innovation 5. To Integrate functional areas into strategic business problems from a general management perspective 6. To develop an ability to work with moral and ethical dilemmas and make decisions using critical thinking					
Course Outcomes	On completion of this course the students will be able to: 1. Integrate management concepts in a technical and innovative setting as required by today's dynamic business environment 2. Possess relevant skills preparing students for entry into management careers in business, government, public, or social service organizations 3. Analyse a business case, propose a creditable solution to a					

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

COURSE CONTENTS

Unit 1: Introduction to management principles [10hrs]

Development of Management Thought-Early Management Approaches-Modern Management Approaches, Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of Management - Management as a Science, Art or Profession, Management & Administration, Levels of Management, Roles of Manager. Communication-meaning and importance-Forms and types of communication

Unit 2: Management Process [12hrs]

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

Unit 3: Project Preparation [10hrs]

The Management for Engineers-Personal Management-Personal Management-Objective setting-Self Appraisal Preparation Of Project-Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Errors of Project Report; Project Appraisal.

Unit 4: Entrepreneurship [12hrs]

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur. Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.

Small Scale Industry- Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start an SSI - Government policy towards SSI; Different Policies of S.S.I.; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I., Effect of WTO/GATT Supporting Agencies of Government for S.S.I. Meaning

Text books:

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

Reference Books:

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

Sub Code: B18EE4062	Electricity Act	L	T	P	C	CH
Duration: weeks		4	0	0	4	4
Course Objectives	1. To provide Power factor scenario before Enactment of Electricity act 2003 2. To provide information about regulatory commission and Power trading 3. To understand the necessity of Consumer protection act, Factories Act and workmen compensation act etc., 4. To make understand need for the formation of BEE					
Course Outcomes	On completion of this course the students will be able to: 1. To understand the different Electricity act, enactment of electricity act, power trading. 2. To understand the importance and necessity of reducing transmission and distribution loss. 3. To understand relevant acts and rules					

COURSE CONTENTS

Unit 1. **[10Hrs]**

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

Unit 2. **[12Hrs]**

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

Unit 3. **[14Hrs]**

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

Unit 4. **[14Hrs]**

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

Reference

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

Sub Code: B18EE4063	**Programmable Logic Controllers**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. To provide knowledge levels of PLC programming 2. To train the students for creating ladder logic for PLC processes programming. 3. To apply the knowledge of Timers and Counters for Industrial applications					
Course Outcomes	On completion of this course the students will be able to: 1. Ability to gain knowledge on Programmable Logic Controllers. 2. To provide the knowledge about various types of registers in PLC. 3. Able to create the ladder diagrams from process and control descriptions					

COURSE CONTENTS

Unit 1: **[10Hrs]**

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

Unit 2: **[10Hrs]**

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

Unit 3: **[10hrs]**

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

Unit 4: **[10hrs]**

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

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

Text Books:

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

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

Sub Code: B18EE4064	Data Structures Using C++	L	T	P	C	CH
Duration: 14 Weeks		4	0	0	**4**	4
Course Objectives	1. Introduce the basic concepts for defining classes with data and member functions. 2. Explain the knowledge of structure, operations and applications of various data structures like arrays, structures, unions, lists, stacks, queues, trees, graphs, hash tables and heaps. 3. Provide the students with solid foundations in the basic concepts of programming: data structures and algorithms. 4. Familiarize the concept of Abstract Data Types (ADT) and Implement ADT in several programming languages					
Course Outcomes	On completion of this course the students will be able to: 1. Implement classes and objects for a given problem. 2. Demonstrate the ability of accessing members in the written programs. 3. Impart the effectiveness of data structures and algorithms for solving a given problem. 4. Package a set of data structures and algorithms as an abstract data type.					

COURSE CONTENTS

Unit 1: **[10hrs]**

Introduction: Overview of C++, Introduction to variables in C++, I/O operators, Function overloading, Inline function, Recursive function.

Classes & Objects: Introduction to Classes, Member Functions and Member data, Constructors and Destructors, The scope resolution operator, Static Class members.

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

Unit 2: **[11hrs]**

Introduction to Data structures and Algorithms: Data, Data Types, Abstract Data Types and Examples, Algorithms, Arrays: One Dimensional and Two Dimensional, Structures: Introduction to structures and nested structures.

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

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

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

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE4070	**Electrical Machines-I Lab**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		0	0	2	**2**	2
Course Objectives	1. To Evaluate the performance of a given machine through testing. 2. To control the speed of Induction Motor 3. Evaluate the various characteristics of Induction motor and transformer for industrial applications. 4. To demonstrate the conversion of 3-phase system to 2-phase system					
Course outcomes	At the end of this course, Student will be able to 1. Apply the three phase transformer in the industrial needs like electrical drives and agricultural pumps etc. 2. Understand parallel operation of transformer, three phase transformer, auto transformer and their practical applications. 3. Analyze equivalent circuits of single phase transformers. 4. Understand the different testing methods for evaluating the various losses of the transformers and Induction motors					

List of Experiments:

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

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

Sub Code: B18EE4080	**Microcontroller Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		0	0	2	**2**	2
Course Objectives	1. Understand the architecture of microcontroller and various features associated with the different models of the microcontrollers. 2. Understanding of various computations and accessing methods associated with the microcontrollers. 3. Gain the knowledge of programming. 4. Develop the ability to program the microcontroller in controlling the different applications in real time. 5. Develop the capability to program and interface various devices to the microcontroller.					
Course Outcomes	After the completion of the course the student will be able to: 1. Understand the architecture of the 8051 and features 2. Make use of various inbuilt features and external peripherals based on the requirement. 3. Design simple electronic circuits which could be controlled using the microcontroller. 4. Develop the capability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller.					

List of Experiments:

I. PROGRAMMING

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

II. INTERFACING:

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

Course Code	Soft Skill	Course Type	L	T	P	C	Hrs./Wk.
B18EE4090		RULO	0	0	2	**2**	2

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

Sub Code: **B18EEX10**	**MOOC / SWAYAM**	**L**	**T**	**P**	**C**	**CH**
		0	0	2	2	4

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

MOOC/ SWAYAM:

Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses.

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

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

Internship: Minimum of four weeks duration internship should be carried out by the student either in industry or in an R&D organization, including educational institutes with excellent research culture. In case, if a student is unable to secure internship either in industry or in an R&D organization, a project may be carried out within the university. The student is expected to submit a formal report at the end of the internship programme. The

student shall be awarded the marks for internship based on the (a) presentation and (b) comprehensive viva by the panel of examiners constituted by the school

Sub Code: **B18EE4X20**	**YOGA / SPORTS / MUSIC / DANCE/ THEATRE**	**L**	**T**	**P**	**C**	**CH**
		0	**0**	**2**	**2**	**4**

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

A. YOGA FOR HEALTH

Course Objectives:

Following are the Course Objectives.

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

Course Outcomes:

On completion of the course learners will be able to:

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

Course Contents

Unit-I:

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

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

Unit-II:

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

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

Unit-III:

Asanas: Prone Position- Bhujangasana, Dhanurasana, Shalabhasana.

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

Karnapeedasana.

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

Unit-IV:

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

Dhyana & its types

Competition format, Rules and their interpretations

B. SPORTS (VOLLEYBALL)

Course Objectives:

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

Course Outcomes:

On completion of the course learners will be able to:

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

Course Contents:

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

C. SPORTS (BASKETBALL)

Course Objectives:

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

Course Outcomes:

On completion of the course learners will be able to:

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

Course Contents:

Unit-I

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

Unit-II

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

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

Unit-III

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

Unit-IV

- Court marking, Rules and their interpretations

D. SPORTS (FOOTBALL)

Course Objectives:

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

Course Outcomes:

On completion of the course learners will be able to:

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

Course Content:

Unit-I

Football: Introduction

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

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

Unit-II

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

Unit-III

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

Unit-IV

- Ground marking, Rules and their interpretations

E. SPORTS (TRACK AND FIELD)

Course Objectives:

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

Course Outcomes:

On completion of the course learners will be able to:

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

Course Content:

Unit-I

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

Race walking - Technique, Faults and Officiating.

Middle and Long distance races – Technique and Training

Unit-II

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

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

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

Unit-III

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

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

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

Unit-IV

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

Reference Books

(Athletics Part-I and Athletics Part-II)

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

F. DRAMATICS

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

Course Objectives:

•To imbibe the acting skills.

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

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

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

Course Outcomes:

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

• Freely express improvisation in non-verbal communication.

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

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

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

Course Content:

UNIT – 1

Working on Body:

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

UNIT – 2

Sound and Movement:

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

UNIT – 3

Characterization and Improvisation:

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

UNIT – 4

Group work and Production:

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

Reference Books:

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

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

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

Note: Non-classical dancers can also join.

Course Objectives:

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

Course Outcomes:

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

Course Content:

Unit 1

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

Unit 2

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

Unit 3

Adavus –II (Bharathanatyam , Kuchipudi, Mohiniyattam)

Unit 4

Learn a basic composition in the chosen dance form.

Reference Books:

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

H. PERCUSSION INSTRUMENT (TABLA AND MRIDANGAM)

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

Course Objectives:

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

Course Outcomes:

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

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

Course Content:

UNIT 1

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

UNIT 2

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

UNIT 3

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

UNIT 4

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

Reference Books:

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

V Semester

Sub Code: B18EE5010	Power System Analysis	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To model the power system under steady state operating condition. 2. To model and analyze the power systems under abnormal (or) fault conditions. 3. To model and analyze the transient behavior of power system when it is subjected to a fault.					
Course Outcomes	At the end of this course, Student will be able to 1. Obtain the equivalent models of different power system components 2. Analyze the symmetrical fault condition. 3. Calculate the fault current under different unsymmetrical fault conditions.					

Unit 1: Introduction to Power System [14hrs]

Modern Power System – basic components of a power system. Generator model, transformer model, transmission system model and load representation. Single line diagram – per phase and per unit representation – change of base.

Unit 2: Fault Analysis – Balance Faults [14hrs]

Importance short circuit (or) for fault analysis – basic assumptions in fault analysis of power systems. Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents.

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

Unit 4: Fault Analysis – Unbalanced Faults [8 hrs]

Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions. Unbalanced fault analysis – problem formulation – analysis using Z-bus impedance matrix – (algorithm and flow chart).

Text Books:

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

References:

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

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

Sub Code: B18EE5020	**Switchgear and Protection**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Prerequisites:	Basic knowledge of Electro magnetism, Ionization process, AC Machines, Transmission and Distribution					
Course Objectives	1. To introduce students to power system protection and switchgear. 2. To teach students theory and applications of the main components used in power system protection. 3. To enable the students to understand theory, construction advantages and disadvantages of various circuit breakers 4. To teach the students, the theory and construction of various protective relays and their characteristics 5. To teach students the protection systems used for Electrical machines such as Transformers, generators and Induction Motors					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the operation of switch gear and protection system. 2. Classify various types of Circuit Breakers and Relays 3. Explain the theory, construction, advantages and disadvantages of different types of Circuit Breakers and Relays. 4. Describe protection schemes for transformers, alternators and induction motors 5. List the applications of circuit breakers and relays in real life.					

Course Contents:

UNIT I: **[10 Hrs]**

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

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

UNIT II: **[11 Hrs]**

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

UNIT III: **[11 Hrs]**

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

UNIT IV: **[10Hrs]**

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE5030	**High Voltage Engineering**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To enable the students understand various breakdown mechanisms. 2. To enable the students understand various principles of generating high DC, AC and impulse voltages. 3. To teach the students about various methods for measuring high voltages and currents. 4. To teach the students various high voltage tests performed on various electrical apparatus such as cables, insulators etc.					
Course Outcomes	After the completion of the course the student will be able to: 1. Describe the principles of the generation and measurement of high voltage AC, DC and impulse voltages. 2. Describe the fundamentals of breakdown. 3. Understand discharge phenomena, to prevent them. 4. Know the origins of overvoltage and protection against them. 5. Understand insulation coordination concept					

COURSE CONTENTS

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

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

Electrical Breakdown in Gases, Solids and Liquids

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

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

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

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

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

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

Text Books :

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

Sub Code: B18EE5041	**Design of Electrical Machines**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Prerequisites	Mathematics, Electrical Machines I & II					
Course Objectives	1. To enable students to understand the application of basic electro-magnetic laws. 2. To give an insight into constructional details of internal parts of the machines 3. To enable students understand different machine parameters and develop design equations					
Course Outcomes	On completion of this course the students will be able to: 1. Be able to apply basic electro-magnetic laws to mould the laboratory modules. 2. Be able to select efficient materials for the best performance of the machine					

Course Contents:

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

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

Unit 2: Single Phase and Three Phase Transformers Design [12hrs]

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

Unit 3: Three Phase Induction Motor Design [10hrs]

Output equation, Choice of specific loadings, main dimensions of three phase induction motor, Stator winding design, choice of length of the air gap, estimation of number of slots for the squirrel cage rotor, design of rotor bars and end ring, design of slip ring induction motor, estimation of no load current and leakage reactance, and circle diagram.

Unit 4: Synchronous Machines [10hrs]

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

Recommended Learning Resources (Text books):

1. A.K. Sawhney, 'A Course In Electrical Machine Design', Dhanpat Rai & Sons
2. V. N. Mittle, 'Design Of Electrical Machines', 4th edition

Recommended Learning Resources (Reference books):

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

Sub Code: B18EE5042	**Advanced Power Electronics**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To develop analytical techniques for isolated/non-isolated converters in steady state. 2. To design and simulate a basic dc-dc power supply for given specifications. 3. To describe the operation and pulse width modulation strategies in inverters. 4. To familiarize with various element of a practical power converter circuitry					
Course Outcomes	On completion of this course the students will be able to: 1. Analyze any arbitrary dc-dc converter in steady state. 2. Design the output filter components to meet the required					

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

COURSE CONTENTS

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

Introduction to power processing, Linear Regulator Vs Switching Regulator. IC based linear regulators: LM78xx series.

Basics of steady state analysis- Inductor Volt-second, capacitor charge balance, small ripple approximation. Principle of operation of buck, boost, buck-boost, Design of output filters components, selection of switch ratings. -Numerical problems

Discontinuous conduction Mode Operation: Buck and Boost converters.

Analysis using software tools: Simulation of DC-DC converters using MATLAB/LT Spice.

Unit 2: DC Power supplies [9hrs]

DC power supplies: fly back converter, forward converter, push-pull converter, full bridge converter, Harmonics generated by SMPS power supplies, undesirable effect on power systems, power factor. Application of DC-DC converters-Power factor correction, solar power application.

Analysis using software tools: Simulation of DC power supplies using MATLAB/LT Spice

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

Review of basic magnetic theory, Design and selection of magnetic components, inductor, high frequency transformers, Ferrite core table and selection of area product – wire table – selection of wire gauge

Basics elements of PWM Control: PWM control IC and its components, Need for Driver circuit, isolation techniques.

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

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

Applications of inverters- Design of UPS, Grid tied PV system.

Text Books:

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

Reference Books:

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

Sub Code: B18EE5043	VLSI Circuits and Design	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To give clear idea about the basics of VLSI design and its importance. 2. To know about the operating principles of MOS transistor. 3. To understand the basics of MOS process Technology. 4. To study about construction of NMOS, CMOS and Bi-CMOS based logic gates. 5. To understand the necessity of testing and the design strategy of the same					
Course Outcomes	On completion of this course the students will be able to: 1. Understand the characteristics of CMOS circuit construction. 2. Demonstrate the fundamentals of IC technology such as various MOS fabrications. 3. Calculate electrical properties of MOS circuits such as Ids -Vds relationships. 4. Design various gates, adders, Memories, using stick diagrams					

COURSE CONTENTS

Unit 1: Introduction [11hrs]

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

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

Unit 2: VLSI Circuit Design Processes [10hrs]

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

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

Unit 3: Data Path Subsystems [15hrs]

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

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

Unit 4: CMOS Testing [06hrs]

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

Text Books:

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

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

Sub Code: B18EE5044	**Python Programming**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Prerequisites	Object Oriented Programming, HTML, XML, Web Services, Data Structures.					
Course Objectives	1. Define and explain the fundamentals of python statements to output information to the screen, assign values to variables, get numeric information entered as input and perform a counted loop. 2. Interpret the principles of object-oriented programming and the interplay of algorithms and data structures, exception handling in well-written modular code. 3. Explain advanced python programming using regular expressions and HTML processing 4. Define and explain the I/O streams and web services development using python.					
Course Outcomes	On completion of this course the students will be able to: 1. Use python interpreter for designing simple programs. 2. Differentiate between mutable and immutable types 3. Demonstrate usage of object oriented features, file and exception handling. 4. Understanding and usage of advanced features like regular expressions to solve a problem using python 5. Apply the knowledge of python and use the language scripting elements and constructs and repository of standard library, to develop real world and web based applications.					

Course Contents:

Unit-I: **[11 Hrs]**

Introduction to Python: Installing Python: Python on Windows; Python on RedHat Linux; Python Installation from source; The Interactive Shell

Your First Python Program: Diving in; Declaring Functions; Documenting Functions; Everything Is an Object; Indenting Code; Testing Modules

Native Datatypes: Introducing Dictionaries; Introducing Lists; Introducing Tuples; Declaring variables; Formatting Strings; Mapping Lists; Joining Lists and Splitting Strings

The Power of Introspection: Diving In; Using Optional and Named Arguments; Using type, str, dir, and Other Built−In Functions; Getting Object References With getattr; Filtering Lists; Using lambda Functions;

Unit-II: **[11 Hrs]**

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

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

Unit-III: **[10 Hrs]**

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

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

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

Unit-IV: **[10 Hrs]**

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

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

Recommended Learning Resources:

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

References:

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

Sub Code: B18EE5051	**Operation Research**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To understand the quantitative methods for effective decision making. 2. To study the various techniques for effective decision making to solve business decision problems. 3. To understand the model formulation and applications in business decision making.					
Course Outcomes	On completion of this course the students will be able to: 1. Knowledge and understanding - Be able to understand the					

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

COURSE CONTENTS

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

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

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

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

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

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

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

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

Unit -IV:

Transportation Problems **[10hrs]**

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

Assignment Problems

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

Text Books

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

Sub Code: B18EE5052	Electric and Hybrid Vehicle	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. present a comprehensive overview of Electric Vehicles 2. To introduce the applications of various motor drive roadway principles. 3. To enable students to know the characteristics of various types of batteries. 4. To present a comprehensive overview of Hybrid Electric and various Fuel cell Vehicles 5. To equip students with basic concepts to practically design/ implement and modify the existing vehicle to electric vehicle					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the configuration of a typical electric vehicle, and design , develop basic a schemes of electric vehicle 2. Choose a suitable drive motor for EV,HEV application and differentiate among different drive trains. 3. Understand the limitations and advantages of various Battery chemistries. 4. Choose proper energy storage systems for vehicle applications and develop strategies for charging various types of batteries. 5. Describe the configuration of HEV and various types of Fuel Cell Electric Vehicles and realistically implement/ design the fuel for electric vehicle.					

Course Contents:

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

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

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

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

UNIT-III: Batteries: [10 Hrs]

Battery parameters. Types and characteristics of EV batteries. Battery testing and maintenance; charging schemes. Need of **Battery Management System,** Battery monitoring

techniques, Advance Features. Open-circuit voltage and ampere- hour estimation. Battery load levelling.

UNIT-IV: Emerging EV Technologies: [10 Hrs]

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

Text Books and References:

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

Sub Code: B18EE5053	**Digital Image Processing**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To recall the mathematical & signal principles, forming the basic methods for Image processing. 2. To understand image representation, enhancement, filtering, restoration, analysis & reconstruction. 3. To know the processing techniques including various image transformations, Image reconstruction, segmentation & recognition. 4. To design & conduct imaging experiments using MATLAB. 5. To convert image from RGB to gray, black & white, remove blurring effects, noise reduction, edge detection, compression and segmentation. 6. To understand concepts and types of video and video compression standards.					
Course Outcomes	On completion of this course the students will be able to: 1. Acquire the fundamental concepts of a digital image processing system 2. Identify and exploit analogies between them, Signal analysis and processing. 3. Analyze 2D signals in the frequency domain through the Fourier transform 4. Design with MATLAB algorithms for digital image processing operations such as histogram equalization, enhancement, restoration, filtering, and de-noising					

Course Content:

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

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

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

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

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

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

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

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE5054	**Web Programming**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
	1. Understand the various steps in designing a creative and dynamic website. 2. They will have clear understanding of hierarchy of objects in HTML and XML.					

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

COURSE CONTENTS

Unit 1: **[10hrs]**

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols - The World Wide Web-HTTP request message-response message-Web Clients Web Servers-Case Study. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-XML Creating HTML Documents Case Study.

Unit 2: **[12hrs]**

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

Unit 3: **[12hrs]**

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

Unit 4: **[8hrs]**

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

TEXT BOOK:

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

REFERENCES:

1. Deitel, Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education, 2006.
2. Marty Hall and Larry Brown, “Core Web Programming” Second Edition, Volume I and II, Pearson Education, 2001.
3. Bates, “Developing Web Applications”, Wiley, 2006.

Sub Code: B18EE5061	**Electrical Power Quality**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To understand Comprehend concept of Power Quality & its issues for various electrical systems 2. To Understand effects of power quality on electrical apparatus 3. To Know different power quality improvement techniques and devices					
Course Outcomes	After learning the course the students should be able to: 1. Comprehend concept of Power Quality & its issues for various electrical systems 2. Understand effects of power quality on electrical apparatus 3. Know different power quality improvement techniques and devices					

COURSE CONTENTS

UNIT I: **[12Hrs]**

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

UNIT II: **[12Hrs]**

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

UNIT III: **[12Hrs]**

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

UNIT IV: **[10Hrs]**

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

Text Books and References:

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

Sub Code: B18EE5062	**Electricity Regulations and Safety**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. To understand the Indian Electricity rules 1956. 2. To understand the provisions provided in Indian Electricity Act 2003. 3. To highlight about the Electricity scenario in India 4. To provide the first hand information and knowledge on KERC & CERC guidelines for power generation, transmission and distribution					
Course Outcomes	On completion of this course the students will be able to: 1. Apply the electricity rules 1956 for electrical equipment and also power systems. 2. Apply the provisions given in Electricity act 2003 in Electrical power generation, transmission and distribution system. 3. Adopt the norms given by KERC and CERC for power system. 4. Gain knowledge on open access, power trading, power wheeling, power banking and ABT.					

COURSE CONTENTS

Unit 1: **[12hrs]**

Overview of Power Sector: Electricity Scenario at National Level and State Level with Key Statistics relating to Generation, Transmission and Distribution of power.

Organizational Set up and Introduction to Electricity Laws – A brief discussion on functional set up of power sector at national and state level and connectivity among different statutory entities and introduction to EA 2003, EC 2001 and KER Act 1999.

Over View of Regulations Governing Electricity Generation and Transmission – A brief description of Key regulations issued by CERC and KERC on Generation and Transmission activity.

Over View of Regulations Governing Distribution & Trading - A brief description of key regulations issued by CERC and KERC on Distribution and Trading activity.

Unit 2: **[12hrs]**

Provisions relating to Electricity Generation in Act 2003 and related case studies Sl. No. 7, 8, 9, 10 & 11 of Electricity ACT 2003.

Provisions relating to Grid Operation in Act 2003 and related case Studies Sl. No. 25, 26,27,28, 29, 30, 31, 32, 33 & 34 of Electricity ACT 2003

Provision of Power generation by Distributed generations (DG) and interconnection with grid norms from Central Electricity Authority Grid code 2010

Unit 3: **[12hrs]**

Provisions Relating to Electricity Transmission and related cases Sl. No. 38, 39, 40 & 41 of Electricity ACT 2003

Provisions Relating to Electricity Distribution in Act 2003 and related case studies Sl. No. 42, 43, 55, 56 & 135 of Electricity ACT 2003

Key Technical Aspects relating to supply of electricity and supply code

Unit 4: **[12hrs]**

Safety in Supply of Electricity - Regulations and Case studies - Safety Regulations issued by CEA. Electricity Trading and Power Business Trading Regulations issued by CERC and KERC, & Case Studies

Electricity Tariffs – Provisions in the Act, related regulations and case studies Sl. No. 61, 62, 63, 64 & 65 of Electricity Act 2003, Open excess, wheeling & banking of power, Availability Based Tariff (ABT)

Text Books:

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

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

Sub Code: B18EE5063	**Embedded Systems and IOT**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	**3**	4
Course Objectives	1. Provide knowledge about the basics of embedded systems and embedded system design 2. Describe Internet-of-Things and design principles 3. Explain the ease of prototyping and production, and think of deployment for the community. 4. Gain expertise in integrating sensing, actuation and software 5. Give knowledge about internet principles and techniques for writing embedded code					
Course Outcomes	On completion of this course the students will be able to: 1. Explain the basics of embedded systems and design embedded systems 2. Design and Develop Internet-of-Things based applications 3. Develop prototypes of Internet-of-Things based applications, and deploy for the usage of the community. 4. Integrate sensing, actuation and software 5. Write embedded code for constrained sensor devices					

COURSE CONTENTS

Unit 1: Introduction to Embedded Systems **[10hrs]**

Embedded systems, Processor embedded in to system, Embedded hardware units and software system, Examples of embedded system, System on Chip, Complex system design and processors, Design process and examples in Embedded systems, Classifications of embedded systems, Skills required for embedded system designer.

Unit 2: The Internet of Things: An Overview & Design Principles **[10hrs]**

Introduction to IOT, Wireless sensor networks, Applications of WSN, Roles in WSN, Calm and Ambient technology, Magic as Metaphor, Privacy: Keeping Secrets; Web Thinking for Connected Devices.

Unit 3: Prototyping IOT Devices **[12hrs]**

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

Unit 4: Internet Principles and Techniques for Writing Embedded Code [10hrs]
Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP; IP Addresses: DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses; TCP and UDP Ports: An Example: HTTP Ports,
(**Self-study:** Other Common Ports ;Application Layer Protocols :HTTP , HTTPS; Encrypted HTTP, Performance, , Libraries, Debugging).

Case studies

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE5464	Artificial Intelligence	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. To study the concepts of Artificial Intelligence. 2. To learn the methods of solving problems using Artificial Intelligence. 3. To introduce the concepts of machine learning.					
Course Outcomes	On completion of this course the students will be able to: 1. Knowledge of what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence. 2. Apply Artificial Intelligence techniques for problem solving. 3. Explain how Artificial Intelligence enables capabilities that are beyond conventional technology					

Course Content:

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

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

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

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

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

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

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

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

TEXT BOOKS

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

REFERENCES

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

Sub Code: B18EE5070	Power Electronics Lab	L	T	P	C	CH
Duration: 14 Weeks		0	0	2	2	3
Course Objectives	1. To get an overview of different types of power semi-conductor devices and their static characteristics. 2. To learn about the analog and digital triggering circuit for SCR. 3. To compare the performance of phase controlled rectifiers for various loads. 4. To study the operation and speed control of motors using DC-DC converter and AC Voltage controller. 5. To learn the different modulation techniques of pulse width modulated inverters.					
Course Outcomes	1. Acquire a basic knowledge of solid state electronics devices and its characteristics of SCR, IGBT and power MOSFETs. 2. Design circuit using electronic components such as resistors, capacitors, diodes and transistors. 3. Analyze electronic circuits such as control rectifiers, inverters, choppers & ac voltage regulators. 4. Describe the role of Power Electronics as an enabling technology in various applications.					

List of Experiments:

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

Sub Code: B18EE5080	Electrical Machines Laboratory- II	L	T	P	C	CH
Duration :14 Weeks		0	0	2	**2**	3
Course Objectives	1. To enable the student to understand the working of DC and synchronous machines. 2. To enable the students to conduct testing on different types of electrical machines. 3. To enable the students to analyze the operation of electric machines under different loading conditions 4. To equip the students with the knowledge of synchronization of alternators.					
Course outcomes	At the end of this course, Student will be able to: 1. Calculate the voltage regulation of alternator 2. Determine the .efficiency of various DC Machines 3. Understand the starting and connecting procedures of synchronous generators, and to obtain the 'V' curves of synchronous motors. 4. Obtain the load characteristics of DC Motors and generators 5. Demonstrate the speed control of DC Motor					

List of Experiments:

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

Course Code	Soft Skill	Course Type	L	T	P	C	Hrs./Wk.
B18EE5090		RULO	0	0	2	**2**	2

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

Course Code	Skill Development	Course Type	L	T	P	C	Hrs./Wk.
B18EE5X10		RULO	1	0	1	**2**	2

VI Semester

Sub Code: B18EE6010	Computer Aided Power System Analysis & Stability	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	3	4
QSPre-Requisites	Power system Analysis					
Course Objectives	1. To enable students to understand the basics of network topology and its relevance in Power System Analysis 2. To enable students to understand the analysis of power system network topologies. 3. To enable students to learn the concept of power flow and its analysis by different methods 4. To enable students to understand different methods of stability analysis by different techniques					
Course Outcome	On successful completion of the course, student will be able to: 1. Identify the incidence of elements of given power system network. 2. Solve different examples related to network topology. 3. Identify state of the power system through different load flow techniques. 4. Demonstrate stability of power system through different methods.					

Unit 1: Network Topology **[10hrs]**

Introduction, Elementary graph theory – oriented graph, tree, co-tree, basic cut-sets, basic loops; Incidence matrices – Element-node, Bus incidence, Tree-branch path, Basic cut-set, augmented cut-set, Basic loop and Augmented loop, Primitive network – impedance form and admittance form.

Unit 2: Load Flow Studies **[12hrs]**

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

Unit 3: Stability Analysis **[10hrs]**

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

Unit 4: Transient Stability Studies **[10hrs]**

Numerical solution of Swing Equation – Point-by-point method, Modified Euler's method, Runge-Kutta method, Milne's predictor corrector method. Representation of power system for transient stability studies – load representation, network performance equations. Solution techniques with flow charts.

Text Books:

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

Reference Books:

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

Sub Code: B18EE6020	**Signal Processing**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. Understanding the fundamental characteristics of signals and systems. 2. Understand general signals and system properties and linear and time-invariant systems 3. Apply digital signal processing fundamentals. 4. What are the key DSP concepts and how do they relate to real applications? 5. Master the representation of discrete-time signals in the frequency domain, using z-transform, discrete Fourier transform (DFT), and cosine transform. 6. Understand the implementation of the DFT in terms of the FFT, as well as some of its applications 7. Learn the basic forms of FIR and IIR filters, and how to design filters with desired frequency responses. 8. Appreciate relationships between first order low pass, and high pass filters, and between second-order Peaking and Notching filters. Design digital filters using MATLAB					
Course Outcomes	On completion of this course the students will be able to: 1. Represent discrete-time signals analytically and visualize them in the time domain. 2. Understand convolution sum and integral 3. Understand the meaning and implications of the properties of systems and signals. 4. Understand the Transform domain and its significance and problems related to computational complexity. 5. Be able to specify and design any digital filters using MATLAB					

COURSE CONTENTS

Unit 1: Introduction to signals & systems [12hrs]

Introduction, Definitions of signals and a system, Classification of signals, Basic operations on signals, Elementary signals viewed as interconnections of operations, Properties of systems. Convolution-integral & sum.

Unit 2: Z Transform and Inverse Z transform [10hrs]

Z-transform & Properties of ROC, Properties of Z-transforms, Inversion of Z-transform methods - power series and partial expansion, Transforms analysis of LTI systems - transfer function, Stability and causality.

Unit 3:

3a. Discrete Fourier Transforms [12hrs]

Definitions, properties-linearity, shift, symmetry etc, circular convolution –periodic convolution, use of tabular arrays, circular arrays, linear convolution –two finite duration sequence, one finite & one infinite duration, overlap add and save methods..

3b. Fast Fourier Transforms Algorithms

Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithms, algorithm, inverse decimation in time and inverse decimation in frequency algorithms

Unit 4: Design of IIR&FIR Digital Filters [12hrs]

Introduction, impulse invariant & bilinear transformations, all pole analog filters-Butterworth & Chebyshev, design of digital Butterworth & Chebyshev, frequency transformations FIR: Introduction, windowing, rectangular, modified rectangular, Hamming, Hanning, blackman window(excluding Kaiser window).

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Text Books:

1. Simon Haykin and Barry Van Veen, 'Signals and Systems', John Wiley & Sons, 2nd edition, 2008
2. Michel J Roberts, 'Fundamentals of Signals and Systems ', TMH, 2nd Edition, 2010.
3. Proakis, 'Digital Signal Processing Principle, Algorithm & application', Pearson, 4th edition, 2009.
4. Sanjeet. K. Mitra, 'Digital Signal Processing', TMH, 3rd Edition, 2009.

Reference Books:

1. Johnny R. Johnson, 'Introduction to Digital Signal Processing', PHI, 2009.
2. Openheim, 'Discrete Time Signal Processing', Pearson 2nd edition, 2009.
3. S. Salivahanan, A. Vallaraj, C. Gnanapriya, 'Digital Signal Processing', TMH, 2nd Edition, 2010.
4. Ifeachor Emmauel, 'Digital Signal Processing', Pearson education, 2nd Edition, 2006.
5. Ludeman, John Wiley, 'Fundamentals of Digital Signal Processing', 3rd Edition, 2008
6. Alan V Oppenheim, Alan S. Willsky and S. Hamid Nawab, 'Signals and Systems', PHI, 2nd edition, 2009.

7. H P Hsu and others, 'Signals and Systems' , Schaums Outline Series, TMH, 2nd Edition, 2008

Sub Code: B18EE6030	Control Engineering	L	T	P	C	CH
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. To understand the methods of representation of systems and their transfer function models, reduction of block diagrams to obtain the transfer function. 2. To understand the time response of system and its importance in the design of controllers. 3. To understand the importance of frequency response of the system in the stability analysis of the same 4. To model the given system using state variable method					
Course Outcomes	On completion of this course the students will be able to: 1. Represent the system by its transfer function 2. Demonstrate the time domain specifications of the given system 3. Determine the stability of given system using different frequency response analysis methods. 4. Draw the state space model of the given system					

COURSE CONTENTS

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

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

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

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

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

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

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

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

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

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

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

Text Books:

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.
2. Syed hasan saeed, 'Automatic control systems', publishers of engineering and computer books, new Delhi, 6th edition,2012.

3. Benjamin C. Kuo, 'Automatic Control systems', Pearson Education, New Delhi, 2003.

Reference Books:

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

Sub Code: B18EE6041	**Testing and Commissioning of Electrical Equipment**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. To enable students to understand the standard specifications of various electrical equipment as per BIS(Bureau of Indian Standard) 2. To enable the students to understand standard tests for installation of various electrical equipment as per BIS(Bureau of Indian Standard) 3. To enable the students to understand standard commissioning tests various electrical equipment as per BIS(Bureau of Indian Standard) 4. To enable the students to understand standard performance tests of various electrical equipment as per BIS(Bureau of Indian Standard)					
Course Outcomes	On completion of this course the students will be able to: 1. Be able to describe the standard specifications of various electrical equipment. 2. Be able to describe the standard tests, specifications for installation of various electrical equipment 3. Be able to describe the commissioning tests on various equipment 4. Be able to describe the performance tests on various equipment					

COURSE CONTENTS

Unit 1: Transformers [10hrs]

Specifications: Power and distribution transformers as per BIS standards.

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

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

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

Unit 2: Synchronous Machines [10hrs]

Specifications: As per BIS standards.

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

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

Performance tests: Various tests to estimate the performance of generator operations, slip test, maximum lagging current, maximum reluctance power tests, sudden short circuit tests,

transient & sub transient parameters, measurements of sequence impedances, capacitive reactance, and separation of losses, temperature rise test, and retardation tests.
Factory tests: Gap length, magnetic eccentricity, balancing vibrations, bearing performance

Unit 3: Induction Motors [10hrs]
Specifications: for different types of motors.
Installation: Location of the motors (including the foundation details), shaft & alignment for various coupling, fitting of pulleys & coupling, drying of windings.
Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing.
Electrical Tests: Insulation test, earth resistance, high voltage test, starting up, failure to speed up to take the load, type of test, routine test, factory test and site test (in accordance with ISI code) **Specific Tests:** Performance & temperature raise tests, stray load losses, shaft alignment, and re-rating & special duty capability.

Unit 4: Switch Gear & Protective Devices [10hrs]
Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests.
Text Books:
1. S. Rao, 'Testing & Commissioning Of Electrical Equipment',
2. B .V. S. Rao, 'Testing & Commissioning Of Electrical Equipment'

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

Sub Code:B18EE6042	**Energy Storage Systems**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. To Validate the Necessity of Energy Storage and to study various types of storage systems. 2. To understand the use of fuels for storage Load management, Space conditioning, Transportation, Utility system, Variable energy sources, Role of different energy forms, Energy quality, Energy efficiency, Energy and power densities. 3. To achieve the ability to converse about the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics. Able to analyze the cost effectiveness and eco-friendliness of Fuel Cells					
Course Outcomes	At the end of this course, Student will be able to 1. Explain and use different modes of energy storage 2. Design and use of fuel cell for energy storage 3. Perform calculation regarding energy efficiency					

Course Content

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

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

Unit 3: Magnetic and Electric Energy Storage Systems [10hrs]
Superconducting Magnet Energy Storage (SMES) systems; Capacitor and Batteries: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube.

Unit 4: Fuel Cell Basics [10hrs]
Fuel cell definition, Difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cells, Fuel cell thermodynamics and its efficiency, Electrochemical kinetics, Butler-Volmer equation. Types of fuel cells and its chemistries – AFC, PAFC, PEMFC, MCFC and SOFC – merits and demerits. Fuel cells- global research development trends and application of PEMFC in automobile industry and application SOFC in stationery. Current issues in PEMFC.

Text Books:

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

References:

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

Sub Code: B18EE6043	**Electrical Engineering Materials**	**L**	**T**	**P**	**C**	**CH**
Duration:14 WEEKS		3	0	0	3	4
Course Objectives	1. To impart the knowledge of conducting, dielectric, insulating and magnetic materials and their applications. 2. To impart the knowledge of superconducting materials and their applications 3. To impart the knowledge of plastics and materials for Opto - Electronic devices. 4. To impart knowledge on electrical engineering materials used for special applications & Modern techniques involved in material studies					

Course Outcome	On successful completion of the course, student will be able to: 1. Understand various types of electrical & electronic materials & their applications. 2. Understand about magnetic and superconductive materials with their applications. 3. Understand about properties of Dielectric & various types of insulating materials. 4. Understand the special applications of the materials & modern techniques used for materials study.

COURSE CONTENT

Unit 1: **[11Hrs]**

Introduction to Electrical and Electronic Materials: Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, Requirement of Engineering materials, Classification of solids on the basis of energy gap, Products – working principle and materials, Types of engineering materials, Levels of material structure. Spintronics and Spintronic materials, Ferromagnetic semiconductors, Left handed materials.

Conductors: Conductor materials, Factors affecting conductivity, Thermal conductivity, Heating effect of current, Thermoelectric effect, Seebeck effect, Thomson effect, Wiedemann – Franz law and Lorentz relation, Problems .

Unit 2: **[11Hrs]**

Magnetic Materials: Introduction, Types of magnetic materials, Soft and hard magnetic materials, High energy magnetic materials, magnetostriction.

Superconductive Materials: Concept of superconductors, Meaning of phenomenon of superconductivity, Properties of superconductors, Types of superconductors, Critical magnetic field and critical temperature, Effects of Isotopic mass on critical temperature, Silsbee rule, Depth of penetration and coherence length. Ideal and Hard superconductors, Mechanism of super conduction, London's theory for Type I superconductors, GLAG theory for Type I superconductors, BCS theory. Applications and limitations

Unit 3: **[10Hrs]**

Dielectrics: Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss. Dielectrics polarization under static fields- electronic ionic and dipolar polarizations, behavior of dielectrics in alternating fields, Factors influencing dielectric strength and capacitor materials.

Insulating materials: Inorganic materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and Bakelite), resins and varnishes, liquid insulators (transformer oil) gaseous insulators (air, SF6 and nitrogen) and ageing of insulators.

Unit 4: **[10Hrs]**

Materials for Special applications: Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, and sintered alloys for breaker and switch contacts.

Modern Techniques for Materials studies: Optical microscopy, Electron microscopy, Photo electron spectroscopy, Atomic absorption spectroscopy, magnetic resonance, nuclear magnetic resonance, electron spin resonance and ferromagnetic resonance.

Text Books:

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

Reference Books:

1. Electronic Engineering Materials R.K. Shukla Archana Singh McGraw Hill 2012
2. Electrical Properties of Materials L Solymar et al Oxford 9th Edition, 2014
3. Electrical Engineering Materials A.J. Dekker Pearson 2016
4. Principle of Electronic Materials and Devices S.O. Kasap McGraw Hill 3rd Edition2010

Sub Code: B18EE6044	**MEMS Technology**	**L**	**T**	**P**	**C**	**CH**
Duration:14 WEEKS		3	0	0	3	4
Pre Requisites	Basic Physics, Chemistry, Electronics and Mechanics, Basics of analog and digital sensors.					
Course Objectives	1. To gain basic knowledge on overview of MEMS (Micro electro mechanical System) 2. To understand various fabrication techniques. 3. To gain knowledge of design, analysis, fabrication and testing the MEMS based components					
Course Outcome	On successful completion of the course, student will be able to: 1. Be familiar with the important concepts applicable to MEMS,their fabrication. 2. Be fluent with the design, analysis and testing of MEMS. 3. Apply the MEMS for different applications. 4. Describe the limitations and current challenges in microsystems technology **5.** Describe the physics,chemical,biological and engineering principles involved in the design and operation of current and future micro devices					

COURSE CONTENTS

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

UNIT-II: Scaling Laws in Miniaturization and Transduction Principles in MEMS & Microsystems: [11hrs]
Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling electrostatic forces, electromagnetic forces, electricity.

Introduction, Micro sensors thermal, radiation, mechanical, magnetic and bio — sensors, Micro actuation, MEMS with micro actuators.

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UNIT III: Microsystems Fabrication Process: [10hrs]

Introduction, Photolithography, Ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process, LASER micromachining.

UNIT-IV: Micro System Design and Modelling: [11 hrs]

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

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

Text books:

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

Sub Code: B18EE6045	**Big Data Analytics and Cloud Computing**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To make the Learners to Understand Hadoop Distributed File system and examine MapReduce Programming 2. To Explore Hadoop tools and manage Hadoop with Ambari 3. Introduce cloud computing and provide knowledge in different layers of cloud computing such as: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) 4. Describe various cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology, service technology.					
Course Outcomes	Upon successful completion of this course, students will be able to 1. Master the concepts of HDFS and MapReduce framework 2. Investigate Hadoop related tools for Big Data Analytics and perform basic Hadoop Administration 3. Explain the cloud computing concepts such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) 4. Use various cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology; service technology					

COURSE CONTENTS

Unit –I: **[11 Hrs]**

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

Unit –II: **[10 Hrs]**

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

Unit-III: **[11 Hrs]**

Introduction to Cloud Computing**:** Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges.

Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

Unit-IV: **[10 Hrs]**

Cloud Computing Technologies: Broadband networks and internet architecture, data center technology, virtualization technology, web technology, multitenant technology, service technology

Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication, Ready-made environment

Text books:

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

Reference Books:

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

Sub Code: B18EE6051	Power System Planning and Reliability	L	T	P	C	CH
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To Introduce Concepts of Power System Planning 2. To Introduce Concepts of Load Forecasting 3. To Illustrate and Study The Concepts of Generation Planning 4. To Illustrate The Processes Of Transmission And Distribution Planning 5. To Introduce The Concepts of Demand Side Management & Energy Conservation 6. To Introduce The Concepts of Power System Reliability And Policies Involved					
Course Outcomes	On completion of this course the students will be able to: 1. Describe The Process Of Power System Planning and Load Forecasting 2. Visualize The Concepts Involved In Generation Planning 3. Realize The Importance Of Renovation And Modernization of Existing Power Plants 4. Identify The Objectives And Principles Involved In Transmission And Distribution Planning 5. Visualize The Concepts Of Power System Reliability 6. Describe The Concepts Pertaining To Financial And Techno – Economic Evaluation Of Power System					

COURSE CONTENTS

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

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

Unit 2: Generation Planning [12 Hrs]

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

Unit 3: Transmission & Distribution Planning [12 Hrs]

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

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

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE6052	**Modelling & Simulation of Electrical Machines**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To understand the concept of 2-axis representation of an Electrical machine. 2. To know the concepts of representing transfer function model of a DC machine. 3. To know the representation of 3-phase induction motor in various reference frames 4. To know the modeling of 3-phase synch. Motor in 2- axis representation. 5. An understanding of modeling and behavior of synchronous machines 6. To understand the importance reluctance motor and its principle					
Course Outcomes	Upon successful completion of this course, students will be able to 1. Determine the torque developed in a salient pole synchronous machine using the park's transformation and identify contribution of saliency torque-damping torque and excitation torque. 2. Determine the developed torque in an electrical machines using the concepts of filed energy and co-energy and determine the dynamic model of a DC Machine 3. Learn the different types of reference frame theories and transformation relationships. 4. Students understand the relationship between real and reactive power control with application to the equivalent circuit of a synchronous machines 5. Determine the torque developed in a salient pole synchronous machine using the park's transformation and identify contribution of saliency torque-damping torque and excitation torque. 6. Determine the dynamic model of an induction machine based on the					

	dq0 transformation and determine instantaneous torque developed in an induction machine-which leads to advanced control strategies such as vector control and direct torque control. 7. Familiarize the modeling of electrical machines through equivalent circuit parameters and understand the variation in load change.

COURSE CONTENT

Unit – I **[10 Hrs]**

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

Unit – II **[10 Hrs]**

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

Unit – III **[10 Hrs]**

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

Unit – IV **[10 Hrs]**

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

Text Books:

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

Reference Books:

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

Sub Code: B18EE6053	**Industrial Instrumentation and Automation**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. Learn about the types of transducers for industrial applications. 2. Bring out the various measurements involved in Power Plants. 3. Familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines & their control 4. Know about the tools like PLC, DCS, and SCADA					
Course Outcomes	On completion of this course the students will be able to: 1. Select instruments and transducers for various physical variables. 2. Get an insight on data acquisition, processing and monitoring system. 3. Design various signal conditioning systems for transducers. 4. Understand the programming realization of PLC					

COURSE CONTENTS

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

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

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

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

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

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

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

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

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

Unit 4: Introduction to Sequence Control [12hrs]

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

Text Books:

1. Curtis D. Johnson, 'Process Control Instrumentation Technology', 7th Edition, Pearson Edition, Pearson Education, New Delhi, 2002 / PHI.
2. DVS. Murthy, 'Transducers and Instrumentation' Second Edition, PHI Learning Pvt. Ltd New Delhi ,2013
3. K Krishnaswamy, M. Ponni Bala, 'Power Plant Instrumentation', Second Edition, PHI Learning Pvt. Ltd, New Delhi, 2013
4. Madhuchhanda Mitra, Samarjit Sengupta, 'Programmable Logic Controllers and Industrial Automation An Introduction', Penram International Publishing (India) Pvt. Ltd., 2009

Reference Books:

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

Sub Code: B18EE6054	**Fundamentals of Robotics**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	At the end of the course the student should be able to 1. Classify Robots and anatomy. 2. Actuators and Kinematics. 3. Sensors and vision systems used in robots. 4. Robot Programming.					
Course Outcomes	On completion of this course the students will be able to: 1. Summarize the basic applications and advantages of using robots in the industry.(a,b,c,d) 2. Do the robot motion analysis. (a,b,c) 3. Relate mathematical modeling in robots. .(a,b,c,d) 4. Recognize the different types of sensors and cameras used in the field of robotics. .(a,b,c,d) **5.** Write robot programs (a,b,c,d,e,.f)					

COURSE CONTENTS

UNIT-1: Introduction of Robotics [10hrs]

Introduction–Robot Anatomy– Common robot configurations, robot motions, Work Volume Robot drive systems, Control systems and Dynamic performance, Precision, end effectors, Basic control system concepts and models Robot Applications:- Manufacturing Industry, Agricultural, Medical, Military, Space exploration.

UNIT- 2: Sensors [12hrs]

Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor-encoders, tachometers, Acceleration sensors, Force and Pressure sensors piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors. Machine Vision systems : Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation.

UNIT- 3: Actuators and Kinematics [10hrs]

Comparison of hydraulic, electric, pneumatic actuators, Hydraulic actuators, Electric motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics. Rotation and Translation of robotics, Euler angle representation for xyz frames. Homogeneous Transformations.

UNIT- 4 : Robot Programming [10hrs]

Methods of Robot programming, A robot program as a path in space, methods of defining positions in space, motion interpolation, wait, signal and delay commands, branching, Robotic languages, constants variables and other data objects, motion command send effectors and sensor commands, program control and subroutines

TEXT BOOKS:

1. Mikell P Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Oderey, " Industrial Robotics", Technology, programming and Applications, McGraw Hill, USA 1986.
2. James G. Keramas, "Robot Technology Fundamentals" Cengage Learning, 1999

REFERENCE BOOKS:

1. Fu K. S., Gonzelez R. C., Lee C. S. G., Robotics: Control, Sensing, Vision, Intelligence" , McGraw Hill Book Co., International edition, 2008.
2. Yorem Koren, "Robotics for Engineers", McGraw-Hill Publication, International edition, 1987
3. Craig, J. J., "Introduction to Robotics: Mechanics and Control", Pearson Prentice-Hall Publications, 3rd edition, 2005.
4. Schilling R. J."Fundamentals of Robotics, Analysis and Control",, Prentice-Hall Publications, Eastern Economy edition, 2007
5. Appu Kuttan K. K., "Robotics" I.K. International Publications, First Edition, 2007

6. R. K. Mittal, I. J. Nagrath, "Robotics and Control" Tata-McGraw-Hill Publications, 2007.

Sub Code: B18EE6055	**Programming in Java**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		3	0	0	3	4
Course Objectives	1. Describe Java language syntax and semantics required for understanding Java programs (applets and applications) 2. Illustrate the usage of a Java-enabled browser and/or the applet viewer to execute Java applets along with Java Application Programming Interface and Java multi-class programs 3. Design, implement, test, and debug Java applications written using basic concepts such as primitive data types, various operators, control structures, single-subscripted arrays, and Java classes 4. Explain the Java applications written using applets and object-based programming techniques including classes, objects and inheritance					
Course Outcomes	On completion of this course the students will be able to: 1. Analyze the principles and concepts of object-oriented programming; 2. Use a Java-enabled browser and/or the applet viewer to execute Java applets 3. Use the Java interpreter to run Java applications 4. Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design. 5. Describe, modify and debug Java programs using primitive data types, various operators, control structures, single-subscripted arrays, multi-class and object-based programming techniques including classes, objects and inheritance					

COURSE CONTENTS

Unit 1: **[10hrs]**

Primitive Data Types and Arithmetic: Data, Data Storage, Identifiers, Syntax, Variables and Constants, the Format of a Simple Program, Arithmetic, Operator Precedence, Casting,

Objects: Introduction to Objects, The String Class, The Anatomy of a Simple Program Revisited, The AVI Package, The Window Class, Input to a Dialog Box, Converting Strings to Numbers, Command Line Arguments, Errors

Unit 2: **[12hrs]**

Object-Oriented Programming: Abstract Data Type, Constructors, Instance Methods, Class Methods, Scope and Lifetime of Identifiers, Software Development, Object-Oriented Program Design, the AVI Package Revisited

Selection: More AVI Classes, If..else Statement, Nested If Statement, Conditional Expressions, Else if Statements, Boolean Data Type, Switch, Wrapper Classes, Yet another AVI Class!, The This Object.

Unit 3: **[12hrs]**

Repetition and One-Dimensional Arrays: Loop Structure, While Loop, Do..while Loop, Increment/Decrement Operators, For Loop, Which Loop?, Arrays Revisited, Declaring and Initializing One-Dimensional Arrays, Using Arrays, Our Last AVI Class: Check Boxes, Formatting Numbers for Output

Advanced Concepts with Classes: Inheritance, An Example of Inheritance, Overriding Superclass Methods, Polymorphism, Instance of Operator, Shadowed Variables, Inner Classes, Abstract Methods and Classes, Interfaces, Constructors Revisited, Instance Methods Revisited, Object Properties, Comparing Objects, Copying Objects, Passing Objects as Parameters, Garbage Collection and Object Finalization

Unit 4: **[8hrs]**

Exceptions and Streams: Introduction, Exception Classes, Catching an Exception, Catching Multiple Exceptions, Creating Your Own Exception Class, Throwing an Exception, Finally Blocks, Using Exception Handling, Stream Input and Output, The Stream Tokenizer Class, Text File Processing, The File Dialog,

Text Books:

1. Barry J. Holmes and Daniel T. Joyce, 'Object-Oriented Programming With Java', second Edition, Jones and Bartlett Publishers,2000
2. Dale Skrien, 'Object-Oriented Design Using Java', McGraw-Hill Higher Education, 2009
3. Danny Poo, 'Object-Oriented Programming and Java', Second Edition, Springer, 2008

Reference Books:

1. Cay Horstmann, 'Big Java',2nd Edition, John Wiley and Sons
2. Herbert Schildt, 'The Complete Reference Java J2SE', 5th Edition, TMH Publishing Company Ltd, New Delhi
3. H.M. Dietel and P.J. Dietel, 'Java: How to Program', Sixth Edition, Pearson Education/PHI
4. Cay. S. Horstmann and Gary Cornell, 'Core Java 2, Vol 1, Fundamentals', Seventh Edition, Pearson Education/PHI
5. Iver Horton, 'Beginning in Java 2', Wrox Publications

Sub Code: B18EE6061	**Smart Grid**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure. 2. To familiarize the power quality management issues in Smart Grid. 3. To familiarize the high-performance computing for Smart Grid applications					
Course Outcomes	On completion of this course 1. Students will develop more understanding on the concepts of Smart Grid and its present developments. 2. Students will study about different Smart Grid technologies. 3. Students will acquire knowledge about different smart meters and advanced metering infrastructure. 4. Students will have knowledge on power quality management in Smart Grids 5. Students will develop more understanding on LAN, WAN and Cloud					

	Computing for Smart Grid applications.

COURSE CONTENTS

UNIT – I

Introduction to Smart Grid **[12Hrs]**

Concept of Smart Grid, Definitions, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Smart Grid Vision & Roadmap for India, Present development & International policies in Smart Grid, Smart Cities, Pilot projects in India.

Smart Grid Technologies: Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Phase Measurement Unit (PMU). Smart Substations, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid (V2G), Grid to vehicles (G2V),

UNIT – II

Smart Meters and Advance Metering Infrastructure **[12Hrs]**

Introduction to Smart Meters, Advanced Metering Infrastructure (AMI), Real Time Prizing, Automatic Meter Reading (AMR), Outage Management System (OMS) Smart Sensors, Smart Appliances, Home & Building Automation, Geographic Information System (GIS). Smart storage technologies: Battery (flow and advanced), SMES, Super Capacitors, Pumped Hydro, Compressed Air Energy Storage (CAES) and its comparison.

UNIT – III **[12Hrs]**

Microgrids

Concept of Microgrid, need & applications of Microgrid, Microgrid Architecture, DC Microgrid, Formation of Microgrid, Issues of interconnection, protection & control of Microgrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Smart Microgrid Renewable Green Energy System, modelling of PV and wind systems, islanding

UNIT – IV

Communication Technology for Smart Grid **[12Hrs]**

Communication Architecture of SG, Wide Area Measurement System (WAMS), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols.

Text books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable
2. Energy in Electric Power Systems", Wiley
3. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand
4. Response", CRC Press.
5. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama,
6. "Smart Grid: Technology and Applications", Wiley Publications.
7. Stuart Borlase, "Smart Grids-Infrastructure, Technology and Solutions", CRC Press,

8. Taylor and Francis group
9. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart
10. Grid Technology and applications", Wiley Publications.
11. James Momoh, "Smart Grid-Fundamentals of design and analysis", Wiley Publications.

Reference books:

1. Nikos Ziargyriour, "Micro grid, Architecture and Control", IEEE Press, Wiley Publications.
2. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, Taylor and Francis group.
3. Lars T. Berger and Krzysztof Iniewski, "Smart Grid-Applications, Communications and Security", Wiley Publications.
4. Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert, "Substation Automation (Power Electronics and Power Systems)", Springer Publications.
5. Stephen F. Bush, "Smart Grid-Communication Enabled Intelligence for the Electric Power Grid", IEEE Press, Wiley Publications
6. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication.

Sub Code: B18EE6062	**Reactive Power Management**	**L**	**T**	**P**	**C**	**CH**
Duration:14 weeks		3	0	0	3	4
Pre Requisites	Power system, Power quality, Power Electronics					
Course Objectives	1. To understand the need for reactive power Compensation. 2. To understand the various types of Compensators for reactive power management. 3. To focus on reactive power co-ordination and management of reactive of reactive power in Distribution side.					
Course Outcome	On successful completion of the course, student will be able to 1. Identify different methods of reactive power compensation types of load patterns and loss reduction methods in distribution lines. 2. Analyze different types of compensations. 3. Identify the quality of power supply and reactive power coordination. 4. Analyze reactive power management in Distribution side.					

Course contents

UNIT-I: Reactive power compensation [10Hrs]

Need for Reactive Power compensation – reactive power characteristics. Ideal compensator, Practical compensation – power factor correction and voltage regulation in single phase system, phase balancing and power factor correction of unsymmetrical loads– examples

UNIT-II: Passive and active compensators [12Hrs]

Introduction, Uniformly distributed fixed compensation, Passive shunt compensation, Control of open circuit voltage by shunt reactance, Reactance of shunt reactors, multiple shunt reactors along the line.
Series compensation: Objectives and practical limitations, Symmetrical line with mid-point series capacitor and shunt reactor, Power transfer characteristics and maximum transmissible power for a general case, Fundamental concepts of compensation by sectioning. Principles of Static Compensation: Principle of operation of thyristor controlled reactor, Thyristors switched capacitor. Series Capacitors: Introduction, protective gear, reinsertion schemes, Varistor protective gear

UNIT-III: Reactive power coordination [10Hrs]
Reactive power coordination: Objective, Mathematical modeling, Operation planning, transmission benefits. Basic concepts of quality of power supply: Disturbances, steady – state variations, effects of under voltages, frequency, Harmonics, radio frequency and electromagnetic interferences.

UNIT-IV: reactive power management [10Hrs]
Demand side management: Load patterns, basic methods of load shaping, power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.
Distribution side Management: System losses, loss reduction methods, examples, Reactive power planning: Objectives, Economic Planning, capacitor placement and retrofitting of capacitor banks.

TEXT BOOKS:

1. T.J.E. Miller, Reactive power control in Electric power systems, John Wiley and Sons, 1982
2. D.M. Tagare, Reactive power Management, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

REFERENCE BOOKS:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, Reactive Power Compensation: A Practical Guide, Wiley, April, 2012.
2. Power System Stability and Control, P. Kundur, TMH, 9th reprint, 2007.
3. Power System Voltage Stability, Carson. W. Taylor, McGraw-Hill, Inc.

Sub Code: B18EE6063	**Advanced Electrical Machines**	**L**	**T**	**P**	**C**	**CH**
Duration:14 weeks		3	0	0	3	4
Course Objectives	1. Know the concepts of Special type of electrical machines. 2. Learn about the different sensors used in Brushless DC Motors 3. Draw the characteristics of special type electrical machines 4. Understand the different control schemes for and PMSM **5.** Model the electrical machines with voltage, current, torque and speed equations.					
Course Outcome	On successful completion of the course, student will be able to 1. Analyze the characteristics of different types of PM type Brushless DC motors and to design suitable controllers 2. Apply the knowledge of sensors used in PMSM which can be					

	used for controllers and synchronous machines. 3. Evaluate the steady state and transient behavior Linear induction motors 4. Analyze the different controllers used in electrical machines to propose the suitability of drives for different industrial applications. 5. Classify the types of DC Linear motors and apply the knowledge of controllers to propose their applications in real world

Course contents

UNIT I: Polyphase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power) **[10Hrs]**

UNIT II: Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications. Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits. **[10Hrs]**

UNIT III: Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PMAC motors, brushless dc motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators. **[10Hrs]**

UNIT IV: Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, linear force, and applications. **[10Hrs]**

Text Books:

1. T.J.E. Miller – Brushless PM and Reluctance Motor Drives, clarendon Press Oxford
2. Jacek Gierasewing - P. M. motor technology, Marcel Dekker.
3. R. Krishnan – Electric Motor Drives, PHI.

References:

1. P.S. Bimbhra "Generalized Theory of Electrical Machines" Khanna Publishers.
2. P.C. Sen "Principles of Electrical Machines and Power Electronics" John Wiley & Sons, 2001
3. G.K. Dubey "Fundamentals of Electric Drives" Narosa Publishing House, 2001

Sub Code: B18EE6064	**Analog and Digital Communication Systems**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. To introduce analog communication and learn the techniques of amplitude modulation and single side band modulation of analog wave 2. To learn vestigial and frequency modulation techniques of analog wave 3. To introduce to digital communication					

	4. To learn digital waveform coding techniques
Course Outcomes	After completion of the course, the student shall able to: 1. Describe and Differentiate different modulators of AM , DSBSC, SSB 2. Describe and Differentiate VSB and FM modulation schemes 3. Able to understand the fundamentals of digital communication schemes 4. Employ various digital waveform digital coding and modulation schemes

Course contents

PART A: ANALOG COMUNICATION

Unit-1: Amplitude Modulation & Single Side Band Modulation (SSB) [11 Hrs]

Introduction, AM: Time-Domain Description, Frequency – Domain Description. Generation of AM Wave: Square Law Modulator. Detection of AM Waves: Square Law Detector. Double Side Band Suppressed Carrier Modulation (DSBSC): Time Domain Description, Frequency-Domain Representation, and Generation of DSBSC Waves: Balanced Modulator. Coherent Detection of DSBSC Modulated Waves. Single Side-Band Modulation, Frequency-Domain Description of SSB Wave, Phase Discrimination Method for Generating an SSB Modulated Wave. Demodulation of SSB Waves

Unit-2: Vestigial Side Band Modulation (VSB) & Frequency Modulation (FM) [10 Hrs]

VSB: Frequency Domain Description, Generation of VSB Modulated Wave, Coherent detection of VSB

FM: Basic Definitions, FM, Narrow Band FM, Wide Band FM, Transmission Bandwidth of FM Waves, Generation of FM Waves: Indirect FM And Direct FM. Demodulation of FM Wave- Balanced Frequency discriminator.

PART B: DIGITAL COMMUNICATION

Unit 3: Digital Communication Fundamentals [11 Hrs]

Digital communication-advantage, medium of transmission, block diagram of digital communication, Sampling theorem, Natural sampling, Flat top sampling, sample and hold circuit, Quadrature sampling of band pass signal, Quantization noise and SNR.

Unit 4: Waveform Coding and Digital Modulation Techniques [10 Hrs]

Waveform Coding Techniques: Time division multiplexing, Line coding , Differential pulse code modulation, Delta modulation, Adaptive delta modulation, Coding speech at Low bit rate, Introduction of Delta modulation errors (granular and slope overload).

Digital Modulation Techniques: Pulse Code Modulation, Coherent binary modulation techniques with constellation diagrams-Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Multiple access-TDMA, FDMA, CDMA

TEXT BOOKS:

1. Simon Haykins, “An Introduction to Analog and Digital Communication”, John Wiley, 2003
2. Simon Haykin, “Digital Communication Systems”, John Wiley publication, 3rd edition, 2008

3. Simon Haykins, “Communication Systems”, John Willey, 3rd Edition, 1996

REFERENCE BOOKS:

1. Simon Haykin, “Digital and Analog Communication Systems”, John Wiley publication, 3 rd edition, 2008.
2. K. Sam Shanmugam, “An introduction to analog and digital Communication system”, John Wiley publication, 3rd edition, 2008.
3. Bernad Sklar, “Digital Communication”, Pearson education 2007. 4. T L Singal, “Digital Communication”, McGraw Hill Education 2015
4. B. P. Lathi, “Modern digital and analog Communication systems”, Oxford University press, 3rd Edition, 2005.

Sub Code: B18EE6065	**Cryptography & Network Security**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		3	0	0	3	4
Course Objectives	1. Explain the concepts of Cyber security 2. Illustrate key management issues and solutions. 3. Familiarize with Cryptography and very essential algorithms					
Course Outcomes	On completion of this course the students will be able to: 1. Discuss cryptography and its need to various applications 2. Design and develop simple cryptography algorithms 3. Understand cyber security and need cyber Law					

Course Contents

Unit-1: **[10 Hrs]**

Introduction - Cyber Attacks, Defense Strategies and Techniques, Guiding Principles, Mathematical Background for Cryptography - Modulo Arithmetic’s, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem, Basics of Cryptography - Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties, Secret Key Cryptography – Product Ciphers, DES Construction, Modes of Operation, MAC and Other Applications, Attacks, Linear Cryptanalysis

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

Public Key Cryptography and RSA – RSA Operations, Why Does RSA Work?, Performance, Applications, Practical Issues, Public Key Cryptography Standard (PKCS), Cryptographic ash - Introduction, Properties, Construction, Applications and Performance, The Birthday Attack,

Discrete Logarithm and its Applications - Introduction, Diffie-Hellman Key Exchange, Other Applications, Elliptic Curve Cryptography and Advanced Encryption Standard - Elliptic urve Cryptography, Applications, Practical Considerations, Advanced Encryption Standard (AES).

Unit-3: **[10 Hrs]**

Key Management - Introduction, Digital Certificates, Public Key Infrastructure, Identity–ased Encryption, Authentication–I - One way Authentication, Mutual Authentication, Dictionary Attacks, Authentication– II – Centralized Authentication, The Needham-Schroeder Protocol, Kerberos, Biometrics, IPSec-Security at the Network Layer – Security at Different layers: Pros and Cons, IPSec in Action, Internet Key Exchange (IKE) Protocol, Security Policy and IPSEC, Virtual Private Networks, Security at the Transport Layer - Introduction, SSL Handshake Protocol, SSL Record Layer Protocol, Open SSL**.**

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

IEEE 802.11 Wireless LAN Security - Background, Authentication, Confidentiality and Integrity, Viruses, Worms, and Other Malware -Preliminaries Viruses, Worm Features, Internet Scanning Worms, Topological Worms, Web Worms and Case Study, Firewalls – Basics, Practical Issues, Intrusion Prevention and Detection - Introduction, Prevention Versus Detection, Types of Instruction Detection Systems, DDoS Attacks Prevention/Detection, Web Service Security – Motivation, Technologies for Web Services, WS- Security, SAML, Other Standards.

Text Books:

1. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition

Reference Books:

1. Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay, Mc-GrawHill, 3rdEdition, 2015
2. Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition
3. Cyber Law simplified- Vivek Sood, Mc-GrawHill, 11threprint , 2013
4. Cyber security and Cyber Laws, Alfred Basta, NadineBasta, Mary brown, ravindra kumar, Cengage learning

Sub Code: B18EE6070	**Power System Simulation Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		0	0	2	2	3
Prerequisites:	Knowledge of transmission and distribution systems, computer techniques for power system analysis, power system analysis and stability.					
Course Objectives	1. To provide basic knowledge of software packages like MATLAB and MIPOWER for power system studies. 2. To adopt the coding skill to build the mathematical models of power system blocks. 3. To adopt the studied theoretical concepts of transmission and distribution systems for calculation of Ybus, and ABCD parameter calculation. 4. To study the stability issues of electrical machines. 5. To provide the basic knowledge of load flow analysis. 6. To equip students with the knowledge of fault and transient stability analysis.					

	7. To enable the students to evaluate the different generation systems for economic operation.
Course Outcomes	After completion of the course, the student shall able to: 1. Express the real world problems into mathematical models 2. Evaluate the given case study to get the desired results. 3. Apply theoretical concepts to get transmission and distribution system models. 4. Interpret the result of stability analysis. 5. Write the coding for different load flow analysis techniques and also able to verify the results using MIPOWER software. 6. Discuss optimal scheduling of thermal power plants on the base of results from MIPOWER Software.

List of lab experiments:

1. Y Bus formation for power systems with and without mutual coupling, by singular transformation.
2. Y Bus formation for power systems by inspection method .
3. ABCD parameters: Formation for symmetric π/T configuration. Verification of AD-BC=1 Determination of efficiency and regulation
4. Determination of power angle diagrams, reluctance power, excitation, emf and regulation for salient and non-salient pole synchronous machines.
5. To obtain swing curve and to determine critical clearing time and regulation for a single machine connected to infinity bus through a pair of identical transmission lines under 3-phase fault on one of the lines for variation of inertia constant/line parameters /fault location/clearing time/pre-fault electrical output.
6. Write a program to perform load flow analysis for GS

Using Mipower Software

1. Load flow analysis using Gauss Siedel method, NR method for both PQ and PV buses.
2. Load flow analysis using fast decoupled method for both PQ and PV buses.
3. Symmetrical and unsymmetrical fault analysis
4. Transient stability analysis.

Sub Code: B18EE6080	**Control System Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Weeks		0	0	2	2	3
Course Objectives:	1. To enable students to understand the usage of discrete components and operation of measuring and testing equipment. 2. To give an insight into usage of software packages like MATLAB/SCILAB for the realization of physical modules without actually exciting them. 3. To enable the student to understand the importance of transfer function in control system					
Course outcomes:	At the end of this course, Student will be able to: 1. Be able to understand the usage of measuring and testing equipment for different applications. 2. Be able to feel the hands on experience. 3. Be able to learn to formulate mathematical models for other physical					

	quantities

List of Experiments:

1. a) Design and test a second order system RLC circuit for a given natural frequency ω_n and damping ratio ζ

   b) Determine experimentally the various performance parameters of a second order system and compare it with theoretical and simulated values.
2. To determine experimentally the frequency response of a second-order system and evaluation of frequency domain specifications.
3. Estimate the effect of open loop gain on the stability and transient response of closed loop system by using Root locus
4. Study the effect of P, PI, PD and PID controller on the step response of a feedback control system (using control engineering trainer/process control simulator). Verify the same by simulation.
5. Using MATLAB/SCILAB examine the relationships between open loop frequency and closed loop transient response
6. Design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response.
7. Design RC lag compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response.
8. Design RC lag-lead compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response.
9. a) Conduct an experiment to draw the speed – torque characteristic of a two - phase A.C. servomotor.

   b) Conduct an experiment to draw speed torque characteristic of a D.C. servomotor.
10. Using MATLAB/SCILAB verify the effect of the input wave form and system type on steady state errors.
11. Conduct an experiment to draw to synchro-pair characteristics

Course Code	**Soft Skill**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs./Wk.**
B18EE6090		RULO	2	0	0	2	2

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

Sub Code: **B18EE6X20**	**MOOC / SWAYAM**	**L**	**T**	**P**	**C**	**CH**
		2	0	0	2	2

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

MOOC/ SWAYAM:

Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses.

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

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

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

Course Code	Skill Development	Course Type	L	T	P	C	Hrs./Wk.
B18EE6X20		RULO	1	0	1	2	2

VII Semester

Sub Code: B18EE7010	Project Phase – I	L	T	P	C	CH
Duration: 14 Weeks		0	1	1	2	2
Course Objectives	1. To Articulate a clear research question or problem and formulate a hypothesis 2. To identify and demonstrate appropriate research methodologies and know when to use them 3. To define, articulate and use terminology, concepts, and theory in their field and know how to use them 4. To use library and other tools to search for existing body of research relevant to their topic 5. To know existing body of research relevant to their topic and explain how their project fits 6. To identify and practice research ethics and responsible to conduct in research					
Course Outcomes	On completion of this course the students will be able to: 1. Define research problem and formulate the hypothesis 2. Demonstrate research methodologies 3. Define terminology and understand the concepts related to the same 4. Do rigorous literature survey based on the problem defined 5. Compare the existing body of research and their proposed work 6. Practice research ethics 7. To document the problem definition, objectives and research methodology chosen to proceed in the form of Synopsis					

GUIDELINES

Guidelines for the preparation of the Report: As per the University Guidelines

Guidelines for the Evaluation:

1. Student has to submit a synopsis and give the preliminary presentation during C1 which carries 20% of the total marks
2. Students has to submit a report which is the documentation of the literature survey carried out and need to give a presentation of the project work , during C2, which carries 20% of the total marks
3. Students has to submit Project phase 1 report and need to give a presentation of the project work, during C3, which carries 60% of the total marks
4. All the above reports must undergo a plagiarism check which should not exceed 25% and failing which lead to resubmission.

Sub Code: B18EE7020	Computer Aided Electrical Drawing	L	T	P	C	CH
Duration: 14 Weeks		2	0	1	3	5
Course Objectives	1. To understand the basics of concept of engineering drawing through AUTO CAD software. 2. To provide an overview of various sectional views of electrical machines. 3. To understand the basic sense of measurement.					

	4. To provide an insight into various dimensions of equipment used in transmission and distribution.
Course Outcomes	On completion of this course the students will be able to: 1. Work with Auto CAD 2D classic and execute the basic commands of auto cad software 2. Draw the isometric and orthographic views of given objects 3. Draw the sectional views of Electrical Machines 4. Differentiate between single and three phase systems 5. Implement the knowledge of CAD and EE drawing in design of real time application

COURSE CONTENTS

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

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

Unit 2: Electrical Machines [12 Hrs]

Electrical machine assembly drawing using designs data or sketches or both.

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

Unit 3: Winding diagrams [12 Hrs]

Developed winding diagrams of D.C. machines – Simplex and multiplex double layer Lap and Wave windings. Developed winding diagrams of A.C. machines Integral and Fractional slot double layer Lap and Wave windings.

Unit 4: Diagrams of Transmission & Distribution Equipment's [12 Hrs]

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

Text Books :

1. M Yogesh, BS Nagaraja, N Nandan, 'Computer Aided Electrical Drawing', First edition PHI 2014

2. SF Devalapur, 'Electrical Drafting', EBP, Seventh edition, 2006

Reference Books :

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

Sub Code: B18EE7031	**Advanced Control Engineering**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	1. To Understand the basics of mathematical modeling 2. To model any given system using state variable method 3. To obtain the transfer function from the state model, Eigen values and Eigen vectors of the given system 4. To test the controllability & observability of the given system 5. To determine the stability of the given non-linear system by Liapunov's methods					
Course Outcomes	On completion of this course the students will be able to: 1. Construct the state model of any given system by using phase variables and physical variables 2. Estimate Eigen values and Eigen vectors for the given system. Also determine transfer function from the state model 3. Test the controllability & observability of the given system 4. Determine the stability of the given non-linear system by Liapunov's methods					

COURSE CONTENTS

Unit 1: Modern Control Theory **[12 Hrs]**

Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems: State space representation using physical-phase and canonical variables, Characteristic equation - Eigen values and Eigen vectors - Invariance of Eigen values -Diagonalization - Jordan Canonical form

Unit 2: System Response **[10 Hrs]**

Transfer function from state model - Transfer matrix - Decomposition of transfer functions Direct, cascade and parallel decomposition techniques - State transition matrix computation- Solution of state equation

Unit 3: System Models **[08 Hrs]**

Concepts of controllability and observability - Kalman's and Gilbert's tests - Controllable and observable phase variable forms

Unit 4: Liapunov's stability **[10 Hrs]**

Liapunov stability analysis - Stability in the sense of Liapunov - Definiteness of Scalar Functions – Quadratic forms - Second method of Liapunov - Liapunov stability analysis of linear time invariant systems

Text Books:

1. Katsuhiko Ogata, 'Modern Control Engineering', Prentice Hall of India Private Ltd., New Delhi, Third Edition, 2002.
2. Nagrath I J and Gopal M, 'Control Systems Engineering', New Age International Publisher, New Delhi, 2006.
3. Gopal M, 'Digital Control and State Variable Methods', Tata McGraw-Hill Publishing Company Limited, New Delhi, India, Second Edition, 2003.
4. Nise S Norman, 'Control Systems Engineering', John Wiley & Sons, Inc, Delhi, Third edition, 2000.
5. Benjamin C Kuo, 'Automatic Control Systems', John Wiley & Sons, Inc., Delhi, 2002.

Reference Books:

1. Vidyasagar .M, 'Nonlinear system analysis', Prentice Hall Inc., New Jersey 2002
2. Singiresu S. Rao, 'Applied Numerical Methods', Prentice Hall, Upper Saddle River, New Jersey, 2001.
3. Jean-Jacques E. Slotine, Weiping Li, 'Applied Nonlinear Control', Prentice Hall Inc., New Jersey, 2004.

Sub Code: B18EE7032	**Electrical Energy Conservation**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	1. To understand the present energy scenario of energy generation and to understand the gap between energy supply & demand 2. To make students to understand the need for energy conservation to save the primary fuel for future generation and also to reduce the environmental burden. 3. To provide an overview of various energy conservation opportunities for electrical equipment. 4. To study the importance of energy conservation for reduction of environmental burden. 5. To understand the importance of energy security and energy growth by implementation of energy conservation measures					
Course Outcomes	On completion of this course the students will be able to: 1. Understand the energy losses in different equipment and control the losses 2. Develop capability in measurement and analysis of data to conserve energy. 3. Conduct performance test on electrical equipment and calculate the energy efficiency of equipment. 4. Develop the awareness on controlling of environmental pollution through implementing energy conservation measures. 5. Become an energy auditor and conduct energy audit					

COURSE CONTENTS

Unit 1: Energy management **[12 Hrs]**

Energy sources, Types of Energy generation systems, Primary fuel and secondary fuel, Gap between energy supply and demand, Energy Conservation Act 2001, Energy audit, Types of energy audits, Preliminary energy audit, Detailed energy audit, Instruments used for energy audit, Energy conservation opportunities, Classification of energy conservation measures, Energy economic feasibility study, simple payback period, time value of money, cash flow, cost to benefit ratio, Reduction of environmental pollution, Energy audit reporting, Star labeling of electrical appliances and problems.

Unit 2: Demand and Power factor management [10 Hrs]

Demand management and Power factor management: Maximum demand, two part tariff, demand controller, concept and application of TOD metering system, smoothening of demand curve, fixed reactive power compensation, automatic reactive power compensation, APFC panels, economics of reactive power compensation and problems

Unit 3: Illumination system [10 Hrs]

Types of lamps used, principle of discharge lamps, performance of fluorescent lamps, compact fluorescent lamps, Lamps efficacy, Colour rendering index (CRI), Installed load efficacy ration (ILER), Types of street lights, Sizing of lighting equipments, Conventional coil wound ballasts, Electronic ballasts, Effect of voltage variation on lighting equipment, illumination level for different applications, LED lighting system and problems.

Unit 4: Electric Equipment [12 Hrs]

Energy conservation in motors: load factor, speed, efficiency, power factor, energy efficient motor, different speed control techniques, variable frequency drives, soft starters, rewinding of motors, and variation of power supply parameters like voltage variation, voltage unbalance and problems.

Energy conservation in transformers: Voltage ratio, loading of transformers, on-load & off load tap changers, power factor on secondary, unbalanced load on secondary, transformer management and problems.

Energy conservation in Air-conditioning system and Air compressors

Text Books & Reference Books:

1. S. Rao and B.B. Parulekar, 'Energy Technology', 4th edition, Khanna Publishers, 2005.
2. Eastop & Croft D.P, 'Energy Efficiency for Engineers and Technologist', Logman Scintific & Technical, ISBN-0-582-03184, 1990.
3. Reay D.A., 'Industrial Energy Conservation', 1st edition, Pergaman Press, 1977.
4. Amit K. Tyagi, 'Handbook on Energy Audits and Management', TERI, 2003.
5. J.B. Gupta, 'Generation, transmission and utilization of electric power', Kataria Publication, New Delhi, 1986.

Sub Code: B18EE7033	**Computer Control of Electrical Drives**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Prerequisites	Mathematics, Industrial drives (DC & AC Drives), Power Electronics					
Course Objectives	1. Concept of development of microcomputer control of drives 2. Explain the architectural features of micro computers and digital implementation of drives 3. Discuss different types of compensators, digital firing schemes for					

	power electronic devices. 4. Discuss micro controllers and micro computers for the control of AC/DC drives. 5. Simulate/Use power electronic devices for control of drives
Course Outcomes	1. Acquire knowledge on micro-computer control of various AC-DC Drives 2. Acquire knowledge on different types of digital firing schemes and compensators for power electronic devices. 3. Apply the knowledge of microcomputers and microcontrollers for the control of drives

Course Contents:

UNIT-I: Micro-Controllers in Electrical Drives [10hrs]

Merits and demerits of Microcomputer Control of Electric Drives, The Microcomputers adopted for control of electrical drives, relative features and architecture, Review of power converters useful for DC and AC drives (GTO, BJT, MOSFET, IGBT, MCT, IGCT), ratings, comparison and their applications, sensing circuits required for microprocessor based control (voltage, current, frequency and speed), Block diagram of power integrated circuit for DC Motor drives.

UNIT-II: AC Motor Drives [10hrs]

General classification and National Electrical manufacturer Association (NEMA) classification,

special control of induction motors with variable voltage, constant frequency, constant voltage variable frequency, (V/f) constant operation, drive operating regions, Microcomputer control of current source fed synchronous motor drive, digital firing circuit , optical encoder , four quadrant operation of synchronous motor drive .

UNIT-III: Microcontroller Control of Drives [12hrs]

Different types of Digital firing schemes for converters, Microcomputer control of converter fed DC motor drives (Digital Leonard control system), Automatic current regulating loop , automatic speed regulating loop and over all algorithm , Basic principle of vector control of Induction motors, phasor diagram and digital block diagram, microcomputer control of vector control of Induction motor. Electromagnetic interference (EMI) and line power quality problems

UNIT-IV: Expert System Based Control of Drives [10hrs]

(Only block diagram approach) Expert System shell, design methodology, ES based P-I tuning of vector controlled drive system, Fuzzy logic control for speed controller in vector control drives structure of fuzzy control in feedback system.

Text Books & References:

1. "A Microcomputer Control of Power Electronics and Drives", B.K Bose, 1987 edition, IEEE press.
2. "Power Electronics and Variable Frequency Drives Technology and Applications", B K Bose, IEEE Press, 1997.
3. Badri Ram "Fundamentals of Microprocessors and Applications", Dhanpat Rai, 2001.
4. W. Leonard "Control of Electric Drives", Springer Verlag, 2001.

5. Haitham Abu-Rub, Atif Iqbal, Jaroslaw Guzinski "High Performance Control of AC Drives", Wiley, 2012

Sub Code: B18EE7034	Advanced Microcontrollers	L	T	P	C	CH
Duration: 14 Weeks		2	1	0	3	3
Prerequisites:	Basics of computer organization, basics of ALP and C programming.					
Course Objectives	1. Understand the architectural features and instruction set of MSP430, Arduino and ARM Cortex M3. 2. Program MSP430,Arduino and ARM Cortex M3 using the various instructions and C language for different applications. 3. To demonstrate the interfacing of various devices to the microcontrollers					
Course Outcomes	On completion of this course the students will be able to: 1. To recognize the architecture MSP430 microcontroller. 2. To program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled using the microcontroller. 3. To develop the ability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller. 4. Apply the knowledge gained for Programming Arduino for different applications. 5. Describe the architectural features and instructions of 32 bit microcontroller ARMCortex M3. 6. Apply the knowledge gained for Programming ARM Cortex M3 for different application					

Course Contents:

UNIT-I: MSP430 Microcontroller [11hrs]

MSP430 Architecture: Introduction –Where does the MSP430 fit, outside view, inside view-Functional block diagram, Memory, Central Processing Unit, Memory Mapped Input and Output, Clock Generator,
Exceptions: Interrupts and Resets, MSP430 family.
Addressing Modes & Instruction Set-Addressing Modes, Instruction set**,** Constant Generator and Emulated Instructions, Program Examples.

UNIT-II: Arduino Microcontroller [11hrs]

Arduino Hardware, software tool, Programming and Applications: Introduction -Arduino IDE tool and family of Arduino boards, Getting Started with IDE, Making the Sketch Do Your Bidding, Mathematical Operators, Serial Communications, Simple Digital and Analog Input, Getting Input from Sensors, Physical Output **.**

UNIT III: Arm Microcontroller [11hrs]

ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM,
Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence

UNIT-IV: ARM Cortex M3 Instruction Sets and Programming: [10 hrs]

Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming.

Text Books:

1. John Davies, "MSP430 Microcontroller Basics", Elsevier, 2010 (Indian edition available).
2. Michael Margolis, "Arduino Cookbook", 2nd –Edition , 2013,Publisher:O'reilly Media Inc,ISBN:978-1-449-31387-6
3. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", 2nd Edition, Newnes,

Sub Code: B18EE7035	**Software Testing**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Wks		2	1	0	3	3
Prerequisites	Software Engineering					
Course Objectives	1. To describe various terminologies of software engineering and testing. 2. To examine fundamental software processes and the activities involved. 3. To understand various software process models and the process activities involved in software engineering and system engineering. 4. To enable students distinguish between verification and validation process in software. 5. To understand the black box testing strategy.					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the terminologies of software engineering and testing 2. Apply the principles of Professional and ethical responsibilities in software engineering practices. 3. Understand various software process models and the process activities involved in software engineering and system engineering. 4. Distinguish between verification and validation process in software. 5. Understand the black box testing strategy.					

Course Contents: This course introduces to the concept of software engineering and the contribution of software testing towards it. It examines fundamental software processes and the activities involved in it. This course emphasises the need for the software testing, especially with regard to critical system. The process of verification and validation and the

different types of testing done on a system is introduced. The process of black box testing is introduced and described briefly.

COURSE CONTENTS:

Unit 1 **[12 Hrs]**

Introduction: Definition and terminology used in software engineering and software testing, FAQs in Software engineering, Professional and ethical responsibility, Socio-Technical systems-emergent properties, Systems engineering.

Software processes: Software process models-waterfall model, evolutionary, CBSE, process activities

Unit 2 **[12 Hrs]**

Software Testing: Psychology of testing, economics of testing, software testing principles. principles of SDLC and Testing, Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies.

Examples: Generalized pseudocode, the triangle problem, the commission problem, The SATM system.

Unit 3 **[12 Hrs]**

Verification & Validation: definitions of V & V, planning V &V, software inspection.

Software testing –system testing, - integration testing, release testing, performance testing; component testing – interface testing.

Unit 4 **[12 Hrs]**

Black box testing techniques: Boundary value analysis, Robustness testing, worst case testing-triangle problem. Equivalence partitioning- classes, triangle problem, Decision table-technique-triangle problem.

Self-learning component:

White box testing, automated testing tools

Recommended Learning Resources (Text books):

1. Ian Summerville; Software Engineering; 8th Edition; Pearson Education; 2007.(unit 1,3)
2. Glenford J. Myers, The Art of Software Testing, John Wiley & Sons 1979 (unit 2)
3. P.C. Jorgensen, Software Testing A Craftman s Approach , CRC Press 1995(unit 2,4)

Recommended Learning Resources (Reference books):

1. William E. Perry, Effective Methods for Software Testing (2nd Edition), John Wiley & Sons 2000.
2. Boris Beizer, Software Testing Techniques (2nd Edition) , Van Nostrand Reinhold1990.

Sub Code: B18EE7041	HVDC	L	T	P	C	CH
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	1. To understand the basic concepts underlying High Voltage dc Transmission. 2. To introduce the various topologies of the power electronics circuits 3. To emphasize the significance of HVDC Transmission and its modern trends and applications. 4. To educate the general principle of HVDC control and harmonic elimination in HVDC Systems					
Course Outcomes	On completion of this course the students will be able to: 1. Identify significance of DC over AC transmission system, types and application of HVDC links in practical power systems. 2. Understand the operation of HVDC conversion technology. 3. Analyze different converters.3, 6 and 12 pulse converter. 4. Analyze AC/DC system interactions and know the operation and control of various MTDC systems. 5. Model AC/DC system and protection for HVDC system against transient overvoltage and over currents apply					

COURSE CONTENTS

UNIT I INTRODUCTION [10Hrs]

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems

UNIT II ANALYSIS OF HVDC CONVERTERS [10Hrs]

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes

UNIT III CONVERTER AND HVDC SYSTEM CONTROL [10Hrs]

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS [10Hrs]

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – Modeling of DC/AC converters, Controller Equations-Solutions of AC/DC load flow —Simultaneous method-Sequential method. case study.

TEXT BOOKS & REFERENCES:

1. HVDC Power Transmission Systems: Technology and system Interactions, K.R. Padiyar, New Age International (P) Limited.
2. J Arrillaga, "*High Voltage Direct current Transmission*", Peter Peregrinus Ltd, UK.
3. EW Kimbark, "*Direct Current Transmission*", Wiley-Interscience, New York.

4. HVDC Transmission, S. Kamakshaiah, V. Kamaraju, The McGraw Hill Companies.

Sub Code: B18EE7042	**Operation & Control of Power Systems**	**L**	**T**	**P**	**C**	**CH**
Duration:		2	1	0	3	3
Pre Requisites	Power system Analysis, Computer Techniques in Power system analysis & Stability					
Course Objectives	1. To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models and Load Frequency Control (LFC). 2. To provide the knowledge of Economic Operation & Unit Commitment used in the power system. 3. To provide the knowledge of Power System security & state estimation. 4. To provide the knowledge of SCADA and the concepts of Deregulation					
Course Outcome	On successful completion of the course, student will be able to: 1. Model and design the Components for generator Control loops. 2. Understand the importance of economic operation & Unit Commitment in power system. 3. Understand the different techniques used to provide security to power system. 4. Understand about SCADA system, Electricity market &power system de-regulation.					

COURSE CONTENTS

Unit-1: Automatic Generation Control [11Hrs]

Automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model. Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of A VR, ALFC of single area systems, concept of control area, multi-area systems, POOL operation-two area systems, tie-line bias control.

Unit-2: Economic Operation of Power Systems & Unit commitment [11Hrs]

Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Iterative techniques; Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula,
Statement of the Unit Commitment problem, need and importance of unit commitment, Constraint in Unit Commitment, Unit Commitment solution methods-Priority lists method, Forward Dynamic Programming method(excluding problem), Spinning reserve.

Unit-3: Power System security [6Hrs]

Introduction, factors affecting power system security, Security analysis, Contingency Selection, Techniques for contingency evaluation-D.C. load flow and fast decoupled load flow.

System Monitoring & Control **[6Hrs]**

Introduction , Basis of power system state estimation(PSSE), mathematical description of PSSE process, minimization technique for PSSE, Least Square estimation, Error and detection in PSSE, System security and emergency control.

Unit 4: SCADA and Power System De-Regulation **[8Hrs]**

Introduction- SCADA, Motivation for restructuring of power systems- Electricity market entities model benefits of deregulation- Terminology-Deregulation in Indian power sector-Operations in power markets-Power pools-Transmission networks and electricity markets.

Text Books:

1. Nagrath, I. J., and Kothari, D. P, 'Modern Power System Analysis', TMH, 3rd Edition, 2003.
2. A.J. Wood & B.F. Woollenberg, 'Operation and Control', John Wiley Power Generation, 2nd edition.

Reference Books:

1. P. Venkatesh. B.V. Manikandan, S. Charles Raja, A. Srinivasan, 'Electrical power systems: Analysis, security, Deregulation', PHI 2012.
2. A. Chakravarthi and S. Halder, 'Power System Analysis Operation and Control ', PHI, 3rd Edition.
3. O I Elgerd, 'Electric Energy Systems', Mc Graw-hill.

Sub Code: B18EE7043	**Non-Conventional Energy Sources**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		2	1	0	3	3
Course Objectives	5. To analyze the environmental and cost economics of using renewable energy sources compared to fossil fuels. 6. To understand the solar geometry required to estimate the solar radiation. 7. To estimate maximum power available in wind. 8. To introduce various renewable energy conversion technologies like Biomass, Geothermal, Ocean energy. 9. To introduce Magnetohydrodynamic system and energy storage systems					
Course Outcomes	On completion of this course the students will be able to: 5. Select the appropriate renewable energy as an alternate for conventional power in any application. 6. Design solar PV module for any given application. 7. Deduce maximum power available in any given location. 8. Acquire the knowledge of modern energy conversion technologies. 9. Understand characteristics of the storage systems					

COURSE CONTENTS

Unit 1:
[12hrs]

Introduction: Energy Sources and their availability, renewable energy sources, Prospects of renewable energy sources.

Energy Scenario: Energy needs of India – Energy consumption patterns – Worldwide Potentials of these sources – Energy efficiency – Energy security – Energy and its environmental impacts – Global environmental concern – Kyoto Protocol.

Unit 2:
[12hrs]

Solar Energy: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems);

Solar thermal Systems – Types of collectors – Collection systems – Applications – Photo Voltaic (PV) technology – Solar cells – Cell technologies – Characteristics of PV systems – Equivalent circuit – Building integrated PV system and its components – Sizing and economics – Peak power operation – Standalone and grid interactive systems.

Wind Energy: Energy available from wind, General formula, Lift and drag. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, Advantages and Disadvantages of WECS.

Unit 3:
[12hrs]

Bio Mass Energy: Biomass conversion technologies bio mass generation, classification of Bio Gas Plants, Factors affecting Biogas generation, Biomass program in India.

Geothermal Energy: Sources of Geothermal energy Estimation of Geothermal Power, Geothermal Power Plants, Geothermal energy in India and Prospects.

Ocean Energy: Ocean thermal energy conversion(OTEC), Principle of OTEC system, Methods of OTEC power generation, site selection, Prospects of ocean energy in India, –

Principle of Tidal Power, Tidal Power Plant, Prospects in India.

Unit 4:
[12hrs]

MHD & Hydrogen Energy: Basic Principle of MHD (magnetohydrodynamic) system, advantages, Power OUTPUT of MHD Generation, future Prospects. Principle and classification of fuel cell energy, hydrogen as alternative fuel for Generation of Electrical Energy & applications.

Energy Storage: Battery – Types – Equivalent circuit – Performance characteristics – Battery design – Charging and charge regulators – Battery management – Fly wheel energy relations – Components – Benefits over battery – Storage systems – Ultra capacitors.

Text Books :

6. Rai, G. D., 'Non-Conventional Energy Sources', Khanna Publishers, 5th edition.
7. D.P Kothari, K.C.Singla, Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies', PHI Publications.
8. Bansal Keemann, Meliss, 'Renewable energy sources and conversion technology', Tata McGraw Hill.

Reference Books:

1. Mittal, 'Non-conventional Energy Systems', Wheelers Publication.

Ramesh R & Kumar K U, 'Renewable Energy Technologies', Narosa Publishing House

Sub Code: B18EE7044	**Optical Fibre Communication**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 weeks		2	1	0	3	3
Course Objectives	1. Conceptualize and analyze mathematically propagation of optical signals over optical Fiber cables. 2. Conceptualize the degradation of signals during propagation of optical signals over optical fiber. 3. Explain the construction and characteristics of optical sources and detectors. 4. Analyze various techniques for coherent transmission and system performance factors in optical Communication system.					
Course Outcomes	After completion of the course, the student shall able to: 1. Conceptualize and analyze mathematically propagation of optical signals over optical Fiber cables. 2. Conceptualize the degradation of signals during propagation of optical signals over optical fiber. 3. Explain the construction and characteristics of optical sources and detectors. 4. Analyze various techniques for coherent transmission and system					

	performance factors in optical Communication system.

Course Contents:

Unit-1: Overview to Optical Fiber Communication [11 Hrs]

Electromagnetic spectrum, Optical spectral Bands, Multiplexing Techniques, WDM concepts, General system, Advantages and Applications of fiber optic transmission systems, Optical laws and Definitions - TIR , Numerical Aperture, Acceptance angle, Fiber Modes and Configurations, Step-index and Graded-index fiber, Single mode and Multi-Mode fibers, Modal Concepts - V Number, Average optical power, Cutoff wavelength, Modes supported by SI and GI fiber, MFD, Fiber Materials

Unit-2: Signal Distortion in Optical Fibers [10 Hrs]

Attenuation, Scattering Losses – Concepts of Rayleigh, Mie, Brillouin and Raman Scattering, Fiber Bend Loss, Dispersion – Concepts of Modal Dispersion, Material Dispersion, Waveguide Dispersion, Polarization Mode Dispersion, Optical Amplifier – Principle Operation of EDFA, Fiber to Fiber Joints, Fiber Connectors – Butt Joint Connector, Expanded Beam Connector, Fiber Couplers – FBT coupler, Star coupler using FBT technique, Fiber Splicing Techniques

Unit 3: Optical Transmitter and Receiver [11 Hrs]

Semiconductor Physics background, Optical sources – LED structures, Materials, Laser Diodes –Modes & threshold conditions, Construction and Principle operation of Semiconductor Laser, Concepts of Fabry-Perot resonator, Optical Detectors – Physical Principle of PIN and APD, Definitions – Photo Detector Noise, Detector Response Time, Comparison of Photo Detectors, Optical Receiver – Fundamental Receiver Operation, Receiver sensitivity, Quantum Limit, Eye diagrams, Concepts of Coherent detection.

Unit 4: OFC System Design Considerations [10 Hrs]

Analog Links – Overview of Analog Links, CNR, Multichannel Transmission Techniques, Link Parameters Definitions – Gain, Noise Figure, SFDR, Digital Links – Simplex Point to point link, System Considerations, Link Power Budget and Rise Time Budget with examples, Power Penalties, Modal noise, Mode-Partition Noise ,Reflection Noise, Chirping

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Sub Code: B18EE7045	Computer Network Concepts and Protocols	L	T	P	C	CH
Duration: 14 weeks		2	1	0	3	3
Prerequisites	Fundamentals of Computer Science, Digital Principles and Computer Organization.					
Course Objectives	1. Describe the concept of Protocol Stacks (OSI and TCP/IP), data communication with packet switching and virtual circuit networks. 2. Give knowledge about network topologies and Ethernet standards 3. Explain various media access techniques, error detection and correction mechanisms 4. Familiarize the students with routing and error reporting protocols 5. Gain expertise in transport layer and application layer standards and protocols.					
Course Outcomes	After completion of the course, the student shall able to: 1. Use protocol stacks (OSI and TCP/IP) for developing data communication applications 2. Apply error detection & correction strategies for data transmission 3. Establish network of computing devices using topology and Ethernet standards 4. Experiment routing protocols and error reporting protocols 5. Design and develop communication applications using TCP/UDP standards					

Course Contents:

Unit – I: [11 Hrs]

Introduction to Data Communication and Networking: Internet history and Internet today, Data Communications, Networks, Protocols & Standards, Layered Tasks, The OSI model, Layers in OSI model, TCP/IP Protocol suite, Addressing. Introduction to switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.

Unit – II: [11 Hrs]

Concepts of Multiplexing, FDM, WDM, TDM, Line coding methods, Digital Modulation techniques, **Networking Devices:** Digital Subscriber Line Modems, Cable Modems, Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways.

Error Detection and Correction: Introduction, cyclic Codes: Cyclic redundancy code generation for checksum. Frames, Packets, Point-to-Point Protocol, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token passing.

Unit-III: [11 Hr]

Network Topologies, Classification of Networks, Protocols, PPP, IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.11, Architecture, MAC Sublayer, Addressing Mechanism. IPv4 addresses, IPv6 addresses, transition from IPv4 to IPv6.

Unit-IV: [11 Hrs]

Standards and Protocols: User Datagram Protocol (UDP): UDP Segment, Transmission Control Protocol (TCP): TCP Segment, Connection Set up, Application of TCP and UDP. TCP Congestion Control.

Domain Name System (DNS): Name/Address Mapping, DNS Message Format. Remote Login Protocols: TELNET Protocol and SSH Protocol. Electronic Mail (E-Mail), World Wide Web (WWW).
Basic concepts of FTP, GSM, LTE, MPLS, VPN, ATM, Bluetooth. WiFi, WiMax.

Recommended Learning Resources:

1. Behrouz A Forouzan: Data Communications and Networking, 4th Edition, McGraw – Hill, 2006
2. Nader F. Mir: Computer and Communication Networks, Pearson Education, 2009

Sub Code: B18EE7060	**Signals Processing Laboratory**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		0	0	2	2	3
Course Objectives	The main objectives of this course are to: 1. Design & implementation on various DSP operations using MATLAB. 2. Demonstrate convolution and filtering operations using DSP processor. 3. To design and implementation of IIR and FIR filters for given frequency specifications. 4. To help the students in developing software skills.					
Course Outcomes	On completion of this course the student will be able to: 1. Demonstrate the concept of sampling. 2. Compute the convolution of the pair of signals in time domain. 3. Determine the impulse response of IIR Filter and FIR Filter. 4. Design of Butterworth and Chebyshev filter for different specification.					

A. List of Experiments using MATLAB:

1. Perform the Linear convolution of any two given sequences in time domain.
2. Computation of N point DFT of a given sequence using the definition of DFT and plot magnitude and phase spectrum, and verify using built in function (using FFT).
3. Perform the Circular convolution of two given sequences in time domain.
4. Perform Circular convolution of any two given sequences in frequency domain by using DFT and IDFT. 5. Obtain the Auto correlation and cross correlation of a given sequence and verify its properties.
5. Verification of Sampling theorem.
6. Design of digital Low-pass and High-pass Butterworth IIR filter to meet the given specifications using Bilinear transformations.
7. Design of digital Low-pass and High-pass Chebyshev IIR filter to meet the given specifications using Bilinear transformations.
8. Design of digital Low-pass FIR filter to meet the given specifications using windowing technique.

B. List of Experiments using DSP Processor:

1. Linear convolution of two given sequences.
2. Circular convolution of two given sequences.

3. Computation of N-point DFT of a given sequence.
4. Solving a linear constant coefficient difference equation.
5. Audio applications such as to plot time and frequency spectrum, display of microphone output plus a cosine using DSP. Read a wav file and match with their respective spectrograms.

Sub Code: B18EE7070	**Relay and High Voltage Lab**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Weeks		0	0	2	2	3
Course Objectives:	1. To make the students gain the knowledge of operation of over current, under voltage relays. 2. To measure HVAC and HVDC using spheres. 3. To analyze the characteristics of fuse.					
Course outcomes	At the end of this course, Student will be able to: 1. Develop skills to measure HVAC and HVDC parameters. 2. To understand the operation of different relays					

List of Lab Experiments:

1. Determination of current time characteristics of electro mechanical over current relay.
2. Determination of current time characteristics of Microcontroller based over current relay.
3. Determination of operating characteristics of Microcontroller based Under voltage relay.
4. Observing the operation of Motor protection Relay for various faults.
5. Observing the operation of Negative Sequence Relay.
6. To draw operating characteristics of fuse under constant current and constant length conditions.
7. Determination of break down strength of liquid dielectric.
8. Measurement of HVAC using standard spheres.
9. Measurement of HVDC using standard spheres.
10. Measurement of HVAC for different electrode configurations.
11. Field mapping using Electrolytic tank for capacitor model.

Sub Code: B18EE705X	**Open Elective -Subject**	**L**	**T**	**P**	**C**	**CH**
Duration :14 Weeks		3	0	0	3	3
Course Objectives:	4. To make the students gain the knowledge of operation of over current, under voltage relays. 5. To measure HVAC and HVDC using spheres. 6. To analyze the characteristics of fuse.					
Course outcomes	At the end of this course, Student will be able to: 3. Develop skills to measure HVAC and HVDC parameters. 4. To understand the operation of different relays					

VIII Semester

Sub Code: B18EE8010	Project Phase - II	L	T	P	C	CH
Duration :14 Weeks		0	1	7	8	16
Course Objectives:	1. Identify and practice research ethics and responsible to conduct in research 2. To know and apply problem solving skills to constructively address research setbacks 3. To work collaboratively with other researchers, using listening and communication skills 4. To work autonomously in an effective manner and setting and meeting deadlines 5. To reflect on their own research, identifying lessons learned, strengths, and ways to improve 6. To communicate confidently and constructively with fellow graduate students and faculty as mentors 7. To explain their research to others in the field and to broader audiences through research presentations 8. To articulate the relevance of their research to their coursework and professional future, synthesizing their research, academic, and professional interests and goals 9. To identify and describe what they could expect as a graduate student 10. To reflect constructively on their research experience in making decisions about their future.					
Course outcomes	At the end of this course, Student will be able to: 1. Apply relevant knowledge and skills, within the main area, to a given problem - within given constraints, 2. Analyze and discuss complex inquiries/problems and handle larger problems independently even with limited information 3. Evaluate and critically assess one's own and others' scientific results 4. Document and present one's work with strict requirements on structure, format, and language usage 5. Identify one's need for further knowledge and continuously develop one's own knowledge					

GUIDELINES

Guidelines for the preparation of the Report: As per the University Guidelines

Guidelines for the Evaluation:

1. The student must meet the guides minimum once a week and give the project progress and also discuss the hardware progress with guides.
2. The guides have to maintain the attendance report and also the progress of the students

projects.

3. Student has to submit a progress report -I and give the presentation during IA1 which carries 15% of the total marks
4. Students has to submit a progress report -II and give the presentation of the project work during IA2, which carries 15% of the total marks
5. Students has to submit a progress report -II and give the presentation of the project work during IA3, which carries 10% of the total marks
6. Students have to submit the Project Thesis and need to give a presentation of the project work and face Viva-Voce during Semester end exam (SEE), which carries 60% of the total marks
7. All the above reports must undergo a plagiarism check which should not exceed 25% of similarity index and failing which lead to resubmission.

Sub Code: B18EE8021	**Trouble Shooting of Common Electrical Appliances**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	4
Course Objectives	1. To teach safety rules , important tools used in trouble shooting 2. To teach different types of wires & wire splicing, termination. 3. To teach usage of important electrical meters which are used in the process of trouble shooting. 4. To teach probable faults, causes & remedies on some common electrical equipment.					
Course Outcomes	On completion of this course the students will be able to: 1. Understand safety rules , important tools used in trouble shooting 2. Understand different types of wires & wire splicing , 3. Understand the usage of important electrical meters which are used in the process of trouble shooting. 4. Find out faults, causes and remedies for common electrical equipment.					

COURSE CONTENTS

Unit 1: Safety rules & Tools **[10hrs]**

Introduction , safety precautions, safety rules, screw driver , pliers, wire stripper, pocket knife, hammers, chisels, hand & Electric drill, hack saw, Rawlplug tool, neon tester, test lamp, switch board.

Unit 2: Wires, wire splicing and termination **[10hrs]**

Sizes of wires, stranded wires, types of wires, rubber covered, taped, braided, compounded wire, western union splice(joints) DOL starter for 3-Phase Induction motor. Control of Domestic motor- pump set.

Unit 3: Usage of meters **[10hrs]**

Ammeter, voltmeter, ohm meter (multi meter) megger, earth tester. Measurement of Earth resistance.

Domestic wiring, two & 3- way control of a lamp, Fluorescence lamp set, Sodium vapor lamp.

Unit 4: Probable Faults, Causes, and remedies on common Electric Equipment's [12hrs]
Mixer grinder, Table fan and ceiling fan , Electric iron, 3-Phase Induction motor,

Text Books:

1. S.L. Uppal, 'Electrical wiring Estimation & costing', Khanna Publications, 5th edition, reprint, 2006
2. Madhvi Gupta, 'Installation, Maintenance & Repair of Electrical Machines & Equipment', Kataria & Sons, 1st Edition, 2014.

Reference Books:

1. Philip Kiameh, 'Electrical equipment Hand book trouble shooting & maintenance', McGraw Hill, Chicago, 2003.

Sub Code: B18EE8022	Introduction to Flexible AC Transmission Systems	L	T	P	C	CH
Duration: 14 Weeks		2	1	0	3	4
Course Objectives	1. To emphasis the need for FACTS controllers. 2. To review the static devices for series and shunt control. 3. To study the operation of controllers for enhancing the transmission capability.					
Course Outcomes	**On completion of this course the students will be able to:** 1. Describe the need of flexible AC transmission and the associated problems. 2. Describe the characteristics, applications and modeling of series and shunt FACTS controllers. 3. Analyze the interaction of different FACTS controller with the power system.					

COURSE CONTENTS

Unit 1: AC Transmission Line and Reactive Power Compensation [8hrs]
Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controller

Unit 2: Voltage Sourced Converters [12hrs]
Power semiconductor devices: types of high power devices, principle of high power device characteristics and requirements, power device material, diode, MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT).
Voltage sourced converters: Basic concepts, single-phase full wave bridge converter operation, and square wave voltage harmonics for a single-phase bridge 3-phase full wave converters.

Unit 3: Static Series Compensators [8hrs]
GCSC, TSSC, TCSC and SSSC, objectives of series compensation, variables impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators.

Unit4: Self and Line Commutated Current Source Converter [12hrs]

Basic concepts, 3 phase full wave rectifier, thyristor based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter.

STATIC SHUNT COMPENSATORS SVC AND STATCOM: Objective of shunt compensation, methods of controllable Var generation, Static Var Compensator (SVC) and STATCOM, comparison between SVC and STATCOM.

Text Books:

1. N.G. Hungorian & Laszlo gyugyi, 'Understanding Facts - Concepts and technology of flexible AC Transmission system', IEEE Press, standard publisher, 2001.

Reference Books:

1. S. Rao, 'EHV - AC, HYDC Transmission & Distribution Engineering', Khanna publishers, 3rd edition 2003.
2. K.R. Padiyar, 'FACTS - Controllers in Power Transmission distribution', New age publishers, 2007.

Sub Code: B18EE8023	**Wireless Communication**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	4
Prerequisites	Fourier analysis, Linear Systems, Probability Theory, Introductory Modulation and Antenna Theory					
Course Objectives	1. Know the characteristic of wireless channel 2. Understand the concepts behind various digital signaling schemes for fading channels 3. Understand the various multipath mitigation techniques 4. Understand Wireless Networks 5. Understand Wireless LAN and Bluetooth Technology					
Course Outcomes	On completion of this course the students will be able to: 1. Characterize wireless channels (a, b) 2. Design and implement various signaling schemes for fading channels (a, b, d, e) 3. Compare multipath mitigation techniques and analyze their performance (a, b, d) 4. Compare various types of wireless networks (a, b, d)					

Course Contents:

Unit- 1: Wireless Channels [11Hrs]

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion

parameters Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

Unit-2: Multipath Mitigation Techniques [10Hrs]
Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

Unit-3: Satellite Networks and Wireless Application Protocol [11Hrs]
Satellite networks: Satellite parameters and configuration, Capacity allocation,
Wireless system operations and standards: Cordless systems, Wireless local loop, Mobile IP and Wireless Application Protocol:

Unit- 4: Wireless LAN and Bluetooth Technology [10Hrs]
Wireless LAN Technology: Infrared LANs, spread spectrum LANs, Narrowband Microwave LANs,
Wi-Fi- and the IEEE 802.11 Wireless LAN standard: IEEE 802 architecture, IEEE 802.11 Architecture and services, Medium access control, Physical layer, other IEEE 802 standards, Wi-Fi protected access, Bluetooth and IEEE 802.15: Radio specification, Baseband specification, Link manager specification

Text Books:

1. Rappaport, T.S**., "Wireless communications",** Second Edition, Pearson Education, 2010**.**
2. Andreas. F. Molisch**, "Wireless Communications",** John Wiley – India, 2006**.**
3. William Stallings**, "Wireless Communication and Networks",** Second Edition, Pearson, 2013.

Reference Books:

1. David Tse and Pramod Viswanath**, "Fundamentals of Wireless Communication",** Cambridge University Press, 2005.
2. Behrouz A. Forouzan**, " Data Communication and Networking",** McGraw- Hill Higher Education, Second edition, 2000.

Sub Code: B18EE8024	**Machine Learning and Applications**	**L**	**T**	**P**	**C**	**CH**
		2	1	0	3	4
Prerequisites	Students must have studied Data Structure, Algorithms and Mathematics					
Course Objectives	1. Study the basic theory underlying machine learning. 2. Explain machine learning algorithms to solve problems of moderate complexity for data analysis. 3. Describe the concept of Genetic Programming and Artificial Neural Network. 4. Discuss the implementation of Machine learning algorithms and modules.					
Course Outcomes	On completion of this course the students will be able to: 1. Explain the basics of machine learning concepts. 2. Implement machine learning algorithms for intelligent applications. 3. Apprehend how to perform evaluation of learning algorithms and model					

	selection.

Course Contents

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

Introduction: Well-Posed Learning Problems, Designing a Learning System, Perspectives and Issues tin Machine Learning Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, and Reinforcement Learning. Supervised Learning. Concept Learning and the General-to-Specific Ordering: A Concept Learning Task, Concept Learning as Search, FIND-S.

Unit-2: **[11 Hrs]**

Dimensionality Reduction: Subset Selection, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis. Classification.

Unit-3: **[10 Hrs]**

Clustering: Introduction**,** kmeans, nearest neighbor, expectation maximization algorithm, Supervised learning after clustering, hierarchical clustering, choosing the number of clusters. Decision Tree Learning.

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

Artificial Neural Networks: Introduction, Perceptions, Multilayer Networks and the Backpropagation Algorithm. Reinforcement Learning: Introduction, Learning task ,Q-learning. Design and Analysis of Machine Learning Algorithms and experiments using WEKA//Rapid Miner Tool

Recommended Learning Resources (Text Books):

1. Tom Mitchell: Introduction to Machine Learning Chapters 1, 2, 3, 4, 6, 8, 9.1 to 9.4, 13
2. Ethem Al paydin: Second edition MIT press McGraw-Hill Chapters 1, 2, 6, 7, 19
3. William W Hsieh Machine Learning Methods in the Environmental Sciences, Neural Networks, Cambridge University Press.

Reference Books:

1. Ethem Al paydin: Introduction to Machine Learning, Second edition MIT press, 2010. Chapters 1, 2, 6, 7, 19.
2. Yoshua Bengio and Aaron Courville, Deep Learning -Ian Good fellow, MIT Press book, 2016
3. Richard O. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
4. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

The laboratory exercises will include use of various machine learning algorithm for data classification, data regression, clustering using WEKA Tools.

The list of experiments are:

The Weka tool should be taught to the students:

1) Introduction to WEKA, installation of WEKA Tool and demonstration.
2) Perform data preprocessing.
3) Perform classification to the dataset.
4) Perform Clustering using k-means for the contact lens dataset.
5) Perform Logic Regression for Iris data set.
6) To Visualize the results using the Tool.
7) To Analyze the results using the Tool.
8) Apply ID3 decision tree algorithm to House database.
9) Apply CART decision tree algorithm To IRIS database.

CAREER DEVELOPMENT AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

a. Willingness to learn
b. Self motivation
c. Team work
d. Communication skills and application of these skills to real scenarios
e. Requirement of gathering, design and analysis, development and testing skills
f. Analytical and Technical skills
g. Computer skills
h. Internet searching skills
i. Information consolidation and presentation skills
j. Role play
k. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Electrical & Electronics Engineering is not only the knowledge in the subject, but also the ability take just decisions and skills to perform the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous

training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and March forward to make better career. The School of Electrical & Electronics Engineering also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

DO'S AND DON'TS

DO'S

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

DON'TS

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

Use of Crackers, explosives and ammunition etc