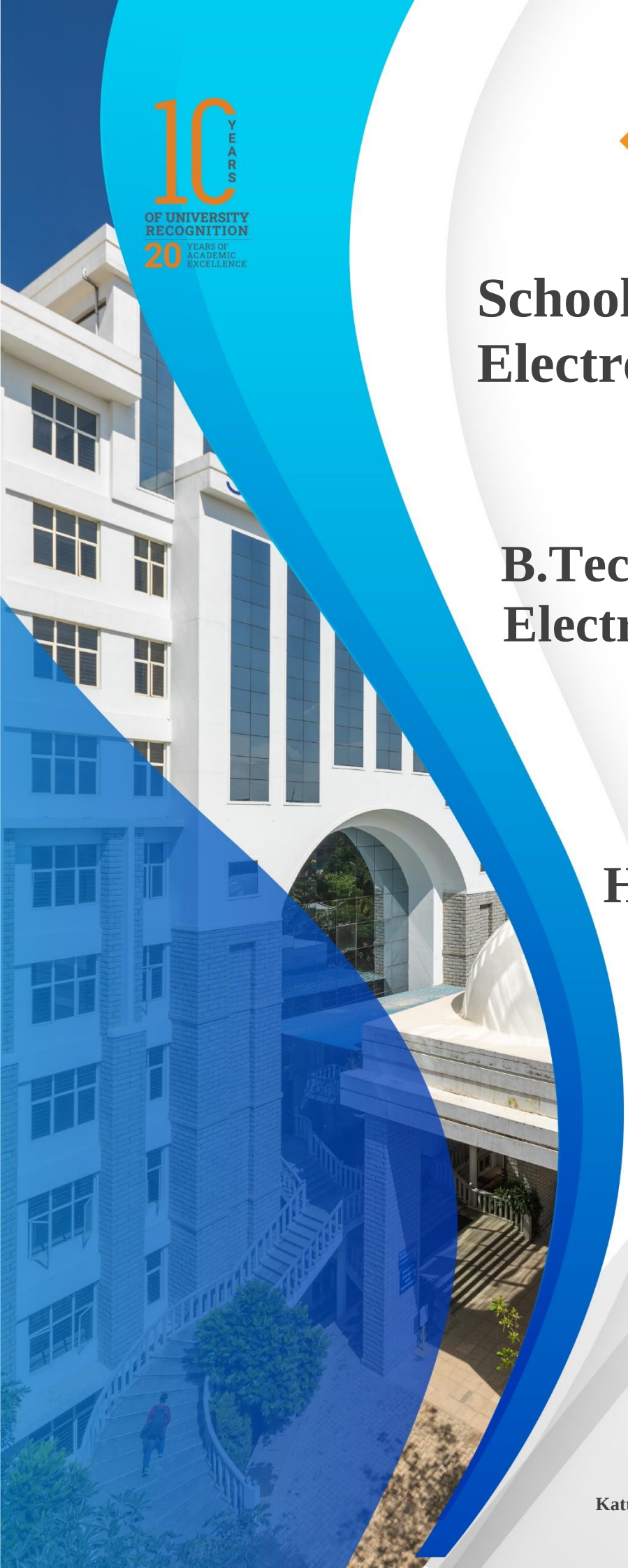

REVA UNIVERSITY
Bengaluru, India

School of Electrical and Electronics Engineering

B.Tech in Electrical and Electronics Engineering

Handbook – 2021-25

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
www.reva.edu.in

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

HANDBOOK

B.Tech in Electrical and Electronics Engineering

2021-2025

Rukmini Knowledge Park,
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Phone No: +91-90211 90211/080-46966966

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 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. M Dhanamjaya

Vice-Chancelleor

Director's Message

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. 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

School of Electrical and Electronics Engineering

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

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

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

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

ABOUT REVA UNIVERSITY

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

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

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

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

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

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

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

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

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several addon courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

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

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

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted

Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defense Dr. Sathish Reddy, Scientific Advisor, Ministry of Defense, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

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

Vision

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

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education
- reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas

- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values

Objectives

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

ABOUT SCHOOL OF 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 software. 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 counselling of students for academic performance, additional coaching classes for important subjects for all the semesters, soft skill development classes, scientific and student centric 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/hand-outs 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 identify and nurture students' talents to guide them to choose the correct career option
- To mould students to become skilled, ethical and responsible engineers for the betterment of society by establishing academic infrastructures thus developing program specific competencies
- To provide student centric learning and innovative pedagogy inculcating scientific temperament to arouse interest in tackling real world challenges in the field of Electrical, Electronics and Computer Engineering through industry-institute partnership
- To inculcate research bent of mind, social responsibilities, moral values by involving in IEEE activities and other social outreach activities to develop leadership traits.
- To promote team work & entrepreneurship by involving in the multidisciplinary team tasks

Program 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, analyze, 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.

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.

Program Educational Objectives (PEO's)

After few years of graduation, the graduates of B. Tech in Electrical & Electronics Engineering will:

- PEO 1: Work as a member or lead a team for successful career and communicate effectively in multidisciplinary environment with highest ethics
- PEO 2: Continue to learn in the areas of Electrical & Electronics Engineering and allied areas and implement effective strategies with the advancement of technologies in Electrical & Electronics Engineering
- PEO 3: Become an entrepreneur in the domain of Electrical & Electronics Engineering and other allied areas

Program Outcomes (POs)

On successful completion of the Program, the graduates of B. Tech in Electrical & Electronics Engineering will:

- PO 1: Understand the concept, identify, formulate, and solve complex electrical engineering problems by applying knowledge & principles of engineering, science, and mathematics
- PO 2: Identify, formulate, review research literature, analyze, interpret and draw conclusions from quantitative & qualitative data of an electrical and electronics system, component, or process to meet desired needs.
- PO 3: Design solutions for engineering problems and system components related to electrical & electronic systems that meet economic, environmental, social, political, health, safety and sustainability requirements.
- PO 4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in the field of electrical & electronics engineering.
- PO 5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling of complex electrical and electronics circuits with an understanding of the limitations.
- PO 6: Apply contextual knowledge to assess social, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO 7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO 8: Apply ethical principles and solve professional, legal and ethical issues pertaining to electrical & electronics engineering and its related fields
- PO 9: Function effectively as a team member or leader in diverse teams to accomplish a common goal in a multi-disciplinary team.
- PO 10: Communicate effectively on complex engineering activities with the engineering community and with society at large in both verbal and written forms.

- PO 11: Demonstrate knowledge and understanding of the engineering and management principles to manage projects effectively in diverse environments as a member or leader of a team.
- PO 12: Engage in independent and life-long learning in the broader context of technological change for continued professional development

Program Specific Outcomes (PSO)

On successful completion of the program, the graduates of B. Tech in Electrical & Electronics Engineering will:

- PSO 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 electronic circuits, control systems, electrical machines, power system, renewable energy system and electric vehicle
- PSO 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 and to successfully adapt in multi-disciplinary environments
- PSO 3: Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively

Regulations – B. Tech., Degree Program
Academic Year 2021-22 Batch

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

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – B. Tech., Degree Program 2020-21 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

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

2. The Programs:

These regulations cover the following B. Tech., Degree programs of REVA University offered during 2019-20

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

3. Duration and Medium of Instructions:

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

3.2 The medium of instruction shall be English.

4. Definitions:

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

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

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

Where:

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

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

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

4.2 Classification of Courses

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

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

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

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

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

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

4.2.5 Open Elective Course (OE):

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

4.2.6 Project Work / Dissertation:

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

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

5. Eligibility for Admission:

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

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

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

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

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

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

6.3 The credit hours defined as below:

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

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

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

The following table describes credit pattern

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

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

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

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

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

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

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

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

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

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

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

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

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

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

8.7 Add- on Proficiency Certification:

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

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

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

The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the

candidate contains the courses studied and grades earned.

9 Assessment and Evaluation

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

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

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

9.3 The 50 marks of internal assessment shall comprise of:

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

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

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

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

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

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

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

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

9.9 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question

paper(s). However, these question papers shall be scrutinized by the Question Paper Scrutiny Committee to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4 week online course – 1 credit

8 week online course / MOOC – 2 credits

12 week online course / MOOC – 3 credits

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

Summary of Internal Assessment and Evaluation Schedule

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

10 Assessment of Students Performance in Practical Courses

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

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

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

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

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

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

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

For > 3 credit courses

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

For 1 & 2 credit courses

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

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

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with

the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

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

12. Requirements to Pass a Course:

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

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

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

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

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

a. **Computation of SGPA and CGPA**

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

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

Illustration for Computation of SGPA and CGPA

Illustration No. 1

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

Thus, **SGPA = 159 ÷ 19 = 8.37**

Illustration No. 2

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

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

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

Thus**, SGPA = 199 ÷ 24 = 8.29**

b. **Cumulative Grade Point Average (CGPA):**

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

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

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	19	6.83	19 x 6.83 = 129.77
2	21	7.29	21 x 7.29 = 153.09
3	22	8.11	22 x 8.11 = 178.42
4	22	7.40	22 x 7.40 = 162.80
5	22	8.29	22 x 8.29 = 182.38
6	22	8.58	22 x 8.58 = 188.76
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**160**		**1288.36**

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

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

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.05 x 10=80.5

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

13. Classification of Results

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

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

Overall percentage=10*CGPA

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

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

14. Attendance Requirement:

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

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

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

15. Re-Registration and Re-Admission:

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

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

16. Absence during Internal Test:

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

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and

Assignments), he/she can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. He/she can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the Grievance committee is final.

18. Grievance Committee:

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

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

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

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

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

20. Provision for Supplementary Examination

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

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

The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to

next semester of succeeding year(s) of study till 8th semester. And he / she shall appear for Semester End examination of failed courses of previous semesters concurrently with odd semester end examinations and / or even semester end examinations of current year of study.

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

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

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

22. Challenge Valuation:

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

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

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

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

SCHEME OF INSTRUCTION

I SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0102	Calculus and Differential Equations	FC	3	0	0	3	3
2	B20AS0104	Engineering Chemistry	FC	2	1	0	3	3
3	B20CI0101	Introduction to Python Programming	HC	2	0	1	3	4
4	B20EE0101	Basic Electrical and Electronics Engineering	HC	3	0	1	4	5
5	B20ME0103	Elements of Mechanical and Civil Engineering	HC	3	0	0	3	3
TOTAL				**13**	**1**	**2**	**16**	**18**
Practical /Term Work / Sessions								
6	B20AS0109	Biology for Engineers	FC	1	0	0	1	1
7	B20ME0102	Design Thinking	FC	1	0	1	2	3
TOTAL				**2**	**0**	**1**	**3**	**4**
TOTAL SEMESTER CREDITS								**19**
TOTAL CUMULATIVE CREDITS								**19**
TOTAL CONTACT HOURS								**22**

II SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0203	Integral Transforms	FC	4	0	0	4	4
2	B20AS0202	Engineering Physics	FC	3	0	1	4	5
3	B20CS0101	Introduction to Data Science	HC	2	0	1	3	4

4	B20EE0202	Electrical Power Generation and Transmission	HC	3	0	0	3	3
5	B20EE0201	Electrical and Electronic Measurements	HC	2	0	1	3	4
TOTAL				**14**	**0**	**3**	**17**	**20**
Practical /Term Work / Sessions								
6	B20EC0101	IoT and Applications	HC	1	0	1	2	3
7	B20ME0104	Entrepreneurship	HC	1	0	0	1	1
8	B20EE0203	Electrical Safety, Earthing & Solar PV System	HC	0	0	1	1	2
TOTAL				**2**	**0**	**2**	**4**	**6**
TOTAL SEMESTER CREDITS								**21**
TOTAL CUMULATIVE CREDITS								**40**
TOTAL CONTACT HOURS								**26**

III SEMESTER

III SEMESTER

Sl. No	**Course Code**	**Title of the Course**	**HC/FC/SC/ OE**	**Credit Pattern & Credit Value**				**Contact Hours / Week**
				L	**T**	**P**	**Total**	
1	B20AS0305	Linear algebra and Partial Differential Equations	FC	3	0	0	3	3
2	B20EE0301	Electrical Circuit Theory	FC	3	0	0	3	3
3	B20EM0302	Electrical Machines-I	HC	3	0	0	3	3
4	B20EE0302	Problem Solving Using C Programming	HC	2	0	0	2	2
5	B20EM0301	Analog Electronic & Linear Integrated Circuits	HC	3	0	0	3	3
TOTAL				**14**	**0**	**0**	**14**	**14**
Practical /Term Work / Sessions								
6	B20EE0303	Problem Solving Using C Programming Lab	HC	0	0	1	1	2

7	B20EM0303	Analog Electronic & Linear Integrated Circuits	HC	0	0	1	1	2
8	B20EM0304	Electrical Machines-I Lab	HC	0	0	1	1	2
9	B20AS0301	Environmental Science	FC	2	0	0	2	2
10	B20MGM301	Management Science	FC	2	0	0	2	2
11	B20AHM302 /301	Basics of Kannada/Advanced Kannada	MC	0	0	0	0	1
TOTAL				**4**	**0**	**3**	**7**	**11**
TOTAL SEMESTER CREDITS								**21**
TOTAL CUMULATIVE CREDITS								**61**
TOTAL CONTACT HOURS								**25**

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20AS0402	Probability and Random Process	FC	3	0	0	3	3
2	B20EM0401	Electrical Machines-II	HC	3	0	0	3	3
3	B20EM0403	Physics – Electromagnetism	FC	3	0	0	3	3
4	B20EM0402	Electrical Power Utilization	HC	3	0	0	3	3
5	B20EE0401	Microcontrollers and Applications	HC	3	0	0	3	3
6	B20XXS4XX	Professional Elective-1	SC	3	0	0	3	3
TOTAL				**18**	**0**	**0**	**18**	**18**
Practical /Term Work / Sessions								
7	B20EE0402	Microcontrollers and Applications Lab	HC	0	0	1	1	2
8	B20EM0404	Electrical Machines-II Lab	HC	0	0	1	1	2
9	B20AH0301	Communication Skills	FC	2	0	0	2	2
10	B20LS0301	Indian Constitution & Professional Ethics	FC	2	0	0	2	2

11	B20AHM401	Universal Human Values	HC	0	0	0	0	1
TOTAL				**4**	**0**	**2**	**6**	**9**
TOTAL SEMESTER CREDITS								**24**
TOTAL CUMULATIVE CREDITS								**85**
TOTAL CONTACT HOURS								**27**

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EE0501	Control System Engineering	HC	3	0	0	3	3
2	B20EE0502	Power Electronics	HC	3	0	0	4	5
3	B20EM0501	Object Oriented Programming using C++	HC	3	0	0	4	5
4	B20XXS5XX	Professional Elective-2	SC	3	0	0	3	3
5	B20XXO5XX	Open Elective 1	OE	3	0	0	3	3
TOTAL				**15**	**0**	**0**	**17**	**19**
Practical /Term Work / Sessions								
6	B20EE0505	Control System Lab	HC	0	0	1	1	2
7	B20EE0506	Power Electronics Lab	HC	0	0	1	1	2
8	B20EM0502	C++ Lab	HC	0	0	1	1	2
9	B20EE0503	Technical Documentation	FC	1	0	0	1	1
10	B20EE0504	Mini project/Internship	HC	0	0	2	2	4
TOTAL				**1**	**0**	**5**	**6**	**11**
TOTAL SEMESTER CREDITS								**23**
TOTAL CUMULATIVE CREDITS								**108**
TOTAL CONTACT HOURS								**30**

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EE0601	Computer Aided Electrical Drawing	HC	3	0	1	4	5
2	B20EM0601	High Voltage Engineering	HC	3	0	0	3	3
3	B20EM0602	Digital System Design	HC	3	0	0	3	3

4	B20XXS6XX	Professional Elective-3	SC	3	0	0	3	3
5	B20XXO6XX	Open Elective 2	OE	3	0	0	3	3
TOTAL				**15**	**0**	**1**	**16**	**17**
Practical /Term Work / Sessions								
6	B20EM0603	High Voltage Engineering Lab	HC	0	0	1	1	2
7	B20EM0604	Digital System Design Lab	HC	0	0	1	1	2
8	B20PA0501	Indian Tradition and Culture	FC	1	0	0	1	1
9	B20EE0602	Embedded System Design	FC	1	0	1	2	3
10	B20EE0603	Research Based Project	HC	0	0	1	1	2
TOTAL				**2**	**0**	**4**	**6**	**10**
TOTAL SEMESTER CREDITS								**22**
TOTAL CUMULATIVE CREDITS								**130**
TOTAL CONTACT HOURS								**27**

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20EE0701	Computer Aided Power System Analysis	HC	3	0	0	3	3
2	B20EM0701	Signal Processing	HC	3	0	0	3	3
3	B20EM0702	Renewable Energy System	HC	3	0	0	3	3
4	B20XXS7XX	Professional Elective-4	SC	3	0	0	3	3
5	B20XXS7XX	Professional Elective-5	SC	3	0	0	3	3
6	B20XXO7XX	Open Elective 3	OE	3	0	0	3	3
TOTAL				**18**	**0**	**0**	**18**	**18**
Practical /Term Work / Sessions								
7	B20EM0703	Power System Analysis Lab	HC	0	0	1	1	**2**
8	B20EM0704	Signal Processing Lab	HC	0	0	1	1	**2**
9	B20EE0702	Major Project Phase-1	HC	0	0	2	2	**4**

TOTAL	0	0	2	2	**4**
TOTAL SEMESTER CREDITS					**20**
TOTAL CUMULATIVE CREDITS					**150**
TOTAL CONTACT HOURS					**25**

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20XXO8XX	Open Elective 4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessions								
2	B20EE0801	Major Project Phase-2	HC	1	1	5	7	13
TOTAL				1	1	5	7	**14**
TOTAL SEMESTER CREDITS								**10**
TOTAL CUMULATIVE CREDITS								**160**
TOTAL CONTACT HOURS								**17**

Professional Elective-1

Sl No	Course Code	Title of the Course
1.	B20EES401	Data Structures using Python
2.	B20EES402	Electrical Engineering Materials
3.	B20EES403	Energy Storage Systems
4.	B20EES404	Programmable Logic Circuits
5.	B20EES405	Switch Gear and Protection

Professional Elective-2

Sl No	Course Code	Title of the Course
1.	B20EES501	Design of Electrical Machines
2.	B20EES502	Electric Drives
3.	B20EES503	Embedded Systems & IOT
4.	B20EES504	Operation Research
5.	B20EES505	Smart Grid
6.	B20EES506	Relational Data Base Management System

Professional Elective-3

Sl No	Course Code	Title of the Course
1.	B20EES601	Advance Power Electronics
2.	B20EES602	Electric & Hybrid Vehicles
3.	B20EES603	Electrical Power Quality
4.	B20EES604	Modeling and Simulation of Electrical Machines
5.	B20EES605	Reactive Power Management
6.	B20EES606	VLSI Circuits and Design
7.	B20EES607	Big Data Analytics and Cloud Computing
8.	B20EES608	JAVA Programming

Professional Elective-4

Sl No	Course Code	Title of the Course
1.	B20EES701	Advance Control Engineering
2.	B20EES702	Fundamentals of Robotics
3.	B20EES703	HVDC
4.	B20EES704	Industrial Instrumentation and Automation
5.	B20EES705	Power System Planning and Reliability
6.	B20EES706	Computer Networks

Professional Elective-5

Sl No	Course Code	Title of the Course
1.	B20EES707	Advanced Electrical Machines
2.	B20EES708	Advanced Microcontrollers
3.	B20EES709	Electrical Standard & Electricity regulations
4.	B20EES710	Operation and Control of Power Systems
5.	B20EES711	Testing and Commissioning of Electrical Equipment
6.	B20EES712	Artificial Intelligence & Machine Learning Techniques

OPEN ELECTIVES OFFERED TO OTHER SCHOOLS

Sl No	Course Code	Title of the Course	Semester offered
1	B20EEO501	Energy Conservation	5
2	B20EEO601	Electrical Power Utlization and Safety ~~(Electrical Safety and Regulations)~~	6
3	B20EEO701	Renewable Energy System	7
4	B20EEO801	Trouble Shooting of Common Electrical Appliances	8

DETAILED SYLLABUS

I SEMESTER

Course Title	Calculus and Differential Equations				Course Type		Foundation	
Course Code	B20AS0102	Credits	3		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	3	4	4	36	0	50%	50%

COURSE OVERVIEW:

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

COURSE OBJECTIVE:

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

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of differential calculus in the field of wave theory and communication systems.		
CO2	Analyse and apply the knowledge of Partial differentiation in the field of Engineering.		
CO3	Understand the knowledge of multiple integrals to determine area,volume, etc.		
CO4	To apply the knowledge of linear differential equations in modelling.		

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO3		✓				
CO4			✓			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

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

and simple problems.
UNIT-4 **Differential equations** **Differential equations of first order:** solution of linear equations, Bernoulli's equations, Exact equations. (reducible to exact not included) **Linear Differential Equations:** Definitions, Complete solution, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral. Method of variation of parameters (simple problems). Cauchy's and Legendre's linear differential equations.

Text books:

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

Reference Books:

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

Journals:

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

SWAYAM/NPTEL/MOOCs:

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

1.	If $z = log(x^2+y^2)\ find\ \frac{\partial z}{\partial x}\ and\ \frac{\partial z}{\partial y}$
2.	If $x + y + z = logz\ find\ \frac{\partial z}{\partial x}\ and\ \frac{\partial z}{\partial y}$
3.	If $u = x^3 - 3xy^2 + x + e^x cosy + 1$, show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$
4.	If $u = \log\left(\frac{x^2+y^2}{x+y}\right)$ show that $xu_x + yu_y = 1$
5.	Verify $u_{xy} = u_{yx}$ for the following functions, i. $u = \sin^{-1}(y/x)$ ii. $u = x^y$ iii. $u = log\left(\frac{x^2+y^2}{x+y}\right)$
6.	If $u = log\sqrt{x^2 + y^2 + z^2}$, show that $(x^2 + y^2 + z^2)\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right) = 1$

7.	State and prove Euler's theorem for Homogeneous functions.
8.	If $u = \frac{x^3+y^3}{\sqrt{x+y}}$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{5}{2}u$
9.	If $u = sin^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, show that $xu_x + yu_y = 2tanu$
10.	Find the Jacobian of u, v, w w.r.t x, y, z given $u = x + y + z,\ v = y + z,\ w = z$
11.	If $x = rsin\theta\ cos\varphi,\ \ y = rsin\theta\ sin\varphi,\ z = rcos\theta$ show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2 sin\theta$
12.	If $x = rsin\theta\ cos\varphi,\ \ y = rsin\theta\ sin\varphi,\ z = rcos\theta$ show that $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2 sin\theta$
13.	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy\ dy\ dx$
14.	Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y\ dx\ dy$

Course Title	Engineering Chemistry				Course Type		Foundation	
Course Code	B20AS0104	Credits	3		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	3	3	3	36	0	50%	50%

COURSE OVERVIEW

Engineering chemistry covers very relevant topics compatible with ECE, EEE and C&IT students and make them aware of importance of various aspects of basic science in engineering.

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

COURSE OBJECTIVE

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

1. Engineering chemistry covers the very basic knowledge required for engineering students to understand its importance of Science in technology.
2. It provide the basic knowledge on Interaction of light and matter to know the electronic transitions in materials and storage and conversion devices.
3. Corrosion and metal finishing, explains the phenomenon of corrosion and its Prevention. It also covers the importance of metal finishing in various industries and fabrication of PCB

4. Polymers are all about the properties of various polymeric materials and their Commercial significance. The chapter reveals about technical and commercial Importance of composite materials.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the phenomenon of light and matter interaction to study the materials	1.2, 4	2
CO2	Demonstrate the electrode processes in Batteries and conversion devices.	1,2,7,11	2
CO3	Describe Corrosion phenomenon and precautions to be taken in the selection of materials in controlling corrosion, Fabrication of PCB and industrial applications.	1,2,4,7	2
CO4	Illustrate the properties of polymers, nano materials, composite materials and their applications in various fields.	1,2, 11,12	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT THEORY

Content
Unit -1
Light and matter interaction: Eelctro-magnetic spectrum-Applications in Engineering, Interaction of EM radiation with matter, work function of matter, Electrons in matter. Bonding theories: MOT, Band structure of matters HOMO-LUMO. Photochemical and thermal reactions: Laws of photochemistry, quantum yield, high and low quantum yield

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

Text Book:

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

Reference Books:

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

Journals/Magazines

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

SWAYAM/NPTEL/MOOCs:

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

PROBLEM BASED LEARNING

No	Problems
1	Calculation of wavelength and frequencies of the radiations

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

PROJECT BASED LEARNING

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

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

Course Title	Introduction to Python Programming				Course Type		Hardcore	
Course Code	B20CI0101	Credits	3		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	3	4	4	24	24	50	50

COURSE OVERVIEW

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

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

BOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT THEORY:

Contents

UNIT - 1
Introduction to Computer Fundamentals: Computer Components, accessories, specifications of computers and external devices. Flowchart symbols and guidelines, types and advantages, Algorithm design. **Python Fundamentals:** Introduction to Python: History, Applications, Your First Python Program, Constants, Variables, Naming conventions, simple data types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions. Introduction to GitHub and applications.
UNIT2 -2
Strings: Unicode, Formatting Strings, Format Specifiers, other Common String Methods, Slicing a String. **Regular Expressions:** Case Study: Street Addresses, Case Study: Roman Numerals, Checking for Thousands, Checking for Hundreds, Using the {n,m} Syntax, Checking for Tens and Ones.
UNIT - 3
Object Oriented Programming: Defining Classes, The init() Method, Instantiating Classes, OOP features: Abstraction. Encapsulation, Single Inheritance, Polymorphism. **Files:** Reading from Text Files, Writing to text files, Reading and Writing the Binary Files.
UNIT - 4
Numpy: Introduction to numpy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output. **Pandas and Data Visualization:** Introduction, Series and Data Frames in pandas and Data Visualization.

PRACTICE:

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

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

	b).The dictionary "**DICT1**" contains the pass percentage of each semester of B. Tech in CSE, where, " Semester" acts as the key and "Pass Percentage" acts as the value. A Python Pandas dataframe is required to be created using the dictionary "**DICT1**" and display it using a user defined function.		Pandas Series usability.
	Part-B (Mini Project: Library Management System)		
1.	Develop a program to create the **class "USER"** with the attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add_user(), delete_user(), edit_user(), search_user() should be part of the class. Instantiate "User" class with 10 objects. Read the attributes of each "User" object using input() and store them in the file "**User_File.txt**".	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes of user and store them in a file.
2	Develop a program to get the name of the "User" object whose details are to be deleted. Read the "**User_File.txt**" and delete the "User" object if found. Display the contents of "**User_File.txt**" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes and delete the object.
3	Develop a program to get the name of the **"User"** object whose details are to be edited (modified). Edit the details of the user object in the file "**User_File.txt**" and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
4	Develop a program to create the **class "BOOK"** with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add_book(), delete_book(), edit_book() and search_book(). Instantiate "Book" class with 10 objects. Read the attributes of each "**BOOK**" object using input () and store them in the file "**Book_File.txt**".	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes of user and store them in a file.
5	Develop a program to get the name of the "**BOOK**" object whose details are to be deleted. Read the "**Book_File.txt**" and delete the "**BOOK**" object whose details match with the data entered. Display the contents of "**Book_File.txt**" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes and delete the object.
6	Develop a program to get the name of the **"BOOK"** object whose details are to be edited (modified). Edit the details of the "**Book**" object in the file "**Book_File.txt**" and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
7	Develop a program to create the class **"TRANSACTION"** with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue_book(), return_book() and search_book(). Instantiate "Transaction" class with 10 objects. Read the attributes of each "Transaction" object using input() and store them in the file "**TransactionFile.txt**". Develop a program to **issue the book** as requested by the user. Update the attributes in "Transaction _File" and display the contents of file.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operations.

8	Develop a program to **return the book**. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in "**TransactionFile.txt**" and display the contents after modification. Compute the fine amount to be paid if return_date is not same as due_date. If both return_date and due_date are same and put zero in fine_amount.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operation.
9	Develop a program to search for a book using its **"author"**. Display the message **"available**" if search is successful otherwise display the message "not available".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
10	Develop a program to get a **list of users** by referring to "**User_File.txt" and "Transaction_File.txt".**	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
11	Develop a program to get **List of Books in stock** by referring to "**Book_File.txt" and "Transaction_File.txt".**	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
12	Develop a program to get **List of Books Issued** by referring to "**User_File", "Book_File" and "Transaction_File".**	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
13	Develop a project by integrating User, Books, Transaction and Reports Modules.	Windows/Linux OS, IDE, Jupyter	Module integration and project development.

Text Book:

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

Reference Books:

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

Journals/Magazines

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

4. https://ieeexplore.ieee.org/document/4160250
1. Python for scientific computing

SWAYAM/NPTEL/MOOCs:

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

Self-Learning Exercises:

a) Explore PYTHON library for IOT programming
b) More exploration on GIThub
c) Data Visualization packages
d) C modules interface

<table>
<tr><td>Course Title</td><td colspan="4">BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</td><td colspan="2">Course Type</td><td colspan="2">Hardcore</td></tr>
<tr><td>Course Code</td><td>B20EE0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Class Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>36</td><td>24</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

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

COURSE OBJECTIVE (S):

1. Explain the basics of electrical and electronics engineering terminologies.
2. Distinguish the single and three phase systems.
3. Illustrate the different building blocks in digital electronics using logic gates and explain simple logic functions using basic universal gates.
4. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
5. To build a broad concept for hands on experience in various types of electrical apparatus,
a. Tools and instrumentation with electrical safety norms.
6. To analyze the schematics for making electrical connection and to interpret experimental data for various electrical appliances

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Summarize the basics of electrical engineering terminology and the usage.	1-6	1,2
CO-2	Analyze the concepts and applications of DC & AC Machines.	1-5	1,2
CO-3	Apply the concept of domestic wiring, importance of safety and sensing devices	1-5,10	1,2
CO-4	Analyze the different building blocks in digital electronics using logic gates and applications of diode in rectifiers, filter circuits and wave shaping. .	1-5	1,2
CO-5	Interpret, Identify and use appropriate electrical tools for electrical connections and to repair electrical equipment's.	1,4	1,2
CO-6	Compare experimental results with theoretical analysis and the ability to critically evaluate the performance of electrical appliances.	1,5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2				√		
CO-3			√			
CO-4				√		
CO-5			√			
CO-6				√		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

CONTENT
UNIT-1
Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Resistive, Inductive, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations, Network Theorems (Superposition, Thevenin's & Norton's) Generation of an alternating Emf–average and rms values of alternating quantity–representation of alternating quantities by phasors–single phase series and parallel circuits (simple problems), three phase systems and power calculations.
UNIT-2
DC-Machines: Construction and Principle of operation of DC Machines–Emf & Speed equations-types–applications. AC-Machines: Principle of operation of single phase transformers–Emf equation–losses–efficiency and regulation-Construction and working principle of induction motors–Slip–torque characteristics–applications-Construction and Principle of operation of alternators applications.
UNIT-3
Instruments: Basic Principle of indicating instruments–PMMC&MI instruments. Tariff, Protective Devices and Sensors: Tariff schemes, basic concepts of domestic wiring and types, Earthing, protective fuses, MCB, sensors: pressure sensors, strain gage, proximity sensors, displacement sensors, Rotatory encoder and ultrasonic sensors and civil engineering applications.
UNIT-4
Diodes: Introduction, Physical operation of p-n junction diodes, Characteristics of p-n junction diodes, Zener diode, Rectifier circuits (half-wave, full-wave, bridge and peak rectifiers),Light emitting diodes. Digital Electronic Principles: Introduction, Binary digits, Logic levels and Digital waveforms, Introduction to basic logic operation, Number system, Decimal numbers, Binary numbers, Decimal-to-Binary conversion, Simple binary arithmetic.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Electrical Safety Training. a) To Study the importance of Earthing during accidental shorting of line wire and the body of equipment. b) To conduct experiment and to know the Importance and mechanism of FUSE c) To study the Importance and mechanism of MCB.	Trainer kit Ohms Law Fall of resistance	Importance & applications of Earthing, Fuse & MCB
2.	Home Electrical Wiring Demonstration. a) To study & verify the connection procedure for fluorescent lamp wiring.	Fluorescent Lamp wiring Panel	Connection & Trouble shooting of Fluorescent

	b) To study the connection of Fan with switch and regulator.	Fan with switch and regulator Kit	lamp wiring & Fan with switch and regulator
3.	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring	Two-way switch or staircase wiring Kit	Connection, Working & application of Two-way switch
4.	Behaviour of current and voltage in series and parallel circuits. a)To study and verify the behaviour of current and voltage in series circuit.	Series and parallel circuits Kit	Connection & behaviour of current & voltage in series , parallel circuit
	b) To study and verify the behaviour of current and voltage in parallel circuit.		
5.	Polarity test on single phase transformer. a)To determine the additive polarity of a single-phase transformer.	Transformer Kit	Polarities of single phase transformer
	b) To determine the subtractive polarity of a single-phase transformer.		
6.	Determination of VI characteristics of Zener Diode	VI characteristics of Zener Diode kit	VI characteristics of Zener Diode
7.	Determination of VI characteristics of Silicon Diode	VI characteristics of Silicon Diode kit	VI characteristics of Silicon Diode
8.	Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Rectifier kit	Determine the efficiency, Voltage regulation, ripple factor of rectifiers
9.	Determine the Characteristics of BJT in Common Emitter Configuration	Characteristics of BJT in Common Emitter Configuration	Input & Output Characteristics of BJT
10.	Determine the Characteristics of JFET in Common Source Configuration	Characteristics of JFET in Common Source Configuration	Input & Output Characteristics of JFET
11.	Realization of Universal gates using basic logic gates.	Trainer kit	Universal gates will be realized using basic gates

Text Book:

1. Nagrath I.J. and D. P. Kothari, “Basic Electrical Engineering”, Third Edition Tata McGraw Hill, 2009.
2. Hayt and Kimberly, “Engineering Circuit Analysis”, 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.
5. Hughes, E., “Electrical Technology”, Pearson, 2005.
6. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
7. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.

Reference Books:

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

Journals/Magazines

1. International Journal of Electrical Power and Energy Systems (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)
2. Journal of Electrical Engineering (https://link.springer.com/journal/202)

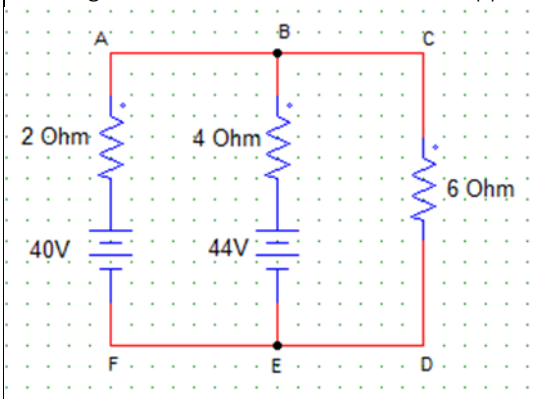
SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/108/108108076/

SELF-LEARNING EXERCISES:

a) Build a electrical circuit using BJT as a switch
b) Identifying the practical application of Electromagnetic Induction

PROBLEM BASED LEARNING

No	Problems
1	A current of 20A flows through two ammeter A and B in series. Potential difference across A is 0.2V and across B is 0.8 V. Find how the same current will divide between A and B when they are joined in parallel
2	For the given circuit calculate the current supplied by each battery and current in 6 ohm resistor. 
3	Two 12V batteries with internal resistances 0.2 ohm and 0.25 ohm respectively are joined in parallel and a resistance of 1 ohm is placed across the terminals. Find the current supplied by each battery.
4	A 6 pole induction motor is connected to a 50 Hz supply. It is running at a speed of 970 R.P.M. Find the synchronous speed and the slip
5	If A= $(1011)_2$ and B = $(1110)_2$, perform the following arithmetic operations. i)Addition ii) subtraction ii) Multiplication
6	Simplify the given Boolean expression and implement using logic gates. i)Y=AB+ABC+AB(D+E) ii) Y=ABCD+ABD iii) Y=AB+A(B+C)+B(B+C)
7	Simplify the given Boolean Expression: i) Y= XY+XYZ+XY$\bar{Z}$+$\overline{XYZ}$ ii) $Y = \bar{A}\bar{B}$C+$\bar{A}$B$\bar{C}$+$\bar{A}$BC iii) Y= AC+C(A+$\bar{A}$B)
8	a) Perform the following operations: (i)Convert $(01110111)_2$ to decimal (ii) Convert $(21)_{10}$ to binary (iii) Add: $(1010)_2$ and $(0011)_2$ (iv) Subtract: $(111.111)_2$ from $(1010.01)_2$ (v) Divide: $(101101)_2$ by $(110)_2$

PROJECT BASED LEARNING

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

No.	Suggested Projects
1.	Design & Development of a rectifier circuit
2.	Identify the types of wiring
3.	Electricity bill calculation
4.	Identify the types of motors used in domestic & industrial application with nameplate details.
5.	Identification of different transformer based on their rating used for various applications.

<table>
<tr><td>Course Title</td><td colspan="4">ELEMENTS OF MECHANICAL AND CIVIL ENGINEERING</td><td colspan="2">Course Type</td><td colspan="2">Hardcore</td></tr>
<tr><td>Course Code</td><td>B20ME0103</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>36</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

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

COURSE OBJECTIVE

This course enables graduating students

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

COURSE OUTCOMES (COs)

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

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY

CONTENT
UNIT-1
Introduction to Mechanical Engineering: Overview of Mechanical Engineering, Importance and applications of Mechanical Engineering in different fields. Thermal Energy Systems: Introduction to IC Engines, Classification, parts of IC Engine, working of 4-stroke Petrol engine with PV-diagram. Simple numerical on calculation of IP, BP and Mechanical efficiency, Introduction to refrigeration system, working of vapour compression refrigeration and window spit air conditioning system. Applications of refrigeration systems

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

Text Book:

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

Reference Books:

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

Journals/Magazines

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

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/103/112103262/#

2. https://www.my-mooc.com/en/mooc/fundamentals-manufacturing-processes-mitx-2-008x/
3. https://www.coursera.org/learn/3d-printing-applications

<table>
<tr><td>Course Title</td><td colspan="4">BIOLOGY FOR ENGINEERS</td><td colspan="2">Course Type</td><td colspan="2">Hardcore</td></tr>
<tr><td>Course Code</td><td>B20AS0109</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>12</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

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

COURSE OBJECTIVE

1. To inculcate the basic concepts of biology from engineering perspective among students
2. To understand the interplay between biology and engineering disciplines
3. To conceptualize the engineering design/process/product for life science challenges

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the biology concepts from engineering perspective.	1	1
CO2	Develop process/product related to the field of Life Sciences.	1,3	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

TEXT BOOK:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES

1. Current Sciences

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNING EXERCISES:

1. Case study: Bio based electrical engineering for sustainable society.
2. Biosensors and its applications in agriculture/Medicine electrical mechanical

PROBLEM BASED LEARNING

No.	
1	Case study: Bio based electrical engineering for sustainable society.
2	Case study: Biosensors and its applications in agriculture/Medicine electrical mechanical

Course Title	DESIGN THINKING			Course Type	Hardcore
Course Code	B20ME0102	Credits	2	Class	I Semester

	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Tutorial	0	0	0				
Design Thinking	Practice	1	2	2	Theory	Practical	IA	SEE
	Total	2	3	3	12	24	50%	50%

COURSE OVERVIEW

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

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

COURSE OBJECTIVES

1. To impart knowledge on design thinking process for understanding designs.
2. To provide design skills to analyze design thinking issues and apply the tools and techniques of design.
3. To inculcate attitude to solve societal problems using design thinking tools.

COURSE OUTCOMES (CO'S):

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the problems that fall under the purview of human centered design process for creative problem solving.	1,2 , 9,10,12	2
CO2	Create empathy maps to visualize user attitudes and Develop innovative products or services for a customer base using ideation techniques	1,2,9,10,12	2
CO3	Build simple prototypes for problems using gathered user requirements.	1,3, 9,10,12	1,2
CO4	Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.	1,4,8,9,10,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO4				✓		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

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

PRACTICE:

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

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

Text Books:

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

Reference Books:

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

Journals/Magazines/Additional Sources

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

SWAYAM/NPTEL/MOOCs:

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

SEMESTER – II

Title	Integral transforms				Course Type		Foundation Course	
Course Code	B20AS0203	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	4	4	4				
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	3	3	3	48	0	50%	50%

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

COURSE OBJECTIVE: This course enables graduating students to understand applications of the concepts Laplace and Fourier transforms in signal processing, communications, circuit design.

COURSE OUTCOMES (COs)

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO3			✓			
CO4			✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
A35012														
A35013														
A35014														
A35015														

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

COURSE CONTENT THEORY

Contents
UNIT-1
Definition, Transforms of elementary functions, properties of Laplace Transforms (without proof) problems. Transforms of periodic functions (only statement and problems) Unit step functions and unit impulse functions. Inverse Laplace transforms- Problems, convolution theorem (without proof) no verification and only evaluation of problems, solution of linear differential equation using Laplace transforms
UNIT-2
Convergence and divergence of infinite series of positive terms - definition, Periodic functions, Dirichlet's conditions and Fourier series of period functions of period 2π and arbitrary period , half range Fourier series , Complex form of Fourier series and Practical Harmonic analysis. Illustrative examples from engineering field
UNIT-3
Infinite Fourier Transform-Fourier sine and cosine transforms, Finite Fourier sine and cosine transforms, properties of Fourier transforms, Convolution theorem for F-transforms, Parseval's identity for F-transform . Applications of F-transforms to boundary value problems
UNIT-4
Z-transforms - Definition, standard Z-transforms, damping rule, shifting rule, initial value and final value theorems (proof), inverse Z-transform, application of Z-transform to solve difference equations.

Text Book:

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

Reference Books:

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

Journals/Magazines

1. https://www.researchgate.net/publication/323218108_A_review_on_applications_of_laplace_transformations_in_various_fields
2. https://www.researchgate.net/journal/10695869_Journal_of_Fourier_Analysis_and_Applications

SWAYAM/NPTEL/MOOCs:

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

PROBLEMS BASED LEARNING

1.	Find the Laplace transform of $f(t) = \begin{cases} t, & 0 < t < 4 \\ 5, & t > 4 \end{cases}$
2.	Find the Laplace transform of $f(t) = \begin{cases} sin2t, & 0 < t < \pi \\ 0, & t > \pi \end{cases}$
3.	Show that $\int_0^\infty t^3 e^{-t} sint\ dt = 0$
4.	Show that $\int_0^\infty te^{-2t} sin4t\ dt = \frac{1}{25}$
5.	Find the value of $\int_0^\infty te^{-3t} cos2t\ dt$ using Laplace Transform
6.	Evaluate $\int_0^\infty \frac{e^{-t} sint}{t} dt$ using Laplace transforms
7.	Evaluate $\int_0^\infty \frac{cos6t - cos4t}{t} dt$ using Laplace transforms
8.	Evaluate $\int_0^\infty \frac{e^{-at} - e^{-bt}}{t} dt$ using Laplace transforms
9.	If $f(t) = t^2,\ 0 < t < 2$ and $f(t+2) = f(t)$ for $t > 0$, find $L\{f(t)\}$
10.	A periodic function of period $2a$, is defined by $(t) = \begin{cases} E & for\ 0 \le t \le a/2 \\ -E & for\ a/2 \le t \le a \end{cases}$, then show that $L(f(t)) = \frac{E}{S} tanh\left(\frac{as}{4}\right)$
11.	If $L(f(t)) = F(s)$ then prove that $L\{f(t-a)U(t-a)\} = e^{-as}F(s)$
12.	Find inverse Laplace transform of the following (i) $\frac{s+5}{s^2-4s+13}$ (ii) $\frac{s^2}{(s+1)^3}$ (iii) $\frac{7s+4}{4s^2+4s+9}$
13.	Find inverse Laplace transform of the following (i) $log\left(\frac{s+a}{s+b}\right)$ (ii) $log\left(1 - \frac{a^2}{s^2}\right)$
14.	Using convolution theorem find inverse LT of the following functions

	(i) $\frac{s}{(s^2+a^2)^2}$ (ii) $\frac{s^2}{(s^2+a^2)(s^2+b^2)}$
15.	Solve by using Laplace transforms $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$ given $y(0)=y'(0)=0$
16.	Solve by using Laplace transforms $\frac{d^2y}{dx^2}+5\frac{dy}{dx}+6y=5e^{2x}$ given $y(0)=2, y'(0)=1$
17.	Solve by using Laplace transforms $x''-2x'+x=e^{2t}$ with $x(0)=0,\ x'(0)=-1$
18.	Obtain the Fourier series of $f(x)=x-x^2$ in $-\pi<x<\pi$. Hence deduce that $\frac{\pi^2}{12}=\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}----$
19.	Sketch the graph of the function $f(x)=\lvert x\rvert \quad in\ -\pi<x<\pi$ and hence obtain Fourier series. Hence deduce that $\frac{\pi^2}{8}=\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}----$
20.	Obtain the Fourier series for the function $f(x)=x$ in the interval$(-3,3)$.
21	Obtain the Fourier series expansion for the function $f(x)=\begin{cases}1+2x & in\quad -3<x<0\\ 1-2x & in\quad 0<x<3\end{cases}$
22	Obtain the Fourier series for the function $f(x)=2x-x^2$ in the interval$(0,3)$.
23	Obtain the sine half range Fourier series of $f(x)=x^2$ in $0<x<\pi$
24	Find a cosine series for $f(x)=(x-1)^2,\quad 0\le x\le 1$.
25	Find the complex Fourier transform of the function $f(x)=\begin{cases}1, & for \quad \lvert x\rvert\le a\\ 0, & for \quad \lvert x\rvert>a\end{cases}$ Hence evaluate $\int_0^\infty \frac{sin\,x}{x}dx$
26	Find the complex Fourier transform of the function $f(x)=\begin{cases}x, & for \quad \lvert x\rvert\le \alpha\\ 0, & for \quad \lvert x\rvert>\alpha\end{cases}$ where α is a positive constant.
27	Find the inverse Fourier sine transform of $\hat{f}_s(\alpha)=\frac{1}{\alpha}\,e^{-a\alpha},\ \ a>0.$
28	Solve the integral equation $\int_0^\infty f(\theta)\,cos\,\alpha\theta\,d\theta=\begin{cases}1-\alpha, & 0\le\alpha\le 1\\ 0, & \alpha>1\end{cases}$

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

Course Title	Engineering Physics				Course Type		Foundation course	
Course Code	B20AS0202	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	1	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	4	5	4	36	24	40%	60%

COURSE OVERVIEW

Engineering Physics is very important and necessary basic subject for all branches of engineering students. It provides the fundamental knowledge of basic principles of Physics which is required for basic foundation in engineering education irrespective of branch. This course introduces the basic concepts of Physics and its applications to Mechanical Engineering courses by emphasizing the concepts underlying four units .1 ELECTRICAL PROPERTIES OF MATERIALS, 2. SEMICONDUCTOR PHYSICS 3. MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS, and 4. OPTICAL PROPERTIES OF MATERIALS. This subject has basic laws expressions and theories which helps to increase the scientific knowledge to analyze upcoming technologies. The course also consists of real time and numerical examples which makes subject interesting and attractive.

COURSE OBJECTIVE

This course enables graduating students

1. To understand the basic concepts and principles of Physics to analyze practical engineering problems and apply its solutions effectively and efficiently.
2. To gain the knowledge of different physical phenomena, quantum/wave mechanics, and materials science.
3. To understand design issues, practical oriented skills and problem solving challenges

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	To identify the basic difference between the conducting, semiconducting and insulating materials. To classify conducting, semiconducting and insulating materials. To choose an appropriate material for the identified application	PO1, PO2, PO3	PSO1, PSO2, PSO3
CO2	To differentiate N type and P type semiconductors To setup an experiment to identify the give semiconductor is of n ype of p type	PO1,PO2, PO3	PSO1, PSO2, PSO3
CO3	Classify magnetic materials. Identify the appropriate application of the magnetic materials	PO1,PO2,PO3	PSO1, PSO2, PSO3
C04	Identify an optical material for the given application. Classify different types of optical materials.	PO1,PO2, PO3	PSO1, PSO2, PSO3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

CONTENTS
Unit-1
ELECTRICAL PROPERTIES OF MATERIALS Classical free electron theory – Expression for electrical conductivity – Thermal conductivity, expression – Wiedemann-Franz law – Quantum free electron theory-Success and failures – electrons in metals – Schrodinger Wave Equation(qualitative)- Particle in a one dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states(qualitative) – metals and insulators – Electron effective mass
Unit- 2
SEMICONDUCTOR PHYSICS Intrinsic Semiconductors – Energy band diagram – concept of hole-direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport – Einstein's relation – Hall effect and devices
Unit-3
MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS Magnetism in materials – magnetic field and induction – magnetization – magnetic permeability and susceptibility–types of magnetic materials – microscopic classification of magnetic materials – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown – high-k dielectrics.

Unit-4:
OPTICAL PROPERTIES OF MATERIALS Classification of optical materials – carrier generation and recombination processes – Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) – photocurrent in a P- N diode – solar cell –photo detectors – LED – Organic LED – Laser diodes – excitons – **NANOELECTRONIC DEVICES** Introduction – electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures – Density of states in quantum well, quantum wire and quantum dot structures, Carbon Nano Tubes and their properties.

Reference Books:

1. A Text book of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S. Chand & Company Ltd, New Delhi
2. Engineering Physics-Gaur and Gupta-Dhanpat Rai Publications-2017
3. Concepts of Modern Physics-Arthur Beiser: 6 th Ed;Tata McGraw Hill Edu Pvt Ltd- New Delhi 2006
4. Introduction to Mechanics — MK Verma: 2nd Ed, University Press(India) Pvt Ltd, Hyderabad 2009
5. Lasers and Non Linear Optics – BB laud, 3rd Ed, New Age International Publishers 2011
6. Solid State Physics-S O Pillai, 8th Ed- New Age International Publishers-2018

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Variation of Resistivity of intrinsic Semi-conductor crystal using four probe method		
2.	Determination Value of Planck's constant by using light emitting diode		
3.	Attenuation and propagation characteristics of optical fiber cable.		
4.	Determination of numerical aperture of a given optical fiber.		
5.	To find the laser parameters–wavelength and divergence of laser light by diffraction method.		
6.	Photo Diode Characteristics (Study of I–V characteristics in reverse bias and variation of photocurrent as a function of reverse voltage and intensity		
7.	Dielectric constant of a capacitor by charging and discharging of a capacitor		
8.	Determination of particle size using laser.		
9.	Band gap of intrinsic Semi-conductor		
10	Series and parallel LCR Circuits (Determination of resonant frequency and quality factor)		

PROJECT BASED LEARNING

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

No.	Suggested sample Projects
1.	Build a model of different types of sensors.(smoke detectors, water level detectors,)
2.	Preparation of graphene from graphite using a battery.
3.	Collect different type of materials and compare their mechanical and magnetic properties.

Course Title	Introduction to Data Science				Course Type		Hardcore	
Course Code	B20CS0101	Credits	3		Class		II sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	3	4	4	24	24	50%	50%

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the concepts of Data Science in developing the real world applications.	1, 2, 4,10	1,2,3
CO2	Apply the SQL commands in developing the real-world applications.	1,2, 3,9,10	2, 3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	2,3, 4, 8,9, 10	1, 2, 3
C04	Create the real world AI based solutions using different machine learning algorithms	2,3, 4,8, 9, 10	1, 2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

COURSE CONTENT

THEORY:

Contents
Unit-I
Introduction to Microsoft Excel Creating Excel tables, Understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Filters, Grouping. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.
Unit-II
Introduction to Data Science What is Data Science? Probability theory, bayes theorem, bayes probability; Cartesian plane, equations of lines, graphs; exponents, algorithms. Types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions
Unit-III
Data visualization using scatter plots, charts, graphs, histograms and maps Statistical Analysis: Descriptive statistics- Mean, Standard Deviation for Continuous Data, Frequency, Percentage for Categorical Data Introduction to SQL SQL: creation, insertion, deletion, retrieval of Tables by experimental demonstrations. Import SQL Database Data into Excel.
Unit-IV
Data science components Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Description of linear regression and Logistic Regression. Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression. Applications of Data Science

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

PRACTICE

<table>
<tr><th>No</th><th>Title of the Experiment</th><th>Tools and Techniques</th><th>Expected Skill/Ability</th></tr>
<tr><td>1</td><td>The height (in cm) of a group of fathers and sons are given below, Find the lines of regression and estimate the height of son when the height of father is 164 cm.
<table><tr><td>Plot the graph. Hgt of Fathers</td><td>158</td><td>166</td><td>163</td><td>165</td><td>167</td><td>170</td><td>167</td><td>172</td><td>177</td><td>181</td></tr><tr><td>Hgt of Sons</td><td>163</td><td>158</td><td>167</td><td>170</td><td>160</td><td>180</td><td>170</td><td>175</td><td>172</td><td>175</td></tr></table></td><td>MS Excel</td><td>Create and perform operations on Excel data set by applying Linear regression</td></tr>
<tr><td>2</td><td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES, perform the following:
i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trendline feature).
iv) Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
v) Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>3</td><td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.

i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trendline feature).
iv) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
v) Compute the coefficient of determination and the coefficient of correlation

Compute the coefficient of determination and the coefficient of correlation.</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
</table>

<table>
<tr>
<td>4</td>
<td>
<table>
<tr><td>Apply multiple linear regression to predict the stock index price which is a dependent variable of a fictitious economy based on two independent / input variables interest rate and unemployment rate.
year</td><td>month</td><td>interest rate</td><td>unemployment rate</td><td>stock index price</td></tr>
<tr><td>2020</td><td>10</td><td>2.75</td><td>5.3</td><td>1464</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Perform prediction and visualization of data</td>
</tr>
<tr>
<td>5.</td>
<td>
Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10,00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for a loan availed of Rs.10,00,000 during 3 years.
<table>
<tr><td>Sl No.</td><td>A</td><td>B</td></tr>
<tr><td>1</td><td>Principal</td><td>Rs.10,00,000</td></tr>
<tr><td>2</td><td>Annual interest rate</td><td>5.20%</td></tr>
<tr><td>3</td><td>Year of the loan</td><td>3</td></tr>
<tr><td>4</td><td>Starting payment number</td><td>1</td></tr>
<tr><td>5</td><td>Ending payment number</td><td>36</td></tr>
<tr><td>6</td><td>total interest paid during period</td><td>?</td></tr>
</table>
</td>
<td>MS Excel</td>
<td>Create Excel data and perform EMI estimator</td>
</tr>
<tr>
<td>6</td>
<td>Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO, should not be NULL.</td>
<td>SQL</td>
<td>Creating Tables</td>
</tr>
</table>

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

Text Book:

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

Reference Books:

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

Journals/Magazines

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

SWAYAM/NPTEL/MOOCs:

1. Excel Skills for Business: Essentials, Macquarie University (https://www.coursera.org/learn/excel-essentials)

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

SELF-LEARNING EXERCISES:

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

<table>
<tr><td>Course Title</td><td colspan="4">ELECTRICAL POWER GENERATION AND TRANSMISSION</td><td colspan="2">Course Type</td><td colspan="2">Hardcore</td></tr>
<tr><td>Course Code</td><td>B20EM0202</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory Hours</td><td rowspan="2">Practical Hours</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>36</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

This course deals with generation and transmission of electric power. In generation part, the power generation using fossil fuel, hydro and renewable energy sources like solar, wind. The course covers in detail the design, operation and generation of electric power in thermal power plants, hydroelectric power plants, nuclear power plants, solar photovoltaic, wind and other power plants. In the transmission part of electric power, overhead transmission components like conductors, insulators and towers will be dealt along with the concept of corona.

COURSE OBJECTIVE (S):

1. To know various conventional and non-conventional energy resources and learn the principle of their conversion process into electrical energy
2. To study the concepts of various power plant structure, their operations and control
3. To learn the concept of transmission and distribution system and to know about overhead transmission line
4. To read the basics of corona formation in overhead transmission lines and to know about the properties of various insulators

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO-1	Identify various sources of electrical generation and list the pros and cons of available energy sources	1,2	1

CO-2	Design a suitable scheme for transmission and distribution and also analyze the effects of various factors on overhead transmission lines	1, 2,3,4	1
CO-3	List various types of insulation and identify their suitable application	1,2	1
CO-4	Analyze the factors affecting corona formation and solve the issues related to it	1,2,4	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2						√
CO-3	√					
CO-4				√		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

CONTENT
UNIT-1
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-2

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-3

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-4

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 Book:

1. 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. L. Wadhwa "Electrical Power Systems", Wiley Eastern.

Reference Books:

1. Allen J wood & Wollenberg, "Power generation, operation and control", John Wiley and Sons, 2nd Edition
2. S M Singh, 'Electric Power Generation Transmission & Distribution, PHI, 2nd Edition, 2009
3. Dr S L Uppal, 'Electrical Power', Khanna Publications.

Journals/Magazines

1. International Journal of Electrical Power and Energy Systems (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)
2. Journal of Electrical Engineering (https://link.springer.com/journal/202)

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/102/108102047/

Self-Learning Exercises:

- Visit to nearby substations and observe the different types of insulators connected

PROBLEM BASED LEARNING

No	Problems
1	A transmission line has a spam of 150m between the level supports. The conductor has a cross sectional area of $2cm^2$. The tension in the conductor is 2000 kg. The specific gravity of the material is 9.9 gm/cc. The wind pressure is 1.5 kg/m. calculate the sag and vertical sag
2	Each line of a three phase transmission system is suspended by a string of three suspension insulators each containing 3 units and the voltage across the line unit is 22kV. The shunt capacitance is $1/10^{th}$ of the mutual capacitance. Calculate string efficiency
3	A 3Ø, 220V kV, 50 Hz transmission line consists of 1.5 cm radius conductor spaced 2m apart in equilateral triangular formation. If the temperature is 40°C and atmospheric pressure is 76 cm, calculate the corona loss per km of the line. Take m_o =0.85 and g_o = 21.2kV/cm (rms)
4	a)The following observations are made at the Hydropower plant at Nagarjuna Sagar from evening 8:pm to 5:00 am i. It is generating of excess of power and ii. Water from the tail race is sent back to the reservoir. Identify the type of this power plant and explain its working with a block diagram
5	An overhead transmission line has a span of 150m between level supports. The conductor has a cross sectional area of 2cm2. The ultimate strength is 5000 kg/cm2 & factor of safety (FOS) is 5. The specific gravity of the material is 8.9 gm/cc. The wind pressure is 1.5 kg/m. Calculate the height of conductor above the ground level at which it should be supported if a minimum clearance of 7m is to be left between ground & the conductor.
6	An overhead transmission line at a river crossing is supported from two towers at heights of 40m & 90m above water level, the horizontal distance between the towers is 400m.If the maximum allowable tension is 2000kg, find the clearance between the conductor & water at a point mid-way between the towers . Weight of conductor is 1 kg/m

Course Title	Electrical and Electronic Measurements				Course Type	Hardcore
Course Code	B20EM0201	Credits	4		Class	II Semester
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage
	Theory	3	3	3		

Course Structure								
	Practice	1	2	1	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	4	5	4	36	24	50	50

COURSE OVERVIEW

This course deals with electrical and electronic measuring instruments. The course covers units and dimensions of physical parameters and measurement of electrical quantities such as current, voltage, power, energy, power factor, frequency. The course also deals with various measurement systems.

COURSE OBJECTIVE (S):

1. To understand the significance of basic units and dimensions of physical quantities
2. To describe the principles of various measuring instruments and measurement standards
3. To introduce various measurement systems that comprise detector transducer, signal conditioning
4. and signal presentation
5. To propose measurement systems to measure physical quantities like temperature, pressure,
6. displacement, stress, frequency etc.,
4. To understand the working of various electrical bridge and energy meter.
5. To understand the working of Op-amps for signal processing circuits.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Elucidate the concept of several DC and AC bridges for resistance, inductance and capacitance	1,2,5	1,2
CO-2	Identify and use different type of transducers for various applications in industries	2,5	1,2
CO-3	Describe the construction and working of various electrical and electronic instruments	1,2	1,2
CO-4	Measure power and energy with the help of wattmeter and energy meter.	1,2,5	1,2
CO-5	Measure various parameters of given bridge.	1,2,5	1,2
CO-6	Apply the Op-amps in various signal processing circuits	1,5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1		√				
CO-2				√		

CO-3			√			
CO-4				√		
CO-5		√				
CO-6			√			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

CONTENT
Unit-1
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, Shielding of bridges, Desauty's bridge. Problems
Unit-2
Classification and selection of transducers. Strain gauges. Problems. LVDT, Problems Measurement of temperature and pressure. Photo-conductive and photo-voltaic cells. LCD and LED technology. Signal generators and function generators.
Unit-4
Introduction. True RMS voltmeter. Electronic millimeters. Digital voltmeters. Q meter. Problems. Dual trace oscilloscope — front panel details of a typical dual trace oscilloscope, Problems.. Method of measuring voltage, phase, frequency and period. Use of Lissajous patterns. Brief note on current probes, clamp on meters/ tong testers
Unit-4
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.

Construction and operation of single phase energy meter. Problems Smart metering system – AMR, e.g.: Tri-vector meter, ToD meter etc.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Measurement of Low resistance using Kelvin's Double Bridge(Both Hardware & Simulation)	Hardware Kit ORCAD PSPICE	Low resistance is measured & the result can be verified with the simulation
2.	Measurement of inductance using Maxwell's Inductance-Capacitance Bridge & Determination of Dissipation factor(Both Hardware & Simulation)	Hardware Kit, ORCAD PSPICE	Inductance is measured & the result can be verified with the simulation Phasor Diagram can also be analyzed
3.	Measurement of Capacitance using De-Sauty's Bridge & Determination of Q-factor(Both Hardware & Simulation)	Hardware Kit ,ORCAD PSPICE	Capacitance is measured & the result can be verified with the simulation, Phasor Diagram can also be analyzed
4.	Adjustment & calibration of 1-phase energy meter(only Hardware)	Hardware Kit	Energy meter to be calibrated for different errors & Calibration curve can be plotted
5.	Measurement of active & reactive power in balanced 3-phase circuit using 2- wattmeter method(only Hardware)	Hardware Kit	3-phase power can be measured
6.	Inverting, Non-Inverting & scale changing of signals using Op-amp(Simulation)	ORCAD PSPICE	Analyze the difference between Inverting and Non-Inverting Operational Amplifier
7.	RC-Phase shift oscillator using Op-amp (Simulation)	ORCAD PSPICE	Different frequency oscillations can be generated
8.	Rectifier circuits- Bridge rectifier, Diode clipping & clamping circuits (Simulation)	ORCAD PSPICE	Clippers , Clampers & rectifiers circuits are analyzed using diodes
9.	Schmitt Trigger-Inverting & Non- Inverting (Simulation)	,ORCAD PSPICE	Using Op-amp Schmitt Trigger circuit is realized for various UTP & LTP.

Text Book:

1. A. K. Sawhney, Dhanpatrai and Sons, "Electrical and Electronic Measurements and Instrumentation", New Delhi,19th edition,2011
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".

Journals/Magazines

1. https://www.journals.elsevier.com/flow-measurement-and-instrumentation
2. https://iopscience.iop.org/article/10.1088/0957-0233/8/3/024
3. http://ieee-ims.org/publications/other-publications
4. https://www.electricalindia.in/power/instrumentation/
5. https://ieeexplore.ieee.org/abstract/document/4483728

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ee44/preview

SELF-LEARNING EXERCISES:

a) Anderson's Bridge
b) Rectifier Circuits, Clippers, Clampers
c) Instrument Transformers

PROBLEM BASED LEARNING

No	Problems
1	In a low voltage Schering Bridge designed for the measurement of permittivity, the branch 'ab' consists of 2 electrodes between which the specimen under test may be inserted. Arm 'bc': a non-reactive resistor R3 in parallel with standard capacitor C3, Arm 'cd': a non-reactive resistor R4 in parallel with standard capacitor C4.Arm 'da': a standard air capacitor of capacitance C2.Without the specimen between the electrodes balance is obtained with following values;C3=C4=120pF, C2=150pF, R3=R4=5000Ω.With the specimen inserted these values become C3=200pF, C4=1000pF, C2=900pF and R3=R4=5000Ω. In each test ω=5000rad/s. Find the relative permittivity of the specimen.
2	A highly sensitive galvanometer can detect a current of 1nA.This is used in wheat stone bridge with each arm resistance of 1000Ω.If the battery voltage is 20V .Calculate the smallest change in the resistance which can be detected by the galvanometer. The resistance of galvanometer can be neglected.
3	A Kelvin double bridge is balanced with the following constants, outer ratio arms 100Ω and 1000Ω; Inner ratio arm 99.92Ω and 1000.6Ω;Resistance of link is 0.1Ω;standard resistance is 0.00377Ω.Calculate the value of unknown resistance
4	A coil has resistance of 20Ω is connected to terminals of a Q meter in the direct measurement made. Resonance occurs at an oscillator frequency of 6MHz and resonating capacitance of 200pF.Calculate percentage error introduced by the insertion of a resistance of 0.8Ω
5	A strain gauge has a resistance of 20Ω unstrained and the gauge factor is -28.What is the resistance value if the strain is 5%?
6	A three phase 58kVA load has a power factor of 0.157.The power is measured by two wattmeter method. Find the reading of each wattmeter when i) p.f is leading ii) p.f is lagging. Infer the result.

PROJECT BASED LEARNING

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

No.	Suggested Projects
1.	Simulate Kelvin double bridge in MATLAB. Also show the waveform for voltage across the Galvanometer. How would you balance the bridge?
2.	Simulate Maxwell Inductance Bridge for the following values in MATLAB. Also show the waveform for voltage across the Detector. How would you balance the bridge?
3.	Design an Oscillator circuit to generate an oscillation of 50kHz.
4.	Realize Schmitt Trigger circuit for various UTP & LTP. Calculate the reference value to obtain UTP=+8, LTP=+6.
5.	Design a Non-inverting Schmitt trigger without reference voltage with UTP=+5,LTP=-5.

Course Title	IoT and Applications				Course Type		Hardcore	
Course Code	B20EC0101	Credits	2		Class		II Semester	
IoT and Applications	TLP	Credits	Contact Hours	Work Load	Total Number of Class Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	1	2	2	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	2	3	3	13	26	50%	50%

COURSE OVERVIEW

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

COURSE OBJECTIVES

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

Course Outcomes (CO's):

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

CO#	Course Outcomes	POs	PSOs

CO1	Describe the architecture of IoT eco-system	1	1,2
CO2	Identify IoT devices, architecture, sensors and Communication protocols	1	1,2
CO3	Demonstrate the interface of sensors to IoT board	1,5, 12	1,2
CO4	Realize various Applications of IoT through case studies	1,5, 12	1,2
CO5	Develop simple IoT projects and modules	1,5,9, 12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENTS:

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

PRACTICE SESSION:

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

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

PART B: Case Study projects

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

PART C (Mini Project)

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

4	Touchless motion sensor trash can: build touchless motion sensor trash can	Arduino UNO, Ultra sonic sensor, Micro servo motor, Breadboard, Connecting wires	Design and Implementation of IoT project for Engineering applications

Text Books:

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

Reference Books:

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

SWAYAM/NPTEL/MOOCs:

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

SELF-LEARNING EXERCISES:

- Create Arduino project hub

<table>
<tr><td>Course Title</td><td colspan="4">ENTREPRENEURSHIP</td><td colspan="2">Course Type</td><td colspan="2">Hardcore</td></tr>
<tr><td>Course Code</td><td>B20ME0104</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">13Hrs/ Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>12</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

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

COURSE OBJECTIVE

1. To understand the basic terms, concepts in Entrepreneurship Development
2. To apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand and explain the key terms, definitions, and concepts used in Entrepreneurship Development		
CO2	Plan a startup and understand sources available for finance and the supporting schemes offered by state and central governments and other entrepreneurial development organizations		

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

CONTENTS

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

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

TEXT BOOK:

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

REFERENCE BOOKS:

1. Baringer and Ireland, Entrepreneurship, 11th Edition, Pearson, 2020.
2. P. Narayana Reddy, Entrepreneurship – Text and Cases, Cengage Learning India, I edition, 2010
3. "Corporate Entrepreneurship: Building The Entrepreneurial Organization" by Paul Burns published by Palgrave Macmillan.
4. Drucker F Peter,:"Innovation and Entrepreneurship", 1985.Heinemann, London.
5. Entrepreneurship in the New Millennium, India Edition Doanld F Kuratko & Richard M Hodgeth- South-Western, Cengage Learning

JOURNALS/MAGAZINES

1. International Small Business Journal: https://journals.sagepub.com/home/isb
2. Journal of Development Entrepreneurship: https://www.worldscientific.com/worldscinet/jde

SWAYAM/NPTEL/MOOCS:

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

SELF-LEARNING EXERCISES:

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

PROBLEM BASED LEARNING

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

Course Title	Electrical Safety, Earthing and Solar PV System				Course Type		Hardcore	
Course Code	B20EM0203	Credits	1		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	0	0				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	1	2	2	24	0	50%	50%

COURSE OVERVIEW

This course deals with general electric safety. The course also covers electrical safety guidelines for electrical home appliances along with earthing and Safety equipment's. Safety gadgets to be used Operation and Importance of Renewable energy resources is explained along with Construction, operation and Maintenance of Solar PV system .

COURSE OBJECTIVE (S):

1. To understand the importance of electrical safety in work place and safe practices.
2. To provide an overview of information regarding use of safety gadgets.
3. To understand and need of protection to avoid electrical hazards.
4. To understand the operation and Maintenance of Solar PV plants.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Understand the basic electric safety norms	1,6	1
CO-2	Use the appropriate electrical gadgets	1,6	1
CO-3	Adopt the best & safe practices while doing electrical work	1,6	1
CO-4	Understand the importance of Renewable Energy Resources, Installation and Maintenance	1	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create

	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)
CO-1		√				
CO-2		√				
CO-3		√				
CO-4			√			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

CONTENT
Basic concept of Electric safety, Hazards of electricity, Parameters affecting electric shock intensity, Effects of electricity on human body, IE Rule-1956 on Electrical safety.
Electrical safety work practices, Causes of accidents, Unsafe acts, Best practices. Electrical safety guidelines for electrical home appliances,
Type of earthing, Importance of earthing, Measurement of ground resistance, Soil resistivity, Parameters affecting earthing, Measurement of earth resistance, maintenance of earthing, Electrical joints & end terminations and temperature variation
Components of Solar PV Plants, Sizing of Solar PV, Measurement of Solar PV System, Installation of PV Plant, O&M of Solar PV system.

TEXT BOOK:

1. National Electrical Code 2011, Bureau of Indian Standard, 2011.
2. Handbook for Electrical Safety, Cooper Bussmann, Inc., St. Louis, MO 63178-4460, http://www.bussmann.com.
3. Electrical Workers' Safety Handbook, e-contractors.
4. www.ibew38.org/pdf/safety_handbook.pdf.
5. The safe use of Electricity in the home, www.esb.ie/esbnetworks.

REFERENCE BOOKS:

1. Princeton Energy Resources International , "Handbook of International Electrical Safety Practices" ,Wiley Publisher, 2011.
2. Rob Zachariason, "Electrical Safety", International Students 9th Edition, Pearson, 2005.

JOURNALS/MAGAZINES

1. https://www.safetyandhealthmagazine.com/keywords/Electrical%20safety
2. https://www.electricalindia.in/power/safety-power/

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
2. http://npti.gov.in/electrical-safety-industries-and-accidents-prevention

SELF-LEARNING EXERCISES:

1. Wind power plants installation, working and maintenance

III SEMESTER

Course Title	Linear Algebra and Partial differential equations				Course Type		HC	
Course Code	B20AS0305	Credits	3		Class		III Semester	
Linear Algebra and Partial differential equations	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Total	**3**	**3**	**3**	**39**		**50 %**	**50 %**

COURSE OVERVIEW:

Linear algebra is the study of linear systems of equations, vector spaces, and linear transformations. Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in science and engineering. The idea of the course was to give a solid introduction to PDE for advanced undergraduate students. We required only advanced calculus

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	apply the knowledge of Linear Algebra in Image processing and digital signal processing.	1,2,3,5,6	1,2
CO2	apply the knowledge of vector spaces in engineering like digital communication.	1,2,3,4,5,6	1,2,3
CO3	apply the knowledge of vector calculus in engineering like field theory.	1,2,3,4,5,6	1,2
CO4	apply the knowledge of PDE in solivng heat equation, wave equation and Laplace equation	1,2,3,5,6	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY:

Contents
UNIT - 1 **Linear Algebra**: Rank of matrix, Echelon form, (*reference-Normal form: one example), Solution of a system of linear equations by Gauss elimination (*reference-Gauss –Jordan methods: one example), Gauss seidel iterative method, Rayleigh Power method to find the largest Eigen value and corresponding Eigen vector. Linear and Inverse transformation. Diagonalisation of a matrix, Reduction of a quadratic form to canonical form by orthogonal transformation
UNIT - 2 **Vector Space**: Introduction to vector spaces and sub-spaces, definitions, illustrative examples and simple problems. Linearly independent and dependent vectors-definition and problems. Basis vectors, dimension of a vector space. Linear transformations- definition, properties and problems. Rank- Nullity theorem (without proof). Matrix form of linear transformations-Illustrative examples
UNIT - 3 **Vector Calculus**: Curves in space, tangents and normal, Velocity and acceleration related problems, scalar and vector point functions-Gradient, Divergence and curl, directional derivatives. Solenoidal and irrotational vector fields. Vector identities-div ($\emptyset A$), curl ($\emptyset A$), curl (grad$\emptyset$), div (curl A). **Line integral**-Circulation-work, Surface integral: Green's Theorem, Stokes Theorem. Volume integral: Divergence theorem. (**All theorems without proof, no verification, only evaluation)**

UNIT - 4

Partial differential equations: Formation of Partial differential equations by eliminating arbitrar constants and arbitrary variables. Equations solvable by direct integration , Solution of Lagrange' linear PDE. Method of variable separable-D heat equation, 1-D wave equation. Non-linear equations of the fir order. Charpits method.

Text books:

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

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

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th edition, 2013.

2. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

SWAYAM/NPTEL/MOOCs:

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

Course Title	ELECTRICAL CIRCUIT THEORY				Course Type			
Course Code	B20EE0301	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				

	Tutorial	1	2	1	Theory Hours	Tutorial Hours	CIE	SEE
	-	0	-	-				
	Total	4	5	4	42	28	50	50
Course Instructors	Course Lead							
	Theory				Practice			
	Dr. K. Narayana Swamy				Dr. K. Narayana Swamy			

Course overview

Electrical circuit theory is a fundamental and essential course for electrical engineers. The course deals with basic concepts of electrical circuits, Network theorems, Resonant Circuits, Initial and Transient conditions, Network Synthesis and Atttenuators. Students are taught to realize branch voltages and branch currents in electrical circuits, using the concepts discussed above.

COURSE OBJECTIVE (S):

1. To enable students to apply network theorems for solving network problems
2. To discuss the concept of resonance and the associated terminologies for different configurations of the tank circuit
3. To enable the students evaluate the transient response of RLC networks
4. To enable the students to realize a network through different forms
5. To design attenuator networks

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Solve network problems using KCL, KVL, loop, mesh and nodal analysis	1,2,3,4,5,10,12	1,2,3
CO-2	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	1,2,3,4,5,10,12	1,2,3
CO-3	Calculate the initial and transient conditions in power electronic circuits	1,2,3,4,5,10,12	1,2,3
CO-4	Develop network of immittance functions	1,2,3,4,5,10,12	1,2,3
CO-5	Calculate parameters an attenuator for the given specifications and also to analyze attenuation of a probe	1,2,3,4,5,10,12	1,2,3
CO-6	Evaluate the branch current and branch voltage using network theorems	1,2,3,4,5,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1		✓	✓	✓	✓	
CO-2		✓	✓	✓	✓	
CO-3		✓	✓	✓	✓	
CO-4		✓	✓	✓	✓	
CO-5		✓	✓	✓	✓	
CO-6		✓	✓	✓	✓	

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT THEORY

CONTENT
UNIT-1: 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
UNIT-2: 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-3: 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-4: 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.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1	Simulation of independent voltage source with resistive circuits	**MaTLab software tool**	**Able to realize the circuit to analyze and compare the simulation values with theoretical values**
2	Simulation of independent current source with resistive circuits	**MaTLab software tool**	**Able to realize the circuit to analyze and compare the simulation values with theoretical values**
3	Simulation of dependent voltage source with resistive circuits	**MaTLab software tool**	**Able to realize the circuit to analyze and compare the simulation values with theoretical values**
4	Simulation of dependent current source with resistive circuits	**MaTLab software tool**	**Able to realize the circuit to analyze and compare the simulation values with theoretical values**
5	Simulation of resonant circuits	**MaTLab software tool**	**Able to realize the circuit to analyze and compare the simulation values with theoretical values**

Text Book:

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

Journals/Magazines

1. IEEE Journals on Electrical Circuit Theory

SWAYAM/NPTEL/MOOCs:

Self-Learning Exercises:

IEEE Journals on Electrical Circuit Theory

<table>
<tr><td>Course Title</td><td colspan="4">Electrical Machines I</td><td colspan="2">Course Type</td><td colspan="2"></td></tr>
<tr><td>Course Code</td><td>B20EM0302</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="4">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory Hours</td><td rowspan="2">Practical Hours</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td></td><td>Total</td><td>4</td><td>5</td><td>5</td><td>42</td><td>28</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This course provides an introduction to Transformer and Induction Machines and its construction. It opens with an introduction to calculate the losses and efficiency of these machines. Different types of testing these machines to calculate losses and efficiency. Representations using power flow diagram. The course concludes with the introduction to Transformer and Induction Machines and its performances. The formation of rotating magnetic field in the air gap of an induction motor (IM), has been described, when the three-phase balanced winding of the stator is supplied with three-phase balanced voltage. The construction of the stator and two types of rotor – squirrel cage and wound (slip-ring) one, used for three-phase Induction motor will be presented. Also described is the principle of operation, i.e. how the torque is produced. The construction (the stator and two types of rotor – squirrel cage and wound (slip-ring) one), of the three-phase induction motor (IM), has been described. The equivalent circuit per phase of IM will be derived first, to be followed by the presentation of power flow diagram, wherein the various losses, and also where do they occur, are described.

COURSE OBJECTIVE (S):

To enable the students

1. To get familiarize with the theory, construction, classifications and working principle of transformers and Induction motors
2. To learn the necessity of different tests conducted on single phase transformer.
3. To learn about parallel operation on single phase transformers
4. To study the Classification and different connections of three phase Transformers.
5. To draw equivalent circuit & circle diagram for the performance Analysis of three phase induction motor.
6. To enable to understand the necessity of starters & speed control for 3 phase IM

COURSEOUT COMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Reveal their knowledge and understanding of energy conversion in Transformers and Induction machines.	1-6	1,2
CO-2	Analyze the concepts of fundamental torque equation	1-4	1,2
CO-3	Analyze the fundamental characteristics of Transformers	1-4	1,2
CO-4	Interpret experimental results and correlate them with theoretical predictions	1-5	1,2
CO-5	Analyze the fundamental concepts of rotating fields	1-5	1,2
CO-6	Analyze the fundamental characteristics of Induction machines.	1-5	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√	√		
CO-2	√	√	√	√		
CO-3	√	√	√	√		
CO-4	√	√	√	√		√
CO-5	√	√	√	√		
CO-6	√	√		√		√

COURSE ARTICULATIONMATRIX

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

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

COURSECONTENTS THEORY

CONTENTS
UNIT – I **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 **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 **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 **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 Ssarma, Mukesh K. Pathak, Cengage Learning, First edition, 2009.

Reference Books

1. Performance and Design of A C Machines, M G Say, C S B Publishers, 3rdEdition, 2002
2. Electrical Machines and Transformers, Kosow, Pearson, 2nd edition, 2007

Journals/Magazines

1. https://www.edx.org/learn/electricalmachines
2. https://mitpress.mit.edu/books/series/electrical machines-series
3. .https://www.ieee-ras.org/publications/ram

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_me74/preview
2.https://www.udemy.com/topic/electricalmachines/
3.https://www.coursera.org/specializations

Course Title	Problem Solving Using C Programming				Course Type		HC(Integrated)	
Course Code	B20EE0302	Credits	3		Class		III Semester	
Problem Solving Using C Programming	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2				
	-	-	-	-	Theory	Practical	IA	SEE
	Total	**3**	**4**	**4**	**26**	**26**	**50 %**	**50 %**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop an algorithm/flowchart to solve the computational problems	1,2,3,5	1,2,3
CO2	Use the appropriate data types, operators, and flow control statements in problem solving and data processing applications	1,2,3,5	1,2,3
CO3	Write C programs using derived data types like arrays to operate on block of data.	1,2,3,5	1,2,3
CO4	Solve complex problems using function approach .	1,2,3,5	1,2,3
CO5	Design and develop computer programs using the concept of structures.	1,2,3,5	1,2,3
CO6	Design and develop computer programs using the concept of pointers.	1,2,3,5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO1	3	3	2		2								2	2	1
CO2	4	3	2		3								3	2	1
CO3	3	3	2		3								3	3	2
CO4	3	4	3		3								3	3	2
CO5	3	3	4		2								3	2	3
CO6	3	3	2												

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

COURSE CONTENT
THEORY:

Contents

UNIT - 1

Introduction to C-language: Program development: Editor, compiler, interpreter, loader, linker, Integrated Development Environment(IDE).C language and its features, Structure of C program, C tokens, Keywords and Identifiers, Variables, constants, Data types, Input / output functions. Operators and Expressions: Arithmetic Operators, Operators Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional, Special Operators, Evaluation of expressions, Precedence of arithmetic operators.

UNIT - 2

Flow control statements and Arrays: Conditional branching : if, if-else, nested if, else if, switch statements.Unconditional branching: break , continue , goto, and return statements. Looping statements: while, do-while and for loops, Loops with break and continue. Arrays: Single dimensional and two-dimensional arrays.

UNIT - 3

Functions & Structures:

Function declaration, definition, and calling, Parameter passing mechanisms, call by value & call by reference, Recursion and related examples, Scope of variables : Global, local.

Structures : Introduction, Structure definition, declaring and initializing Structure variables, accessing structure members, Arrays of structures.

UNIT - 4

Pointers: Introduction to pointers, Accessing the address of variable , Declaring, and initializing pointers, Accessing a variable through its pointer , Pointer types, Pointer expressions, Accessing arrays through pointers.

PRACTICE SESSION:

Sl. No.	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	Write a Program to calculate and display the volume of a CUBE by reading its height, width and depth from keyboard.	Algorithm, Flowchart, C compiler.	Reading values from input device, calculating and writing results on output device.

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

	terms of his name, age, and salary. b. Write a program to illustrate how a file stored on the disk is read.		

TEXT BOOKS:

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

REFERENCE BOOK:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

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

- Journal: "Research and Development of C Language Programming Experiment Assistant Management Platform Based on Hybrid Architecture", by Elsevier;

link: https://www.sciencedirect.com/science/article/pii/S1877705811020534

SWAYAM/NPTEL/MOOCs:

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

link: https://www.coursera.org/specializations/c-programming

Course Title	**Analog Electronic &Linear Integrated Circuits**				**Course Type**		**Theory (Integrated)**	
Course Code	B20EM0301	**Credits**	**4**		**Class**		**III sem**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	1	Theory	Practical	IA	SEE
	Tutorial	0	-	-				
	Total	4	5	4	42	28	40	60

COURSE OVERVIEW

This course develops a fundamental understanding of the concepts behind analog electronic components like bipolar junction transistors and operational amplifiers.

COURSE OBJECTIVE

1. To provide an insight into features and characteristics of bipolar junction transistor, understand biasing techniques and modeling of bipolar junction transistors
2. To illustrate the application and its design of bipolar junction transistors as amplifiers and oscillators
3. To provide an insight into the features and basic configurations of operational amplifier
4. To employ operational amplifier in linear and non-linear applications

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	To describe the characteristics of bipolar junction transistor	1	1
CO2	To describe the operation of bipolar junction transistor	1	1
CO3	To employ bipolar junction transistor in amplifier and oscillator circuits	1,3	2
CO4	To describe the features of operational amplifiers	1	1
CO5	To describe the basic operation of operational amplifiers	1	1
CO6	To employ operational amplifiers in various linear and non-linear applications	1,3	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

4	3												2		
5	3												2		
6			2											2	

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

COURSE CONTENT THEORY

CONTENTS
Transistors : DC load line, Q point effect on signal swing, biasing techniques, discussion on bias stability, BJT transistor modeling (re models) for various CE configurations (fixed bias, voltage divider bias and emitter bias), Small signal BJT amplifiers: analysis of CE configuration using re-model (voltage divider); emitter follower
Amplifiers: 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)
Op-amp fundamentals: Op-amp structure, IC-741 structure and its characteristics, features of op-amp, 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
Op-amp applications: Precision rectifiers, limiting circuits, clamping circuits, A-D & D-A converters, Schmitt circuits (inverting and non-inverting), multivibrators (astable and monostable), triangular/rectangular waveform generator, low pass and high pass filters, band pass and band stop filters

Laboratory Content:

1. Design of RC coupled single stage BJT amplifier and determination of gain-frequency response and determination of input and output impedances
2. Design and testing of BJT R-C Phase shift Oscillator
3. Design and testing of BJT Hartley Oscillators
4. Design and testing of BJT Colpitt's Oscillators
5. Design of Class-B Push-Pull Amplifier and determination of its conversion efficiency
6. Design and testing of inverting, non-inverting & scale charging of signals using Op amps using simulation packages
7. Design and testing of RC phase shifting oscillator using op amps using simulation packages
8. Design and testing of RC coupled amplifier – frequency response for variation of bias & coupling using simulation packages
9. Design and testing of rectifier circuits – Bridge rectifier, diode clipping & clamping circuits using simulation package.
10. Design and testing of Schmitttrigger - inverting and non-inverting

Text Book:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education. 9th Edition
2. Muhammad H. Rashid, "Electronic Circuits and Applications", Cengage learning, 1st Edition
3. David A Bell, 'Operational amplifiers and linear IC's', PHI

4. Ramakanth A Gayakwad, 'Operational amplifiers and linear IC's', Pearson, 4th edition, 2007

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 Devices and Circuits", Cengage Learning, 1st Edition.
4. D P Leach, A P Malvino, &GouthamSaha, " Digital Principles and applications", Tata McGraw-Hill, 7th Edition, 2010.
5. Moshe Morris Mano, "Digital Design" Prentice Hall, 3rd Edition, 2008.
6. Roy & Choudary, 'Operational amplifiers and linear IC's', New age International.
7. Stanley William D, 'Operational amplifiers and linear IC's', 4th edition, Pearson Education

Journals/Magazines

1. https://www.springer.com/journal/10470
2. https://ieeexplore.ieee.org/document/386008
3. https://www.analog.com/en/education/education-library/op-amp-applications-handbook.html

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_ee45/preview
2. https://nptel.ac.in/courses/117/107/117107094/

Self-Learning Exercises:

1. Design and develop of electronic circuit for applications using bipolar junction transistors
2. Design and develop of electronic circuit for applications using operational amplifiers

Code: B20AS0301	**Environmental Science**	**L**	**T**	**P**	**C**	**Hrs/Wk**
Duration:16 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	Acquire knowledge about sources, effects and control measures of environmental pollution, degradation and waste management.
6	Explore the ways for protecting the environment.

COURSE OUTCOMES

After successful completion of this course, the student will be able to:	
1	Understand, analyse and execute favourable environmental conditions and the role of individual, government and NGO in environmental protection.
2	List the causes, effects & remedial measures and find ways to overcome them by suggesting the pollution-controlled products.
3	Classify different wastes, sources of waste and their effect on population
4	Demonstrate various water conservation methods and suggest appropriate technique for conservation of water
5	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.
6	Analyse the ecological imbalances and provide recommendations to protect the environment.

UNIT-1 **7Hr.**

ENVIRONMENT & ENVIRONMENTAL PROTECTION:

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment. 4 Hr

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations, Initiative and Role of Non-government organizations in India and world. 3 Hr

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

UNIT-2 **7 Hr.**

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. 3Hr

Environmental degradation: Introduction, Global warming and greenhouse effect,
Acid rain-formation & effects, Ozone depletion in stratosphere and its effect. 2 Hr
Waste management: Municipal solid waste, Biomedical waste and Electronic waste (E-Waste). 2 Hr

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

UNIT-3 **7Hr**

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. 4Hr

Natural resources:

Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance. Mineral resources - Types of minerals, Methods of mining & impacts of mining activities. Forest wealth - Importances, Deforestation-Causes, effects and controlling measures 3Hr

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

UNIT-4 **7Hr**

Ecology, ecosystem & field work:

Ecology-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem - Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. 3Hr

Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids. 2Hr

Field work:

Visit to waste water treatment and biogas plant at REVA university campus, and/or
Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. 2Hr

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

Sl. No	Reference Books
1	R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, Co-authored & Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.
2	R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.
3	Benny Joseph, "Environmental Studies", Tata McGraw – Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008.
4	Dr.S.M.Prakash, "Environmental Studies", Elite Publishers, Mangalore, 2nd Edition, 2009.
5	Rajagopalan R, "Environmental Studies – from Crisis to cure", Oxford University Press, New Delhi, 3rd Edition, 2016.
6	Anil Kumar Dey and Arnab Kumar Dey, "Environmental Studies", New age international private limited publishers, New Delhi, 2nd Edition, 2007.

7	Michael Allaby, "Basics of environmental Science", Routledge-Tayler & Francis e-library, New York, 2nd Edition, 2002.
8	Dr.Y.K Singh, "Environmental Science", New age international private limited publishers, New Delhi, 1st Edition, 2006.

MANAGEMENT SCIENCE - B20MGM301

Credits : 02

Course objective

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

Course Outcomes:

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

- Plan organizational structure for a given context in the organisation carry out production operations through Work-study.
- Carry out production operations through Work-study.
- Apply various principles in quality control.
- Understand the markets, customers and competition better and price the given products appropriately.
- Plan and control the HR function better.
- Evolve a strategy for a business or service organization.

UNIT-I:

Introduction to Management and Organisation: Concepts of Management and organization- nature, importance and Functions of Management. Systems Approach to Management - Taylor's Scientific Management Theory- Taylor's Principles of Management, Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory - Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management. Designing Organisational Structures: Basic concepts related to Organisation Depart mentation and Decentralisation.

UNIT - II:

Operations and Marketing Management: Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study --Basic procedure involved in Method Study and Work Measurement - Business Process Reengineering(BPR) Statistical

Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis. Purchase Procedure, Stores Management and Store Records - JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix. And Marketing Strategies based on Product Life Cycle. Channels of distribution.

UNIT - III:

Human Resources Management (HRM): Concepts of HRM. HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR.. Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development. Placement, Wage and Salary Administration, Promotion. Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating -Capability Maturity Model (CMM) Levels - Performance Management System.

UNIT - IV:

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

REFERENCE BOOKS:

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

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

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

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

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

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

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

Advanced Kannada
B20AHM301

Kannadigas Engineering Text Bo

B20AHM302
Basics of Kannada

REVA - non kannadiga-Basics of

Course Title	Analog Electronic &Linear Integrated Circuits Lab			Course Type	Lab
Course Code	B20EM0303	Credits	1	Class	III sem

Laboratory Content:

11. Design of RC coupled single stage BJT amplifier and determination of gain-frequency response and determination of input and output impedances
12. Design and testing of BJT R-C Phase shift Oscillator
13. Design and testing of BJT Hartley Oscillators
14. Design and testing of BJT Colpitt's Oscillators
15. Design of Class-B Push-Pull Amplifier and determination of its conversion efficiency
16. Design and testing of inverting, non-inverting & scale charging of signals using Op amps using simulation packages
17. Design and testing of RC phase shifting oscillator using op amps using simulation packages
18. Design and testing of RC coupled amplifier – frequency response for variation of bias & coupling using simulation packages
19. Design and testing of rectifier circuits – Bridge rectifier, diode clipping & clamping circuits using simulation package.
20. Design and testing of Schmitttrigger - inverting and non-inverting

Course Title	Electrical Machines-I Lab			Course Type	Lab
Course Code	B20EM0304	Credits	1	Class	III sem

SEMESTER IV

Course Title	Probability and Random Process				Course Type		Hard Core	
Course Code	B20AS0402	Credit	3		Class		IV Semester	
Probability and Random Process	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per		Assessment in Weight	
	Theory	3	3	3				
	Total	**3**	**3**	**3**	**39**		**50%**	**50%**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions.	1,2,3,4,5,6	1,2,3
CO2	Calculate probabilities, and derive the marginal distributions of bivariate random variables.	1,2,3,5,6	1,2,3
CO3	Calculate probabilities of absorption and expected hitting times for discrete time Markov chains with absorbing states.	1,2,3,5,6	1,2,3
CO4	Translate real-world problems into probability mode	1,2,3,4,5,6	**1,2,3**

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY:

Contents
UNIT - 1 **Statistics**: Mean, Mode, Median and standard deviation. Correlation, Coefficient of correlation and lines of regression. Rank correlation, Moments, skewness, kurtosis. Curve fitting by the method of least squares- Fitting curves of the form, $y = ax + b$, $y = ab^x, y = ae^{bx}, y = ax^2 + bx + c.$
UNIT - 2 **Probability and Statistics**: Random variables (discrete and continuous), Probability density function, probability distribution – Binomial, Poisson's, Exponential and Normal distributions and problems.[with proof for mean & SD for all distributions], probable error. Normal approximation to binomial distribution.
UNIT - 3 **Joint Probability distribution and Markov chain:** **Joint Probability distribution**:-Concept of joint probability, joint distributions –(both discrete and continuous random variables), independent random variables, problems on expectation and variance. **Markov chain:** Probability vectors, stochastic matrices, Fixed points, Regular stochastic matrices, Markhov chains, Higher transition probabilities. Stationary distribution of regular Markhov chains and absorbing states.

UNIT - 4

Sampling distribution: Sampling, Sampling distributions, standard error, Testing of hypothesis, Type I and Type II errors . Level of significance. Confidence limits of means , One tailed and two-tailed tests. Fitting Theoretical distribution to sample frequency distributions. Student's t-distribution ,Chi-square distributions and F-distributions.

Text books:

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

Reference Books:

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

JOURNALS/MAGAZINES/ ADDITIONAL SOURCES:

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

SWAYAM/NPTEL/MOOCs:

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

Course Title	Electrical Machines-II				**Course Type**		**Theory**	
Course Code	B20EM0401	**Credits**	**4**		**Class**		**IV sem**	
Course Structure	TLP	Credits	Contact	Work Load	Total Number of Classe		Assessment in Weightag	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**4**	**5**	**5**	**39**	**13**	**50**	**50**

COURSE OVERVIEW

This is the fundamental course for the Electrical Engineering program. Also an extension to the previous semester subject, Electrical Machines –I. It introduces the basic working principle and operation of different types of dc Machines. It also introduces the Synchronous machines and their analogy with operation. As the Synchronous

machine is one of the important machine used in all applications it is very much necessary to know about the construction, types and its operations. This subject gives the information of two important electrical machines.

COURSE OBJECTIVE

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 Machine.

COURSE OUTCOMES (COs)

CO#	Course Outcomes	POs	PSOs
CO-1	Understand the concept of electromechanical energy conversion in DC and synchronous machines	1,4	1
CO-2	Analyze the concepts of fundamental torque equation and rotating fields	1,2,4, 5	1
CO-3	Analyze the fundamental characteristics of DC and synchronous machines	1,3,4	1
CO-4	Interpret experimental results and correlate them with theoretical predictions	1,3,4	1
CO-5	Describe the parallel operation of alternators.	1,2, 4	1
CO-6	Understanding the behavior of motors under different loading conditions.	1,2, 4	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2		√		√		
CO-3				√		
CO-4		√	√			
CO-5		√				
CO-6		√				

COURSE ARTICULATION MATRIX

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

CO 1	3			1										
CO 2	1	2		3	1									
CO 3	3		1	2										
CO 4	1		3	2										
CO5	1	2		1										
CO6	1	2	1											

Course contents

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 [11Hrs] 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.

Laboratory (Content)

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

Text Book:

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

ReferenceBooks:

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

Journals/Magazines

1. https://ieeexplore.ieee.org/abstract/document/8952785
2. IS- Codes- On Electrical Machines

SWAYAM/NPTEL/MOOCs:

1. NPTEL- Electrical Machine-II- https://nptel.ac.in/courses/108/105/108105131/
2. NPTEL Electrical Machine-II- https://nptel.ac.in/courses/108/106/108106072/

Self-Learning Exercises:

1. Identifying the practical application of Electromagnetic Induction.
2. Modelling of Machine in MATLAB

Sub Code: B20EM0403	**Physics – Electromagnetism**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		2	1	0	3	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: B20EM0402	**Electrical Power Utilization**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		**2**	**1**	**0**	**3**	**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 [10Hrs]

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: [11Hrs]

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 [10Hrs]

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 **[11Hrs]**

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

<table>
<tr><td>Course Title</td><td colspan="4">Microcontrollers and Applications</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EE0401</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">III sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>Practice</td><td>1</td><td>1</td><td>1</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

Course Overview:

This course describes the basic of microprocessors and microcontrollers, It gives complete details 8 bit microcontroller 8051 and 16 bit Microcontroller MSP430: the details are Architecture, Features, Addressing Modes, Instruction Set, Programming and interfacing, ADC, DAC, PWM, Timers, SPI, I2C etc. This course is delivered through lectures, tutorials and assignments.

COURSE OBJECTIVE (S):

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 (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Recognize the architecture of the 8051 and MSP430 microcontrollers.	1,2	1,2
CO-2	Be adept at using various inbuilt features and external peripherals based on the requirement	1,2, 3	1,2
CO-3	Program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled using the microcontroller.	1-5	1,2
CO-4	Develop the ability to program any microcontroller knowing the features of the chosen IC.	1-5	1,2
CO-5	Analyze the data transfer information through serial & parallel ports.	1-5	1,2
Co-6	Illustrate how the different peripherals are interfaced	1-3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2	√	√	√			
CO-3	√	√	√	√		
CO-4	√	√	√	√		
CO-5	√	√	√	√		
CO-6	√	√	√			

COURSE ARTICULATION MATRIX

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

CO-6	2	3	3	1	1								1	

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

COURSE CONTENT

THEORY
UNIT-1: 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, Memory organization, External memory interfacing, stack, time delay calculations.
UNIT-2: Features of 8051 Instruction set of 8051 along with simple programs, addressing modes, programming in C, Timers/Counters and programming, Interrupts and programming.
UNIT-3: Communication and Interfacing 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-4: MSP 430 microcontroller MSP430 RISC CPU architecture, instruction set, on-chip peripherals of MSP430, Programming in 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)
3. *Kenneth J Ayala, The 8051 Microcontroller , (3/e), Thomson Delmar Learning, 2004*

Reference Books

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

Journals/Magazines

1. https://www.indiamags.com/icicibank/journal-of-microcontroller-engineering-and-applications
2. https://www.journals.elsevier.com/microprocessors-and-microsystems
3. https://mysubs.in/buy/journal-of-microcontroller-engineering-and-applications-journal-subscription
4. https://mysubs.in/buy/journal-of-microcontroller-engineering-and-applications-journal-subscription

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/topic/microcontroller/
2. https://nptel.ac.in/courses/117/104/117104072/

3. https://embeddedschool.in/microcontroller-programming/

Course Title	Data structures using Python				Course Type		SC	
Course Code	B20EES401	Credits	3		Class		III sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50**	**50**

COURSE OVERVIEW

Industrial Instrumentation and Automation is a fundamental and essential course for Process automation. Instrumentation is the science of automated measurement and control. Applications of this science abound in modern research, industry, and everyday living. From automobile engine control systems to home thermostats to aircraft autopilots to the manufacture of pharmaceutical drugs, power Plants, Oil and Gas, Refineries etc.. and automation surrounds us.

COURSE OBJECTIVE

1. Introduction to Programming and problem solving using python
2. To develop the Basic concepts such as Loops, functions, links, strings and tuples
3. To discuss Data structure algorithm such as searching and sorting dynamic programming and backtracking
4. To demonstrate data structures such as : dictionaries, classes and objects, defining user define data types such as linked list and binary search trees - Using python

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate the skills of programming using Python	-	-
CO2	Distinguish the different loops and functions used in Python		
CO3	Demonstrate the different data structure algorithms		
CO4	Demonstrate data structure algorithms using Python		
CO5			

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

Contents

Unit – 1 Demonstrate data structure algorithms using Python

Basics of python: Introduction to programming, downloading and installing python, python- variables, operations, conditional loops, functions, lists, strings, tuples. List operations, slices, binary search, numerical and structural induction, elementary induction sorting

Unit-2

Basics of algorithmic analysis: Input size, Asymptotic complexity, zero () notation, arrays versus lists, merge sort, quick sort, stable sorting

Dictionaries, optional arguments, default values, passing functions as arguments, higher order functions on lists.

Unit-3

Exception handling, basic input and output, handling files, string processing, N-Queens, recording all solutions, local global and non-local names, nested functions, stack Queue and heaps.

Unit-4

Abstract data types, linked list, binary search tress, height balanced binary search trees

Efficient Evaluation of recursive dentitions with other programming languages, C and manual memory managements, other programming paradigms functional programming.

Text books:

1. Roberto Tamassia ,Michael H. Goldwasser , Michael T. Goodrich,2013, "Data Structures and Algorithms in Python"
2. Narasimha Karumanchi , 2020 "Data Structure and Algorithmic Thinking with Python:"
3. Rance D. Necaise Department of Computer Science College of William and Mary, JOHN WILEY & SONS, INC. 2011 "Data Structures and Algorithms Using Python"

Reference books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 'Introduction to Algorithms', IT Press, 2002
2. Horowitz, Sahni, Anderson-Freed, 'Fundamentals of Data Structures in C', 2nd Edition, Universities Press, 2007
3. Joshi, 'Data Structures and Algorithms in C', Tata McGraw-Hill Education, 2010

<table>
<tr><td>Course Title</td><td colspan="3">Electrical Engineering Materials</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES402</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This particular subject covers the topics related to engineering materials, special application related to advanced materials and materials related to opto- electronics devices. This course supports the students to gain knowledge on all types of materials which is related to dielectric insulation and the magnetic materials which are used for different electrical applications.

COURSE OBJECTIVE

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 OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs

CO1	Understand various types of electrical & electronic materials & their applications.	1-2	1,2
CO2	Understand about magnetic materials with their applications.	1-2	1,2
CO3	Understand about properties of Dielectric & various types of dielectric materials.	1-2	1,2
CO4	Understand the special applications of the materials & modern techniques used for materials study.	1-2	1,2
CO5	Understand the superconductive materials with their applications.	1-2	1,2
CO6	Acquire the knowledge on insulating materials with their types.	1-2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PS02**
CO-1	2	2												
CO-2	2	2												
CO-3	2	2												
CO-4	2	2												
CO-5	1	2												

CO-6	1	2												

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

COURSE CONTENT

Contents
Unit 1: Introduction to Electrical and Electronic Materials [11Hrs] 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: Magnetic Materials [11Hrs] 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: Dielectrics [10Hrs] 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: Materials for Special applications [10Hrs]

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 Book:

1. Kapoor PL, "Electrical Engineering Materials", Khanna Publications.
2. K.M. Gupta Nishu Gupta, "Advanced Electrical and Electronics Materials; Processes and Applications", Wiley, First Edition, 2015.
3. P. Rai-Choudary, "MEMS & MOEMS Technology & applications", PHI, 2009.

Reference Books:

1. R.K. Shukla, Archana Singh, "Electronic Engineering Materials", McGraw Hill, 2012.
2. L Solymar, "Electrical Properties of Materials", Oxford, 9th Edition, 2014.
3. A.J. Dekker, "Electrical Engineering Materials", Pearson, 2016.

Course Title	Energy Storage System				**Course Type**		**Theory**	
Course Code	B20EES403	**Credits**	**3**		**Clas**		**IV Sem**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classe		Assessment in	
	Theory	3	3	3				
	Practice				Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50**	**50**

COURSE OVERVIEW

Understand batteries' basic chemistry, Identify the advantage and disadvantages of using alternative battery types, Understand the figure of merits, energy, and power density limits of each electrical energy storage component type, Examine battery testing standards, battery charging systems and state of charge measurement techniques, Learn about hybrid systems using batteries , Understand safety and second-life use of batteries, Learn about a variety of applications such as automotive and grid-energy storage systems

COURSE OBJECTIVES

1. To Validate the Necessity of Energy Storage and to study several 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 (COs)

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

CO#	Course Outcomes	POs	PSOs
CO#1	Explain and use different modes of energy storage	7,11	1
CO#2	Design and use of fuel cell for energy storage	5,4,8	2
CO#3	Perform calculation regarding energy efficiency	1,2,3	2
CO#4	Suggest cost-effective measures towards improving energy efficient and Energy	4, 6	3
CO#5	Develop the awareness on controlling of environmental pollution through implementing	9,10	3
CO#6	To elaborate the advancement in energy storage technologies	4,5	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO#1		L2	L3			
CO#2			L3		L5	
CO#3			L3		L5	
CO#4	L1	L2				
CO#5			L3	L4	L5	L6
CO#6		L2		L4	L5	

COURSE ARTICULATION MATRIX

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

CO#1	3	3	2	2	1	1	1	1	1	1	1	1	3	3
CO#2	2	2	3	3	3	3	1	2	2	1	1	1	2	3
CO#3	3	3	3	3	1	2	2	1	2	2	2	2	3	3
CO#4	2	2	1	1	2	2	2	1	1	3	3	3	2	1
CO#5	1	1	1	3	1	2	1	3	2	3	3	3	3	3
CO#6	1	1	2	1	3	3	3	2	1	2	3	3	2	3

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

COURSE CONTENTS

Unit	Syllabus
Unit-1	**Energy Demand 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

Reference Books:

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

Journals/Magazines

1. L. Chang, W. Zhang, S. Xu and K. Spence, "Review on distributed energy storage systems for utility applications," in *CPSS Transactions on Power Electronics and Applications*, vol. 2, no. 4, pp. 267-276, December 2017, doi: 10.24295/CPSSTPEA.2017.00025

SWAYAM/NPTEL/MOOCs:

https://online.stanford.edu/courses/xeiet139-energy-storage
https://www.edx.org/course/energy-systems-integration-a-trend-or-a-revolution

Sub Code: B20EES404	**Programmable Logic Controllers**	**L**	**T**	**P**	**C**	**C**
Duration: 14 Weeks		2	1	0	3	
Course Objectives	1. To provide knowledge levels of PLC programming 2. To train the students for creating ladder logic for PLC proces programming. 3. To apply the knowledge of Timers and Counters for Industr 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 cont 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

   William Bolton, 'Programmable Logic Controllers', fifth Edition

Sub Code: B20EES405	**Switchgear and Protection**	**L**	**T**	**P**	**C**	**CH**
Duration: 14 Weeks		**2**	**1**	**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.

Course Title	Microcontrollers and Applications Lab			Course Type	Lab
Course Code	B20EE0402	Credits	1	Class	IV sem

Course Title	Electrical Machines-II Lab			Course Type	Lab
Course Code	B20EM0404	Credits	1	Class	IV sem

Laboratory (Content)

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	Course Title	Duration Weeks	Course Type	L	T	P	C	Hrs/ Wk
B20AH0301	Communication Skills	8	FC	2	0	0	2	2

Prerequisites

Fundamentals in Spoken English.

Course Description

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

Course Objectives

The objectives of this course are to:

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

Course Outcomes

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

CO1. Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies (Speaking Skills).
CO 2. Build inferences from the text.
CO3. Make use of accurate writing skills using different components of academic writing.
CO4. Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic

Course Content

UNIT-1

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

UNIT-2

Interpersonal Skills: Grammar: Tenses; Wh-questions, Compound words; Phrasal verbs, Recommendations

UNIT-3

Multitasking Skills Grammar: Conditional Sentences, Homonyms; homophones, Subject-verb agreement.

UNIT 4

Communication Skills Grammar: Direct and indirect speech, Interpreting visual materials (line graphs, pie charts etc.), Single word substitutes.

Recommended Learning Resources (Text books)

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

Recommended Learning Resources (Reference books)

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

B20LS0301 Indian Constitution and Professional Ethics

COURSE OVERVIEW

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

the human rights and human values. It also helps to know the meaning of ethics and need of ethics in personal and professional life

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE CONTENT

THEORY:

UNIT – 1

Indian constitution: Sailent features, fundamental rights and duties (Directive principle and statepolicy), Legislature (Loka Sabha &Rajya Sabha), Executive (President& Governor) and Judiciary (Supreme court & high court), Composition and function of parliament, Council of ministers, prime minister, Speaker, Passing of bills.

UNIT – 2

Human Rights: Nature and Scope of human rights, Universal protection of human rights (UDHR),Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups (children, women & old-age).

Human values: Truth, Honesty, Loyalty, Love, Peace with examples, Difference between ethics, beliefs and morals.

UNIT – 3

Ethics: Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, human values(Good conduct, respect for elders), ethical human conduct (Gender equality), Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

UNIT – 4

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

TEXT BOOKS:

1.Kapoor, S.K., "Human rights under International Law and Indian Law", Prentice Hall of India, New Delhi, 2002.
2. Basu, D.D., "Indian Constitution", Oxford University Press, New Delhi, 2002.
3. Chakraborty, S.K., "Values and ethics for Organizations and Theory Practice", Oxford University Press, New Delhi, 2001.

REFERENCES BOOKS:

1. Meron Theodor, "Human Rights and International Law Legal Policy Issues", Vol. 1 and 2, Oxford University, Press, New Delhi, 2000.
2. M V Pylee, "An Introduction to Constitution of India", S Chand & Company, 5th Edition
3. Durga Das Basu, "Introduction to constitution of India", LexisNexis, 23rd Edition.

Self-Learning Exercises: Abuse of Technologies: Hacking and other crimes, addiction to mobile phone usage, video games and social networking websites

HUMAN VALUES B20AHM401

2-0-0-0

Course Objectives

1.Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.

2.Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

3. Strengthening of self-reflection.

4.Development of commitment and courage to act

Course Outcomes

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

- Understand the significance of value inputs in a classroom and start applying them in their life and profession.
- Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
- Understand the role of a human being in ensuring harmony in society and nature.
- Demonstrate the role of human being in the abetment of pollution.
- Describe appropriate technologies for the safety and security of the society as responsible human being.
- Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

Syllabus

Unit 1

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

Unit 2

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between

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

Unit 3

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

Unit 4

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

TEXT BOOKS

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

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

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

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

REFERENCE BOOKS

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

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

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

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

V SEMESTER

Course Title	CONTROL ENGINEERING				**Course Type**	**Theory**
Course Code	B20EE0501	**Credits**	**3**		**Class**	**VII Semester**
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage
	Theory	3	3			

Course Structure								
	Practice	1	2	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	4	5		42	28	50	50

COURSE OVERVIEW

Control engineering deals with concept of feedback control systems. In this course students are taught mathematical modelling of various physical systems. The time response and frequency response of different systems can be determined for various standard input signals. The concept of stability and error analysis is also dealt with. PID controllers and design of compensators to achieve the required time response and frequency response specification is covered in detail.

COURSE OBJECTIVES

1. To classify control systems and explain importance of feedback control systems.
2. To develop mathematical models of mechanical, electrical, and electro-mechanical systems in determining the transfer functions.
3. To perform time response analysis of linear control systems.
4. To perform the stability analysis using Routh-Hurwitz criteria.
5. To perform frequency response analysis of linear control systems.
6. To design the different compensators for achieving the desired response

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Classify and explain the importance of feedback control systems.	1	1
CO2	Model the physical systems mathematically.	1,2	1
CO3	Demonstrate the time responses of the system.	2	2
CO4	Demonstrate the frequency responses of the system.	2	2
CO5	Realize the system stability by using Routh-Hurwitz criteria.	2,3	2
CO6	Design the compensators for achieving the required response.	2	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

Unit 1: Modeling of control system and their representations

[14hrs]

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
[14hrs]
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
[14Hrs]
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.
Frequency response: Advantages of frequency domain analysis- Bode plot, Relative and absolute stability, Frequency response of closed loop system.
Unit 4: [14Hrs]
Design of compensators: Lead compensator, lag compensator, lead-lag/lag-lead compensators, their design. design of compensation using bode plot.

Textbooks:

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2017.
2. Benjamin C. Kuo, 'Automatic Control systems', Pearson Education, New Delhi, 2014 edition.
3. Syed Hasan Saeed, 'Automatic control systems', publishers of engineering and computer books, new Delhi, 6th edition,2012
4. K. Ogata, 'Modern Control Engineering', 4th edition, PHI, New Delhi, 2002.

Reference Books:

1. M. Gopal, 'Control Systems, Principles and Design', Tata McGraw Hill, New Delhi, 2018.
2. Norman S. Nise, 'Control Systems Engineering', 4th Edition, John Wiley, New Delhi, 2007.
3. Samarajit Ghosh, 'Control systems', Pearson Education, New Delhi, 2004
.
NPTEL:

1. https://nptel.ac.in/courses/108/106/108106098/

Course Title	Power Electronics				Course Type		Theory	
Course Code	B20EE0502	Credits	4		Class		V sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**4**	**5**	**5**	**39**	**13**	**50**	**50**

COURSE OVERVIEW

The course focuses on presenting concepts for conversion, control and monitoring of electric energy using power semiconductor devices. Methods for analyzing power electronic converters suitable for AC/DC, DC/DC and DC/AC electrical energy conversions are presented. Additionally, principles for designing power electronic converters, including their power semiconductors and passive elements are established. It provides an in-depth understanding of the theory of electrical energy conversion using power electronic systems that perform AC/DC, DC/DC or DC/AC conversion, including applications within renewable energy, energy saving and industrial applications. It helps in understanding the operating principles and modulation strategies for single-phase and three phase diode rectifiers, thyristor-based converters, as well as, switch-mode DC/DC power electronic converters and DC/AC inverters.

COURSE OBJECTIVE

1. To understand the characteristics and operation of power semiconductor devices.
2. To understand the operation and behavioral characteristics of thyristors.
3. To familiarize students to the principle of operation, of different phase-controlled rectifier circuits and ac voltage regulators.
4. To provide strong foundation of pulse width modulation techniques for further study of power electronic circuits and system.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Select the power semiconductor devices as per the usage based on various energy conversion and control application.	1,2	1,2

CO-2	Design of firing and commutation circuits for thyristorised converter configurations.	1-3	1,2
CO-3	Analyze various phase-controlled converter and ac voltage regulator configuration / topology with different types of loads.	1,3,4	1,2
CO-4	Formulate and analyze a power electronic design at the system level and assess the performance.	1-4	1,2
CO-5	Familiarize different types of choppers, inverter circuits and their roles in various applications.	1,3,4	1,2
CO-6	Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.	1-4	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2	√	√	√	√		
CO-3	√	√	√	√	√	
CO-4	√	√	√	√		
CO-5	√	√	√	√		
CO-6	√	√	√	√		

COURSE ARTICULATION MATRIX

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

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

THEORY

Unit-1

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

Unit-2

Introduction: Introduction to Thyristors and its family, static and dynamic characteristics, turn-on and turnoff methods-Commutation Techniques. Firing circuits- R, RC, UJT firing circuits & digital firing circuits, Ratings and protection of SCRs, series and parallel operation.

Unit-3

Phase Controlled Converters: Principle of phase control, Single phase and three phase converter circuits with different types of loads, continuous and discontinuous conduction.

AC Voltage Controllers: Types of single-phase voltage controllers, single-phase voltage controller with R and RL type of loads.

Unit-4

DC Choppers: Principle of chopper operation, control strategies, Types of choppers, step up and step-down choppers.

Inverters: Single phase voltage source bridge inverters, three phase bridge inverters with 180^0 and 120^0 modes Single-phase PWM inverters, current source inverters (qualitative approach)

Text books:

1. M.H. Rashid, "Power Electronics: Circuits, Devices, and Applications", Prentice-Hall International third edition 2006.
2. Daniel Hart, 'Power Electronics', Tata McGraw Hill, 2011
3. M D Singh and Khanchandani K B , "Power Electronics", TMH second edition 2001.

Reference Books:

1. Mohan / Undeland / Robbins , "Power Electronics: Converters, Applications, and Design", Wiley third edition 2008.
2. John G. Kassakian, Addison Wesley , "Principles of Power electronics".

Journals/Magazines

1. https://www.powerelectronics.com/markets/automotive/article/21120569/pmic-simplifies-powersupply-design-for-automotive-cameras.

2. https://www.powerelectronics.com/technologies/power-management/article/21121246/calorimeter-deliberately-drives-liion-cells-into-thermal-runaway-and-explosion.
3. http://www.power-mag.com/pdf/feature_pdf/1619093954_GaNSys_feature.pdf.
4. https://www.ieee-pels.org/publications/ieee-open-journal-of-power-electronics.

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/102/108102145/
2. https://www.powerelectronics.com/
3. https://www.my-mooc.com/en/mooc/capstone-design-project-in-power-electronics/

SELF-LEARNING EXERCISES:

No.	Suggested Activities
1	Simulation study of buck-boost (Step up/Step down) converter using PSIM software.
2	Simulation Study of IGBT based single phase full bridge inverter connected to R load.
3	Simulation of Single phase fully controlled rectifier with R and RL loads & plot the graph of output voltage Vs delay angle (α).
4	Simulation of speed control of DC motor using single phase semi converter.

PROBLEM BASED LEARNING

No.	Suggested Problems
1	A BJT switch is used to connect a 24V dc supply across a relay coil, which has a dc resistance of 200Ω. An input pulse of 0 to 5 v amplitude is applied through a series base resistor R_B at the base so as to turn ON the transistor switch. It is given that $V_{CE(sat)} = 0.2V$, $V_{BE(sat)} = 0.7V$ and $\beta = 25$ to 100. Sketch the device current waveform with reference to the input pulse. Calculate i) $I_{CS,}$ ii) Value of resistor R_B required to obtain over drive factor of 2, iii) Total power dissipation in the transistor that occurs during the saturation state.
2	An ac voltage controller has a resistive load of R = 10Ω and the rms input voltage is V_s= 120 V, 60 Hz. The thyristor switch is ON for n=25 cycles and OFF for m= 75 cycles. Determine the i) rms output voltage 'V_0', ii) Input power factor PF and iii) Average and rms current of thyristor.
3	A step-down chopper with resistive load has a resistance of 10Ω and the input voltage is V_s= 220V. When the converter switch remains ON, its voltage drop is 2V and the chopping frequency is f= 1KHz. If the duty cycle is 50%, determine i) Average output voltage ii) RMS output voltage iii) Chopper efficiency iv) The effective input resistance of chopper.
4	Calculate the RMS values of the fundamental and the two lower harmonics of a single-phase full bridge inverter employing single-pulse width modulation for output voltage control. The modulation index is 80% and the dc input voltage is 230V.

PROJECT BASED LEARNING

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

No.	Suggested Projects
1	Develop a home-automation system with an RF controlled remote.

2	Design of a high-efficiency and low-cost drive, which is capable of supplying a single-phase AC to an induction motor with reference to a PWM sinusoidal voltage.
3	Implementation of Industrial Battery Charger by Thyristor Firing Angle Control.
4	Solar Smart Inverter: A Novel Design using Multi level Topology and Pulse Width Modulation with Load Detection**.**

COURSE PACK FOR Programming Language C++

Course Title	**Programming Language C++**				**Course Type**			
Course Code		**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	3	3				
	Practice	1	1	1	Theory Hours	Practical Hours	CIE	SEE
	-	0	-	-				
	Total	**3**	**4**	**4**	**42**	14	**50**	**50**

COURSE VIEW

Object Oriented Programming (OOP) using the C++ language. Topics covered will be C++ classes/objects, input/output streams, overloading, inheritance, templates. students entering the course should already be familiar with the C programming language..

COURSE OBJECTIVE (S):

To enable the students

1. To get familiarize with Oops concepts.
2. To learn the concepts of different operators, arrays and pointers in C++.
3. To learn Objects and Classes.
4. To learn about overloading.
5. To understand pointers and its application.
6. To understand the concept of inheritance and Memory management.

COURSEOUT COMES(COs)

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

CO#	Course Outcomes	Pos	PSOs
CO-1	Reveal their knowledge and understanding about object-oriented programming.	1	1,2

CO-2	Gain knowledge about the different types of functions used in C++.	1,2, 3	1,2
CO-3	Understanding the concepts of array and strings in C++.	1,2	1,2
CO-4	Apply the concept of overloading	1-5,8	1,2
CO-5	Use the pointers appropriately for the required application.	1-5	1,2
CO-6	Apply the concept of object-oriented programming: Such as inheritance, data hiding and Memory management.	1-5	1,2

BLOOM'S LEVELOF THECOURSE OUTCOME

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2	√	√				
CO-3	√	√				
CO-4	√	√	√			
CO-5		√	√			
CO-6	√	√	√	√		

COURSE ARTICULATIONMATRIX

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

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

COURSE ASSESSMENT

S No	Component		Duration inHours	Component WiseMarks	Total Marks	Weightage	Marks
1	Continuous Internal Evaluation (CIE)	Theory:Test-1	75 min	30	100	50%	50
2		Theory:Test-2	75 min	30			
3		Alternate Assessment*	-	20			
4		Practical Exam	2 Hours	20			
5	Semester End Exam(SEE)		3 Hours	100	100	50%	50
						Total Marks	**100**

* Assignment ,Quiz, Classtest, SWAYAM/NPTEL/MOOCsandetc.

COURSECONTENTS

THEORY

UNIT – I **Introduction:** What is object oriented programming? Why do we need object oriented. Programming characteristics of C and object-oriented using C++. C++ Programming basics : Output using cout and Input with cin. Input and Output Directives. Boolean data type. The setw manipulator. Type conversions in C++.
UNIT – II **Functions :** Returning values from functions, Functions with Reference arguments, Overloaded functions, Inline function and functions with default arguments. Functions with Returning by reference. Object and Classes: Making sense of core object concepts (Encapsulation, Abstraction, Polymorphism, Classes, Messages Association, Interfaces) Implementation of class in C++. C++ Objects as physical object, C++ object as data types. Constructors in C++. Objects as function arguments. The default and copy constructors. Returning object from a function. Structures and classes. Classes objects and memory: static class data. Constant and classes.
UNIT – III Arrays and string fundamentals. Arrays as class Data Members: Arrays of objects String: The standard C++ String class. Operator overloading: Overloading unary operations. Overloading binary operators. Pitfalls of operators overloading and conversion keywords: Explicit and Mutable.
UNIT – IV **Inheritance :** Concept of inheritance: Derived class and based class. Derived class constructors, member function. Class hierarchies, inheritance, public and private inheritance. Aggregation : Classes within classes, inheritance and program development.

Pointer : Addresses and pointers. The address of pointer and arrays. Pointers and Function pointers, pointers to objects
Memory management: New and Delete.

Text Books

1. E. Balagurusamy – Object Oriented Programming with C++, Fifth edition, Tata McGraw Education Hill , 2011.

2. Ashok N. Kamthane, Object oriented Programming with ANSI & Turbo C++, First Edition, Pearson India

Reference Books

1. Robert Lafore, Object Oriented Programming in Turbo C++, First Edition, Galgotia Publications.

2. D Ravichandran, Programming with C++, Second edition, Tata McGraw- Hil

Journals/Magazines

1. C++ Forum
2. ACM digital library
3. C++ Links.

SWAYAM/NPTEL/MOOCs:

1. C++ Programming : Step-by-Step Tutorial | Udemy
2. C++ Course - Basic To Advanced Concepts - codingninjas.com
3. Object-Oriented Data Structures in C++ (Coursera)
4. **mooc.com/en/mooc/introduction-c++**

Course Title	**DESIGN OF ELECTRICAL MACHINES**				**Course Type**		**Integrated**	
Course Code	**B20EES501**	**Credits**	**3**		**Class**		**Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	4	4				
	Practice	0	0	0				

	-	0	-	-	Theory Hours	Practical Hours	CIE	SEE
	Total	**4**	**4**	**4**	**42**	**0**	**50**	**50**

Course Overview

Design of Electrical Machines is a fundamental and essential course for electrical engineers. The course deals with basics and fundamentals of electrical machine design, design of DC motor and DC generator, design of single and three phase transformers, design of three phase induction motors and design of synchronous machines. The basic fundamental design knowledge of these machines is the basis in the industry to develop actual machines

COURSE OBJECTIVE (S):

Enable the students to

1. Distinguish between conductors, insulators and magnetic materials and also to estimate the design parameters of DC generator and DC motor for practical applications
2. Distinguish between single phase and three phase transformers for practical applications
3. Distinguish between squirrel cage and slip ring induction motors for practical applications
4. Estimate the design parameters of squirrel cage and slip ring induction motors for practical application
5. Distinguish between synchronous generator and synchronous motor for practical applications
6. Estimate the design parameters of synchronous generator and synchronous motor for practical application

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Acquire knowledge to understand basics of machine design and carry out a detailed design of a dc machine and provide the information required for the fabrication of the same along with an estimate of various performance indices.	1,2	1
CO-2	Acquire knowledge to carry out a detailed design of a transformer and provide the information required for the fabrication of the same	1,3	1
CO-3	Distinguish between squirrel cage and slip ring induction motors for practical applications	1,2	1
CO-4	Estimate the design parameters of squirrel cage and slip ring induction motors for practical application	1,3,4	1
CO-5	Distinguish between synchronous generator and synchronous motor for practical application	1,3	1

CO-6	Design the parameters of salient and non salient pole machines.	1,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√			
CO-2	√	√	√			
CO-3	√	√	√			
CO-4	√	√				
CO-5	√	√				
CO-6	√	√				

COURSE ARTICULATION MATRIX

Acquire knowledge about the constructional details and principle of operation of dc machines.

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

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

Course Content

Theory

CONTENT
Basics of Electrical Machine Design: 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, 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, main poles and interpoles, field windings – shunt, series and interpoles.
Single Phase and Three Phase Transformers Design: 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, estimation of number of turns, 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)
Three Phase Induction Motor Design: 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~~.
Synchronous Machines: 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.

Text Book:

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

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' Shanmugasundarm, G,Gangadharan,R.Palani, 'Design Data Handbook', AWiley Eastern L

Course Title	ELECTRIC DRIVES	Course Type	Integrated

Course Code	B20EES 502	Credits	3		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	4	4				
	Practice	0	0	0	Theory Hours	Practical Hours	CIE	SEE
	-	0	-	-				
	Total	**4**	**4**	**4**	**42**	**0**	**50**	**50**

Course overview

The course aims at giving a broad overview of Electrical Drive Systems. This study gives a prior exposure to Electrical Machines and power electronics. The control principles of various DC and AC motors using solid state converters are discussed. Principles of selection of electric motors are introduced. Some of the applications of electrical drives are also highlighted.

COURSE OBJECTIVE (S):

1. To Investigate dynamics of electric drives, their nature and classification, applying concepts of steady state stability.
2. To familiarize the operation principles, design of braking, and speed control arrangements for electric motors and their applications.
3. To have knowledge of various speed control method of DC drives for different applications.
4. To understand the operation of drive and able to analyze any type of 1Φ & 3Φ rectifiers fed DC motors as well as chopper fed DC motors.
5. Learn speed control of induction motor drives in an energy efficient manner using power electronics.
6. Learn speed control of induction motor drives and their behavior in transient operations.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Understand the principle of operation, dynamics and selection of electrical drive systems.	1,2	1

CO-2	Illustrate speed – torque characteristics and classify different types of braking methods for AC and DC Drives	1,2	1
CO-3	Analyse the performance of control rectifier fed DC Drives	1,4	1
CO-4	Analyse performance of chopper fed DC Drives	1,5	1
CO-5	Analyse performance of Induction motor under unbalancing and single phasing	1,2	1
CO-6	Understand various speed control methods of converter fed Induction Motor Drives	1,5	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2	√	√	√			
CO-3	√	√		√		
CO-4	√	√		√		
CO-5		√		√		
CO-6	√	√	√			

COURSE ARTICULATION MATRIX

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

CO-6	3				2								1	

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

Course content

Basic Elements of Electrical Drives: 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.
DC Drives: Braking- Regenerative, Dynamic, Plugging, related Problems. AC Drives: Induction motor Drive- Speed-Torque characteristics for braking- regenerative, dynamic, plugging.
Speed Control of DC Drive: 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,
Speed control of Induction Motor Drives: 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 Book:

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.

Reference Books:

1. P.C. Sen, 'Principles of Electric Machines and Power Electronics', John Wiley & Sons, 2nd Edition, 1996.
2. Vedam Subrahmaniam, 'Electric Drives', TMH, 1994 R. Krishnan, 'Electrical Motor Drives', PHI, 2003
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

Course Title	EMBEDDED SYSTEMS AND IOT				Course Type		Theory	
Course Code	B20EEPE12	Credits	3		Class		V Sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightag	
	Theory	3	3	3				
	Practice	1	2	1	Theory	Practical	IA	SEE
	Tutorial	0	-	-				
	Total	4	5	4	42	28	40	60

Course overview

Embedded Systems and Internet of Things raises significant challenges that could stand in the way of realizing its potential benefits. Attention-grabbing headlines about the Internet-connected devices, surveillance concerns, and privacy fears already have captured public attention. Embedded Systems deals with the components and various ICs and PCBs execute the code. Internet of Things deals with the IPs, TCP and UDP for the connected embedded devices. Technical challenges remain and new policy, legal and development challenges are emerging. The Internet of Things is an emerging topic of technical, social, and economic significance. Consumer products, durable goods, cars and trucks, industrial and utility components, sensors, and other everyday objects are being combined with Internet connectivity and powerful data analytic capabilities that promise to transform the way we work, live, and play.

COURSE OBJECTIVE

- To provide knowledge about the basics of embedded systems and embedded system design
- To describe Internet-of-Things and design principles
- To explain the ease of prototyping and production, and think of deployment for the community.
- To gain expertise in integrating sensing, actuation and software
- To give knowledge about internet principles and techniques for writing embedded cod

COURSE OUTCOMES (Cos)

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

CO#	Course Outcomes	Pos	PSOs
CO1	Explain the basics of embedded systems and design embedded systems	1-4	1,2
CO2	Design and Develop Internet-of-Things based applications	2-4	1,2
CO3	Develop prototypes of Internet-of-Things based applications, and deploy for the usage of the community	2-4	1,2
CO4	Develop the prototype of online components and protocols	2-4	1,2
CO5	Integrate sensing, actuation, and software	1-4	1,2
CO6	Write embedded code for constrained sensor devices	1-4	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

1	2	3	1	1									1	1
2		2	3	1									1	1
3		1	3	2									1	1
4		1	3										1	1
5	2	2	1	3									1	1
6	1	1	2	2									1	1

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

Course Content

INTRODUCTION TO EMBEDDED SYSTEMS : 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.
THE INTERNET OF THINGS: AN OVERVIEW & DESIGN PRINCIPLES : 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.
PROTOTYPING IOT DEVICES : 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).
INTERNET PRINCIPLES AND TECHNIQUES FOR WRITING EMBEDDED CODE : 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).

Text Book:

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.

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)

Journals/Magazines

1. https://www.comsoc.org/publications/magazines/ieee-internet-things-magazine
2. https://ieeexplore.ieee.org

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in
2. https://www.classcentral.com/course/swayam-introduction-to-internet-of-things

Self-Learning Exercises:

c) Design an embedded systems application using microcontrollers.
d) Develop a code for an embedded system application

<table>
<tr><td>Course Title</td><td colspan="4">Smart Grid</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EEPE09</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course offers a detailed study on automation of substations system, metering system, interconnecting system to monitor and enhance the grid stability.

The course covers the study of advanced Grid technology to overcome the shortcomings in a conventional grid. It also covers the study of various automatic/smart meters for domestic/commercial/industry applications. It also involves a detailed study of communication technology associated in smart grids for efficient networking and data acquisition.

COURSE OBJECTIVES:

1. To understand the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.
2. To understand the concept of Smart Meter, Smart Appliances, Automatic Meter Reading, Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid
3. To understand the concept of Substation Automation, Feeder Automation. Intelligent Electronic Devices, Wide Area Measurement System, and Phase Measurement Unit.
4. To understand the concept of micro grid and its integration with main central grid.
5. To understand the importance of communication technology in smart grid.
6. To the understand the concept of cyber security and several encryption techniques available in smart and central grid

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Understand the fundamentals of Smart Grid Technology and important terminologies	1-6	1,2
CO-2	Explain the concept of Smart Meter and their applications in Smart Grid	1-4	1,2
CO-3	Learn the basics of Microgrid technology and its applications in Community electrification	1-4	1,2
CO-4	To study the communication technologies applicable for Smart Grid	1-5	1,2
CO-5	Carryout the techno-economic analysis and provide the details for community microgrid.	1-6	1-3
CO-6	Apply the knowledge of communication technology and suggest the technologies for Smart grid and Microgrid	1-7	1-3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2	√	√	√			

CO-3		√	√			
CO-4		√		√		
CO-5			√			
CO-6				√		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

Content
Unit 1: Introduction to Smart Grid (12 Hrs.) Concept of Smart Grid, Difference between conventional & smart grid, Opportunities & Barriers of Smart Grid, Smart Grid: Indian perspective, Smart Grid and Smart Cities. Smart Grid Technologies: Energy storage technologies, Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid (V2G), Grid to vehicles (G2V)
Unit 2: Smart Sensing and Automation (12 Hrs.) Smart Meters: Introduction to hardware infrastructure for smart meter, demand side integration, Real Time Prizing, RTU, PMU, intelligent Electronic Devices (IED), Demand side Management
Unit-3: Micro grids (15 Hrs.) Concept of Microgrid, Microgrid Architecture: DC and AC: Droop Control Schemes for Micro Grid Islanding: intentional and unintentional, Nano Grid, modelling of micro–Grid Using MATLAB
Unit 4: Communication Technologies for Smart Grid (15 Hrs.) Communication Architecture of SG, Data communication, , Wide Area Monitoring Protection and Control (WAMPAC), Information security for smart grid: Encryption and decryption techniques and digital signatures, cyber security standards Home Area Network (HAN), Neighborhood Area Network (NAN), Wireless communication and power line communication, Protocols : ZigBee, GPS, Wi-Fi, Wi-Max.

Textbook/s:

Sl. No	Particulars of Books / Articles
1	Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2	Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley Publications.
4	Stuart Borlase, "Smart Grids-Infrastructure, Technology and Solutions", CRC Press, Taylor and Francis group
5	Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid Technology and applications", Wiley Publications.
6	James Momoh, "Smart Grid-Fundamentals of design and analysis", Wiley Publications.

Reference books:

1. Smart power grids by A Keyhani, M Marwali.
2. Computer Relaying for Power Systems by ArunPhadke
3. Microgrids Architecture and control by Nikos Hatziargyriou
4. Renewable Energy Systems by Fang Lin Luo, Hong Ye
5. Voltage-sourced converters in power systems_ modeling, control, and applications by Amirnaser Yazdani, Reza Iravani"

Journal/Magazine:

1. Smart Grids Opportunities, Developments, and Trends(https://link.springer.com/book/10.1007/978-1-4471-5210-1)
2. Smart Grid Integrating Renewable, Distributed (https://www.sciencedirect.com/book/9780123864529/smart-grid)

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ee64/preview
2. https://www.mooc-list.com/course/smart-grids-modeling-edx

https://learnawesome.org/items/e573cc59-3e71-436c-83fa-a2ea112f0efa-introduction-to-smart-grid

Course Title	Relational Database Management Systems				Course Type		Theory	
Course Code		Credits	3		Class		III sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50**	**50**

COURSE OBJECTIVE

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.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Master the basic concepts and appreciate the applications of database systems.	-	-
CO2	Master the basics of SQL and construct queries using SQL.		
CO3	Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.		
CO4	Be familiar with the relational database theory, and be able to write relational algebra expressions for queries		
CO5	Be familiar with the basic issues of transaction processing and concurrency control.		

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

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 [08 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

<table>
<tr><td>Course Title</td><td colspan="4">Power Electronics Lab</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EE0506</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">V sem</td></tr>
<tr><td rowspan="4">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
</table>

	Total	**1**	**2**	**2**	**39**	**13**	**50**	**50**

Prerequisites: Knowledge of Basic Electrical & Electronics, analog electronics circuit design.

Course Objectives

1. To get an overview of different types of power semi-conductor devices and their static characteristics.
2. To provide practical knowledge of power semiconductor devices and their applications
3. To compare the performance of phase -controlled rectifiers, ac regulators for various loads.
4. To study the operation and speed control of motors using AC-DC converter and AC Voltage controller.
5. To learn the different modulation techniques of pulse width modulated inverters.
6. Familiarize the operation of Power Converters using PSIM software modules.

Course Outcomes

1. Acquire a basic knowledge of internal behavior of power semiconductor devices using its static characteristics.
2. Describe the relation between output voltage and delay angle for controlled rectifier circuit for different loads and analyze the significance of freewheeling diode.
3. Analyze the performance of AC voltage controller using TRIAC & DIAC for various loads.
4. Describe the role of Power converters in application-based DC and AC drives using the relation between Speed and delay angle.
5. Analyze the operation of single-phase power converters such as controlled rectifiers, inverters, choppers using hardware and software modules.
6. Develop power semiconductor circuits for various power system and renewable applications.

No	Title of the Experiment	Tools and Techniques	Skill /Ability
1	Conduct an experiment on SCR to plot its VI characteristics	Hardware Module	Analyze the internal behavior of the SCR.
2	Conduct an experiment on MOSFET plot their static characteristics.	Hardware Module	Analyze the internal behavior of the MOSFET.

3	Conduct an experiment on IGBT plot their static characteristics.	Hardware Module	Analyze the internal behavior of the IGBT.
4	Conduct an experiment on Single phase fully controlled rectifier with R and RL loads & plot the graph of output voltage Vs delay angle (α).	Hardware Module	Describe the relation between output voltage and delay angle for controlled rectifier circuit for different load and freewheeling diode significance.
5	Conduct an experiment on AC voltage controller using TRIAC and DIAC combination connected to R and RL loads to obtain the output voltage.	Hardware Module	Describe the relation between output voltage and delay angle for ac voltage controller circuit for various load.
6	Conduct an experiment on DC motor to control its speed using single phase semi converter.	Hardware Module	Explains an application-based DC drives using the relation between Speed and delay angle.
7	Conduct an experiment on universal motor to control its speed using AC voltage controller.	Hardware Module	Explains an application-based AC drives using the relation between Speed and delay angle.
8	Demonstrate an experiment on IGBT based single phase full bridge inverter connected to R load to study its principle of operation.	Hardware Module	Familiarize the operation of full bridge inverter
9	Simulation study of single-phase AC-DC converter using PSIM software.	PSIM software.	Analyze the operation of single-phase full bridge Rectifiers.
10	Simulation study of single-phase DC- AC converter using PSIM software.	PSIM software.	Analyze the operation of single-phase full bridge inverter.
11	Simulation study of buck (step down) converter using PSIM software.	PSIM software.	Analyze the working principle of Buck Converter.
12	Simulation study of boost (Step up) converter using PSIM software.	PSIM software.	Analyze the working principle of Boost Converter.

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√		√	
CO-2	√	√	√	√		
CO-3	√	√	√	√		
CO-4	√	√	√	√	√	
CO-5	√	√	√	√		

CO-6	√	√	√	√	√	

COURSE ARTICULATION MATRIX

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

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

Course Title			**TECHNICAL DOCUMENTATION**			
Course Type	**Theory**	**Course Code**	B20CI0502	**Credits**		
1	**Class**	**V semester**	**Course**	**Structure**	TLP	Credits
Contact	Hours	Work	Load	Total Number of	Classes	
Per Semester	Assessment in	Weightage	Theory	1	1	1
Practice	-	-	-	Theory		
Practical	CIE	SEE	Tutorial			
-	-	-	**Total**	**1**	**1**	**1**
13	**-**	**50**	**50**			

COURSE OVERVIEW:

The goal of this course is to prepare engineering students with the individual and collaborative technical writing, presentation, and research skills necessary to be effective technical communicators

in academic and professional environments

COURSE OBJECTIVE

The objectives of this course are:

1. Understanding the characteristics of technical writing and the importance of purpose, audience, and genre for written communication in technical fields.
2. Planning, drafting, revising, editing, and critiquing technical and professional documents

through individual and collaborative writing.
3. Writing effective technical documents that are grammatically and stylistically correct.
4. Explain the knowledge and skills required for undertaking a research project, for presenting a conference paper and for writing a scientific article.

COURSE OUTCOMES (COs)
After the completion of the course, the student will be able to:

CONTENTS
Introduction Technical Reports: Importance of Reports, Objectives of Reports ,characteristics of a Report,Categories of Reports, Informative Reports , Analytical Reports , Periodic and Special Reports , Oral
and Written Reports , Long and Short Reports , Formal and Informal Reports, Individual and Group Reports
Formats , Prewriting , Purpose and Scope ,Audience , Sources of Information , Organizing the Material ,
Interpreting Information ,Making an Outline , Structure of Reports (Manuscript Format), Prefatory Parts ,
Main Text , Supplementary Parts , Types of Reports , Writing the Report , First Draft ,Revising, Editing, and
Proofreading.

Technical Proposals: Introduction , Definition and Purpose , Types , Characteristics , Structure of Proposals
, Prefatory Parts , Body of the Proposal , Supplementary Parts , Style and Appearance , Evaluation of
Proposals.

TEXTBOOKS:
1. Meenaxi Raman and Sangeetha Sharma, “Technicial communication”, Oxford University press, 2015.
2. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International
Publishers, 2009.
3. R. Panneerselvam, Research Methodology, New Delhi: PHI, 2005.
4. P. Oliver, Writing Your Thesis,New Delhi:Vistaar Publications, 2004.
5. F. Mittelbach and M. Goossens,The LATEX Companion, 2nd. ed. Addison Wesley, 2004

VI SEMESTER

Sub Code: B20EE0601	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/

Subject Code: B20EM0601	**High Voltage Engineering**	**L**	**T**	**P**	**C**	**CH**
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

Course Title	DIGITAL SYSTEM DESIGN USING VHDL				Course Type		Theory (Integrated)	
Course Code	B20EM0602	Credits	3		Class		III sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	1	Theory	Practical	IA	SEE
	Tutorial	0	-	-				
	Total	3	4	3	42	28	40	60

COURSE OVERVIEW

Digital electronics is a field of electronics involving the study of digital signals and the engineering of devices that use or produce them. This is in contrast to analog electronics and analog signals.

VHDL stands for very high-speed integrated circuit hardware description language. It is a programming language used to model a digital system by dataflow, behavioral and structural style of modeling. This language was first introduced in 1981 for the department of Defense (DoD) under the VHSIC program.VHDL is commonly used to write text models that describe a logic circuit. Such a model is processed by a synthesis program, only if it is part of the logic design. A simulation program is used to test the logic design using simulation models to represent the logic circuits that interface to the design. This collection of simulation models is commonly called a testbench.

COURSE OBJECTIVE

1. To present a problem oriented introductory knowledge of digital circuits and its applications
2. To focus on the study of electronics circuits.
3. Implement combinational and sequential CKT Using VHDL.
4. Implementation of logic gates using CMOS logic.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Use digital electronics in the present contemporary world	1,7.	1,2
CO2	Design various combinational digital circuits using logic gates	2,3,4	1,2

CO3	Do the analysis and design procedures for synchronous and asynchronous sequential circuits	3,4	1,2
CO4	Design different logic circuits real world applications	3,4	1,2
CO5	Implement different Combinational circuits using different description of VHDL	2,3	1,2
CO6	Implement different sequential circuits using different description of VHDL	2,3,4	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

Unit 1:
[12hrs]

Combinational Logic: The Half adder, the full adder, subtractor circuit. Multiplxer de-multiplexer, decorder, BCD to seven segment Decorder,encoders.

Sequential Circuits: Flip flop and Timing circuit : set-reset laches, D-flipflop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T flip-flop.

Unit 2:
[12hrs]

Registers & Counters: Synchronous/Asynchronous counter operation,Up/down synchronous counter, application of counter, Serial in/Serial out shift register, Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register.

Unit 3: **[12hrs]**

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

Data –Flow Descriptions: Data-Flow Description, Structureof Data-Flow Description, Data Type – Vectors.

Unit

[12hrs]

BehavioralModelling: 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.

Laboratory Content:

1. To realize half/full adder and half/full subtractor using basic gates.
2. To verify the truth table of multiplexer using 74153 & to verify a demultiplexer using 74139.
3. To verify the truth table of one bit and two bit comparators using logic gates.
4. Truth table verification of Flip-Flops: (i) JK Master Slave (ii)D- Type (iii)T- Type

Using IC-7400

5. Realization of 3-bit counters as a sequential circuit(using IC7476)
6. Design all gates using VHDL.
7. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
a. Half adder b. Full adder
8. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
a. Multiplexer b. Demultiplexer
9. Write a VHDL program for a Down counter and check the wave forms and the hardware generated.
10. Write a VHDL program for a T FLIP-FLOP and check the wave forms and the hardware generated.

Text book/s:

1. Digital Electronics an Introduction to Theory and Practice Prentice Hall (January 1, 2010)
2.John morris Digital Electronics Butterworth-Heinemann; 1st edition (November 12, 2016)
3.Charles H. Roth. Jr, 'Digital Systems Design Using VHDL', Cengage, 2010.
4. A Pedroni, Volnet, 'Digital Electronics and Design With VHDL', Elsevier, 1st edition, 2008

References:

1.StephenBrwon&ZvonkoVranesic, Fundamentals of Digital Circuits
, Motilal UK Books of India; 2nd Revised edition (January 1, 2009)
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 .
Journals/Magazines

1. https://ieeexplore.ieee.org/document/5270831
2. https://ieeexplore.ieee.org/abstract/document/404586
3.https://ieeexplore.ieee.org/abstract/document/545677

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_ee45/preview
2. https://nptel.ac.in/courses/117/107/117107094/

Course Title	ADVANCE POWER ELECTRONICS	Course Type	Theory

Course Code	B20EES601	Credits	3		Class		VI sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	3	3	3			50	50

COURSE OVERVIEW

Power Electronics is the technology for conversion and processing of electrical power and its application. It provides the basis for new electrical circuit architecture that provides substantial improvements in performance, flexibility, and productivity. It has verity of applications in different industries such as home appliances, automotive systems, telecommunication, aerospace, industrial automation, flexible AC transmission lines (FACT), and high voltage DC transmission (HVDC). This course provides a basic overview of power electronic devices and circuits. Introductory analysis of advanced power electronic converters, resonant converters, multi-level converters, and soft switching methods are discussed. State space and generalized state space averaging techniques are explained. Power electronics systems such as uninterruptible power supplies and active filters are also discussed. The basics of digital control for power electronic systems using digital signal processors (DSP) are explained. Circuit analysis software such as Pspice, PSIM, and MATLAB are used for system design and simulation.

COURSE OBJECTIVE

1. To describe basic operation and compare performance of DC - DC converters and switching circuits
2. To study and design an appropriate a power supplies for the required application.
3. To provide the outline of pulse width modulation strategies in inverters.
4. To provide strong foundation for further study of power electronic circuits and systems

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Select an appropriate power semiconductor device and design a switch mode power supplies for the required application.	1-4	1-2

CO2	Determine the power circuit configuration needed to fulfill the required power conversion with applicable constraints.	1-6	1-2
CO3	Determine the drive circuit requirements in terms of electrical isolation and the requirement of bipolar drive and ease of control.	1-5	1-2
CO4	Design the control circuit and the power circuit for a given power converter.	1-4	1-2
CO5	Identify different areas power conversion and related topology for various Applications.	1-6	1-2
CO6	Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.	1-6	1-2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO6	1	1	1	1	1	1							2	2

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

THEORY

Unit-1: Switching Voltage Regulators

Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Cuk converter, Sepic Converter; Design criteria for SMPS.

Unit-2: Resonant Converters

Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero-voltage switching dc-dc converters, zero current switching dc-dc converters.

Unit-3: PWM Control Techniques & Multi-level converters

Basics elements of PWM Control: PWM control IC and its components, Need for Driver circuit, isolation techniques. Need for multi-level inverters, Concept of multi-level, Topologies for multi-level converter, Introduction to carrier based PWM technique for multi-level converters.

Unit-4: Dual Converters

Single-phase and three-phase dual converters: Ideal and practical dual converter, control schemes for non-circulating current type dual converter, analysis of circulating current type dual converter. Power factor improvement of converters.

Text Book:

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

Journals/Magazines

1. https://www.powerelectronics.com/markets/automotive/article/21120569/pmic-simplifies-powersupply-design-for-automotive-cameras.
2. https://www.powerelectronics.com/technologies/power-management/article/21121246/calorimeter-deliberately-drives-liion-cells-into-thermal-runaway-and-explosion.
3. http://www.power-mag.com/pdf/feature_pdf/1619093954_GaNSys_feature.pdf.
4. https://www.ieee-pels.org/publications/ieee-open-journal-of-power-electronics.

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/102/108102145/
2. https://www.powerelectronics.com/
3. https://www.my-mooc.com/en/mooc/capstone-design-project-in-power-electronics/

<table>
<tr><td>Course Title</td><td colspan="4">Electric and Hybrid Vehicle</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES602</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>42</td><td></td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This course introduces the fundamental concepts, principles, analysis and design of EV,HEV. This course goes deeper into the various aspects of hybrid and electric drivetrain such as their configuration, types of electric machines that can be used, energy storage devices, etc.

Each topic will be developed in logical progression with up-to-date information. Several chosen problems will be solved to illustrate the concepts clearly.

COURSE OBJECTIVE

1. To 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 (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Describe the configuration of a typical electric vehicle, and design , develop basic a schemes of electric vehicle	1-6	1,2
CO-2	Choose a suitable drive motor for EV,HEV application and differentiate among different drive trains.	1-3,6	1,2
CO-3	Understand the limitations and advantages of various Battery chemistries.	1,3,4	1,2
CO-4	Choose proper energy storage systems for vehicle applications and develop strategies for charging various types of batteries.	1,3,4	1,2
CO-5	Configure the EV Components for building an Electric Vehicle	1-4	1,2
CO-6	Describe the configuration of HEV and various types of Fuel Cell Electric Vehicles and realistically implement/ design the fuel for electric vehicle.	1-4, 10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				√
CO-2	√	√	√	√		√
CO-3	√	√	√	√	√	√
CO-4	√	√	√	√		√

CO-5		√	√	√		√
CO-6		√	√	√		√

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENTS
THEORY

Unit-1
Introduction to Electric Vehicles (EVs):
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-2
Vehicle Dynamics and Motor Drives:
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-3

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-4

Emerging EV Technologies:

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:

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:

Reference Books:

1. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications With Practical Perspectives, Wiley Publication, 2011.
3. Build Your Own Electric Vehicle, 3rd Edition, Seth Leitman & Bob Brant
4. DIY Lithium Batteries: How to Build your own Battery Packs By Micah Toll

Journals/Magazines

1. www.myev.com
2. www.batteryuniversity.com
3. www.insideevs.com

SWAYAM/NPTEL/MOOCs:

1. https://online-learning.tudelft.nl/courses/electric-cars-introduction/
2. https://www.mooc-list.com/course/hybrid-vehicles-edx
3. https://www.mooc-list.com/course/electric-cars-introduction-edx
4. https://www.coursera.org/learn/electric-vehicles-mobility
5. https://www.udemy.com/course/electric-vehicle-certificate-course/

Course Title	Electrical Power Quality				Course Type		Theory	
Course Code	B20EES603	Credits	3		Class		VI sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	Tutorial	0	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW

The power quality of modern power distribution system is vulgarized due to the increased use of distributed sources, adjustable speed drive, nonlinear load and unbalanced load. The main challenge in the distribution system is the mitigation of power quality problems produced by load disturbances and supply disturbances. It can be mitigated by passive filters as well as active filters. The passive filters are economically cheap but their performance is poor compared to the active power filters. Hence active power filters are preferred in the modern power system.
This course is intended for B.Tech, M.Tech of Power Electronics and power system, Power electronics Engineer / experts from industry like ABB, GE, NTPC, NHPC and all state electric supply board.

COURSE OBJECTIVE

This course enables graduating students
1. To understand comprehend concept of Power Quality & its issues for various electrical systems
2. To learn about power electronic converters
3. To learn about the causes and effects of harmonics
4. To understand effect of harmonics on electrical apparatus
5. To learn power quality issues in distribution network
6. To understand operation and control of power quality improving equipment

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	To assess concept of Power Quality & its issues for various electrical systems	1,2	1,2
CO2	To analyze power electronic converters	1,2,4	1,2
CO3	To analyze the causes and effects of harmonics	1,2,4	1,2
C04	To assess effect of harmonics on electrical apparatus	1,2,3	1,2
CO5	To asses power quality issues in distribution network	1,2,3	1,2,3
CO6	To analyze operation and control of power quality improving equipment	1,2,4	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT THEORY

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

Text Book:

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. Dugan R. C., McGranaghan M. F. and Beaty H. W., “Electrical Power System Quality”, McGraw-Hill International Book Company.
4. Derek A. Paice, “Power Electronic converter harmonics: Multipulse methods for clean power”, IEEE press, 1995

Reference Books:

1. Hirofumi Akagi, Edson Hirokazu Watanabe, Mauricio Aredes, “Instantaneous Power Theory and Applications to Power Conditioning”, John Wiley & Sons, 2007.
2. J.F.G. Cobben, “Power Quality; about the problems and solutions”, CO-Education Arnhem, The Netherlands, 2016.

Journals/Magazines

1. International Journal of Electrical Power & Energy Systems
2. Electric Machines & Power Systems

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/106/108106025/
2. https://www.classcentral.com/course/swayam-power-quality-improvement-technique-17736
3. https://npti.gov.in/power-quality-and-harmonics-mitigation-and-reactive-power-management

Course Title	Modeling and Simulation of Electrical Machines				**Course Type**		**Theory**	
Course Code	B20EES604	**Credits**	**3**		**Class**		**IV Sem**	
Course	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice							

Structure	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Total	**3**	**3**	**3**	**42**	**0**	**50**	**50**

COURSE OVERVIEW

This course deals with the development of mathematical models for electrical machines, suitable for transient analysis of machine performance. The course covers the following topics. Basics of magnetic circuits - flux, mmf, reluctance - self, leakage, magnetizing and mutual inductances. Analysis of magnetic circuits with airgap and permanent magnets. Analysis of singly excited electromechanical system with linear magnetics - nonlinear magnetics using energy and co-energy principles. Derivation of force from co-energy. Inductances of distributed windings - salient pole, cylindrical rotor. Analysis of the doubly excited rotational system with two coils on stator and two on rotor - electrical and mechanical equations. Reference frames - stator attached alpha-beta, synchronous reference frame, arbitrary speed reference frame - power invariance and non-power invariance. Derivation of dc machine systems from the generalized machine - electrical and mechanical equations. Analysis of induction machine - synchronous reference frame - with currents as variables - with rotor flux as variables - basis for vector control - small signal modelling of induction machine. Analysis of the alternator - synchronous reference frame - derivation of salient and cylindrical rotor machine phasor diagrams - three phase short circuit of alternator and various time constants.

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. o understand the importance reluctance motor and its principle

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs

CO#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.	1.7,12	1
CO#2	Determine the developed torque in an electrical machine using the concepts of filed energy and co-energy and determine the dynamic model of a DC Machine	5,4,8	2
CO#3	Learn the different types of reference frame theories and transformation relationships.	1,2,3	2
CO#4	Students understand the relationship between real and reactive power control with application to the equivalent circuit of a synchronous machines Conservation.	4, 6	3
CO#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.	9,10	3
CO#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	1, 4,7,9	3
CO#6	Familiarize the modeling of electrical machines through equivalent circuit parameters and understand the variation in load change.	1.3,5,6	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO#1	L1	L2	L3			
CO#2			L3		L5	
CO#3			L3		L5	
CO#4	L1	L2		L4		

CO#5			L3	L4	L5	L6
CO#6		L2	L2	L4		L6

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENTS

Unit	Syllabus
Unit-1	**Basics of electrical machine modeling [10Hrs]** 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-2	**Modelling of D.C. Machines: [10Hrs]** 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 - 3	**Modeling of Synchronous Machines: [10Hrs]** Modelling 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 - 4	**Modeling of Induction Machines [10Hrs]** 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".
6. Shaahin Filizadeh, "Electric Machines and Drives Principles, Control, Modeling, and Simulation" Copyright Year 2013

Journals/Magazines

1. McLean D. Mathematical Models of Electrical Machines. *Measurement and Control*. 1978;11(6):231-236. doi:10.1177/002029407801100603

SWAYAM/NPTEL/MOOCs:

https://nptel.ac.in/courses/108/106/108106023/#

Course Title	**Reactive Power Management**				**Course Type**		**Theory**	
Course Code	B20EES60	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory Hours	Practical Hours	CIE	SEE
	-	0	-	-				
	Total	**3**	**3**	**3**	**42**		**50**	**50**

COURSE OVERVIEW

The aim of this course is to enable the students to have an in-depth understanding of the applications, overall theory and essential issues relevant to daily operation and maintenance of reactive power management. Use different types of compensation control strategies to identify the quality of power supply and reactive power coordination.

COURSE OBJECTIVE (S):

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 OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Identify different methods of reactive power compensation types of load patterns and loss reduction methods in distribution lines.	1-3	1,2

CO-2	Demonstrate knowledge on types of load patterns and loss reduction methods in distribution system.	1-3	1,2
CO-3	Analyze different types of compensations.control strategies	1-4	1,2
CO-4	Design compensators for reactive power management in domestic , commercial and industrial applications.		
CO-5	Identify the quality of power supply and reactive power coordination.	1-4	1,2
CO-6	Demonstrate knowledge on demand side management and distribution side management	1-5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√			
CO-2	√	√	√	√		
CO-3	√	√	√	√		
CO-4	√	√	√	√		
CO-5	√	√	√	√		
CO-6	√	√	√			

COURSE ARTICULATION MATRIX

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

CO-5	2	3	2	2									1	1
CO-6	2	3	2	1									1	1

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

COURSE CONTENTS
THEORY

UNIT-1: **Reactive power compensation** 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-2: Passive and Active Compensators 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-3: Reactive Power Coordination 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-4: R**eactive Power Management**: 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.

Journals/Magazines

1. IEEE Transactions on Power Systems
2. Electrical Power System Research

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/101/108101040/

<table>
<tr><td>Course Title</td><td colspan="4">VLSI CIRCUIT DESIGN</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES606</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>4</td><td>4</td></tr>
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<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This is an introductory course which covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, testing.

COURSE OBJECTIVE

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 (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the characteristics of CMOS circuit construction and fabrication.	1,2,6,7.	1,2,3
CO2	Design various gates using stick and layout diagram.	2,3,4,7	1,2,3
CO3	Design adders, Memories, using stick diagrams	2,3,4,7	1,2,3
CO4	Understand different testing techniques for IC's.	1,2,6,7	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT
THEORY

CONTENT
Unit 1: Introduction 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
Unit 2: VLSI Circuit Design Processes 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 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 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.

ReferenceBooks:

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

Journals/Magazines

1 IEEE Journals on Low Cost VLSI Architecture for Proposed Adiabatic Offset Encoder and Decoder.

Big Data Analytics and Cloud Computing

Course overview:

Course Description: This course provides practical foundation level training that enables immediate and effective participation in big data projects. The course provides grounding in basic and advanced methods to big data technology and tools, including Hadoop and Spark

Course objective:

1. Explain the concepts of Big Data and its Business Implications.
2. Describe the framework for Scala and Spark for Big-Data Analytics
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 outcome:

Make use of the concepts of Big Data in real world applications

Apply the theories of Hadoop in Scala for Big Data Analytics

Explain the cloud computing concepts such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)

Use various cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology; service technology

Course content:

Unit 1: The Age of the Data Product: What Is a Data Product?, Building Data Products at Scale with Hadoop, Leveraging Large Datasets, Hadoop for Data Products, The Data Science Pipeline and the Hadoop Ecosystem, Big Data Workflows. An Operating System for Big Data: Basic Concepts, Hadoop Architecture, A Hadoop Cluster, HDFS, YARN, Working with a Distributed File System, Basic File System Operations, File Permissions in HDFS, Other HDFS Interfaces, Working with Distributed Computation.

Unit 2: MapReduce: A Functional Programming Model, Implemented on a Cluster, Beyond a Map and Reduce: Job Chaining, Submitting a MapReduce Job to YARN.

Scala Programming: Functional Programming Aspects, What Is Functional Programming? Scala Programming, Features, Functional Programming Aspects of Scala.

Unit 3: 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 4: 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. Sridhar Alla, "Big Data Analytics with Hadoop 3", Packt Publishing Ltd, May 2018 2. Subhashini Chellappan, Dharanitharan Ganesan, "Practical Apache Spark Using the Scala API", A Press, 2018.

2. Thomas Erl , Ricardo Puttini , Zaigham Mahmood Cloud Computing: Concepts, Technology & Architecture PHI, 2013.

3. Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, Distributed and Cloud Computing, MK, 2012.

<table>
<tr><td>Course Title</td><td colspan="4">Java Programming</td><td colspan="2">Course Type</td><td colspan="2"></td></tr>
<tr><td>Course Code</td><td>B20EM</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory Hours</td><td rowspan="2">Practical Hours</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This Java course will provide you with a strong understanding of basic Java programming elements and data abstraction using problem representation and the object-oriented framework. This course will use sample objects such as photos or images to illustrate some important concepts to enhance understanding and retention. You will learn to write

procedural programs using variables, arrays, control statements, loops, recursion, data abstraction and objects in an integrated development environment.

COURSE OBJECTIVE (S):

To enable the students

1. Describe Java language syntax and semantics required for understanding Java programs (applets and applications)
2. Illustrate the usage of a Java-enabled browser, 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
5. Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design.
6. Use the Java interpreter to run Java applications

COURSEOUT COMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Analyze the principles and concepts of object-oriented programming;	1-6	1,2
CO-2	Use a Java-enabled browser and/or the applet viewer to execute Java applets	1-4	1,2
CO-3	Use the Java interpreter to run Java applications	1-4	1,2
CO-4	Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design.	1-5	1,2
CO-5	Apply the knowledge of exceptional handling	1-5	1,2
CO-6	Develop customized apps	1-7	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√	√		
CO-2	√	√	√	√		
CO-3	√	√	√	√		
CO-4	√	√	√	√		√
CO-5	√	√	√	√		√
CO-6	√		√			√

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO-1	3	3	1	1	1	1							1	
CO-2	2	3	2	2									1	
CO-3	2	3	2	1									1	
CO-4	2	2	1	2	3								1	
CO-5	2	3	1										1	
CO-6	3	1	3	2	2		3						1	

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

UNIT – I

An overview of JAVA:

Introduction to Object oriented programming, A first simple program using Java.

Data Types, Variables and Arrays:

The primitive Data types, Variables, Type conversion and casting, Automatic type promotion, Arrays: One-dimensional, two dimensional and Alternative array declaration syntax, introduction to Strings.

UNIT – II

Operators:

Arithmetic operators, The Bitwise operators, Relational operators, Boolean logical Operators, The Assignment operator, The? Operator, Operator precedence, using parentheses.

Control Statements:

Java's selection statements, iteration statements, jump statements.
UNIT – III Introducing Classes: Class fundamentals, Declaring objects, Assigning object reference variables, introducing methods, constructors, The this keyword, The finalize() Method, A stack class. More about Methods and Classes: Overloading of methods, Using Objects as parameters, Returning of objects, Recursion, Introduction to Access control, Introducing Final, Arrays revisited, Introducing Nested and Inner Classes, Exploring the String class, Using command line arguments, Varargs.
UNIT – IV Inheritance: Inheritance Basics, Using Super, Creating multilevel hierarchy, Method overriding, Dynamic method dispatch, Using abstract classes, using final with inheritance, The object classes. Packages and Interfaces: Packages, Access Protection, Importing Packages and Interfaces. Exceptional Handling: Exception Fundamentals, Exception types, Java's built-in exceptions, creating your own exceptions, chained exception, Chained exceptions.

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', 5thEdition, 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

Journals/Magazines

1. https://ieeexplore.ieee.org/document/ACM digital library

2. Java Magazine - Oracle Blogs

SWAYAM/NPTEL/MOOCs:

1. https://learning.codingninjas.com/java
2. Java SE Programming: For Beginners | Udemy
3. Java for Android (Coursera)

INDIAN TRADITION AND CULTURE

COURSE OVERVIEW: This course offers the students with various aspects of culture and heritage of India..This course also enable the students to understand the contribution of our ancestors in the areas of science, medicine, arts, language and literature. COURSE OBJECTIVE 1. To provide conceptual knowledge of Indian culture and traditions 2. To introduce students to the science and technological advancements related to Indian culture 3. To help students understand the Indian spiritual aspects of Indian culture 4. To help learners understand the factors which unite the diverse cultures of India.

COURSE OUTCOME:
Gain conceptual understanding of Indian culture and traditions
Describe various ancient theories in treatment of any disease
Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana
Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food and Understand India as a land united by cultural diversity

COURSE CONTENTS:
UNIT 1: Indian Tradition
i. Culture – Indus Valley Civilization and early cultural practices, The Vedic culture, Influence of Buddhism
and Jainism on Indian Culture, Influence of Islam and Christianity, Indian Cultural Renaissance of the
19th Century
ii. Religion – Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements,
Advent of Christianity
iii. Art – Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional
art forms (dance and music), Folk art, puppetry

iv. Architecture – Engineering and Architecture in Ancient India; Evolution of Hindu Temple Structures,
Sculptures, Coins and Pottery from Ancient India
v. Literature- Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

UNIT 2:
Contribution of ancient India to Science and Mathsi. Development of Science in Ancient India- Astronomy,
Mathematics, Medicine, Metallurgy.
ii. Scientists of Ancient India:
a. Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya
b. Science- Kanad, Varahamihira, Nagarjuna
c. Medical Sciences (Ayurveda and Yoga)- Susruta, Charaka, Yoga and Patanjali
iii. Science and Scientists in Medieval India- Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.
iv. Scientists in Modern India- Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir
Bhabha, Dr, Vikram Ambalal Sarabhai, ,Dr. APJ Abdul Kalam

UNIT-3

Indian Spiritual Aspects
I. Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana,
Mahabharata & Bhagavat Gita.
ii. Hata Yoga and Pranayama- Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga);
Karma yoga; Bhakti Yoga – yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/
Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga
iii. Buddhist, Jaina Spiritualities- Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana -
Ashtanga Marga

Unit 4:
Unity in Diversity
i. Commensality and the Significance of Food – Eating Together as Family and as a Society, Food at

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

TEXT BOOKS:
1. Sundararajan K.R., Hindu Spirituality - Vedas through Vedanta, Cross Road Publications, New York, 1997.
2. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992

REFERENCE BOOKS:
1. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998
2. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.
3. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

JOURNALS/MAGAZINES
1. Arts and Humanities (miscellaneous)
2. History
3. Language and Linguistics
4. History and Philosophy of Science
5. Literature and Literary Theory

SWAYAM/NPTEL/MOOCs:
1. https://nptel.ac.in/courses/109/104/109104102/
2. https://nptel.ac.in/courses/109/103/109103018/

SELF-LEARNING EXERCISES:
Different languages of India, Indian history

SEMESTER VII

Course Title	Signal Processing				Course Type		Theory	
Course Code:	B20EM0701	Credits	3		Class		VI sem	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	4	4				
	Practice	-	-	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**4**	**4**	**42**	**-**	**50**	**50**

COURSE OVERVIEW

Signal processing is an electrical engineering subfield that focuses on analysing, modifying, and synthesizing signals such as sound, images, and scientific measurements. Signal processing techniques can be used to improve transmission, storage efficiency and subjective quality and to also emphasize or detect components of interest in a measured signal. As previously mentioned, signal processing condenses measurements to extract information about some distant state of nature. Signal processing can be described from different perspectives. To an acoustician, it is a tool to turn measured signals into useful information. To a sonar designer, it is one part of a sonar system. To an electrical engineer, it is often restricted to digitization, sampling, filtering, and spectral estimation.

COURSE OBJECTIVE

1. Understanding the fundamental characteristics of signals and systems linear and time-invariant systems.
2. Master the representation of discrete-time signals in the frequency domain, using z-transform, discrete Fourier transform (DFT), and cosine transform.
3. Understand the implementation of the DFT in terms of the FFT, as well as some of its applications.
4. Learn the basic forms of FIR and IIR filters, and how to design filters with desired frequency responses.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Represent continuous and discrete-time signals analytically and visualize them in the time domain.	1,3,4,7	1,2,3
CO2	Convert discrete time signal into a complex frequency domain representation.	1,2,3,7	1,2
CO3	Understand the Transform domain and its significance and problems related to computational complexity.	1,3,4,7	1,2
CO4	Design FIR and IIR filters.	1,3,4,7	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1		√	√	√		
CO-2				√	√	√
CO-3		√	√		√	
CO-4		√		√		√

COURSE ARTICULATION MATRIX

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

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1		√	√	√		
CO-2				√	√	√
CO-3		√	√		√	
CO-4		√		√		√

Course content

Unit 1: Introduction to signals & systems : 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: 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** 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 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). .

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

Journals/Magazines :
1. IEEE Journals on Low Cost VLSI Architecture for Proposed Adiabatic Offset Encoder and Decoder

SWAYAM/NPTEL/MOOCs:
1. https://www.maven-silicon.com/online-vlsi-course-march/?gclid=Cj0KCQjwytOEBhD5ARIsANnRjVi1xf4ZxXziY2T5glxNpdoWq7vE4YUYSgAFpQau6T2vUp883kbxIvEaAtGUEALw_wcB
2. https://www.udemy.com/topic/vlsi/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_Catchall_la.EN_cc.INDIA&utm_content=deal4584&utm_term=_._ag_82569850245_._ad_437477497173_._kw__._de_c_._dm__._pl__._ti_dsa437115340933_._li_9062047_._pd__._&matchtype=b&gclid=Cj0KCQjwytOEBhD5ARIsANnRjVgWiUUyWqPr4K8ISOKwCFgP1CDjHYsrHW7y6h3NT2ZPx7NLbxFgn_AaAvQ5EALw_wcB

Self-Learning Exercises:
IEEE Journals on Bio-medical applications

CourseTitle	Renewable Energy System				**Course Type**	**Theory**
CourseCode	B20EM0702	**Credits**	**3**		**Class**	**VII Sem**
	TLP	Credits	Contact Hours	Work Load	Total Number of	Assessment in

Course Structure	Theory	3	3	3	Classes Per Semester		Weightage	
	Practice	-	-	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	3	3	3	42	-	50	50

COURSE OVERVIEW

The Renewable and Sustainable Energy Systems course provides a graduate-level understanding of the conversion principles and technology behind various renewable energy sources. It also examines the issues involved in the integration of various renewable energy sources and their economics for heat, power, and transportation needs. Based on the technical and sustainability challenges, the future outlook for each of the sources and systems is discussed. This is a required core course for the Master of Professional Studies in Renewable Energy and Sustainability Systems Program.
The course presents the various sources of renewable energy including wind, solar, and biomass as potential sources of energy and investigates the contribution they can make to the energy profile of the nation. The technology used to harness these resources will be presented. Discussions of economic, environment, politics and social policy are integral components of the course.

COURSE OBJECTIVE

1. To discuss economic, technical and sustainability issues involved in the integration of renewable energy systems.
2. To know the principles of operation of the broad spectrum of renewable energy technologies
3. To study the technical challenges for each of the renewable sources.
4. To conduct preliminary resource assessments for a variety of renewable energy technologies.

COURSEOUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Able to understand economic, technical and sustainability issues involved in the integration of renewable energy systems.	1,4	1

CO2	Able to understand the principles of operation of the broad spectrum of renewable energy technologies	1,2,4	1
CO3	Able to learn & steady the technical challenges for each of the renewable sources	1,2,4	1
CO4	Able to investigate the preliminary resource assessments for a variety of renewable energy technologies.	1,2,4	1
CO5	Able to discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.	1,2, 4	1
CO6	Able to study types of solar collectors, their configurations, solar cell system, its characteristics and their applications.	1,2, 4	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	✓	✓		✓		
CO-2	✓	✓		✓		
CO-3	✓	✓		✓		
CO-4			✓			
CO-5	✓	✓	✓			
CO-6	✓	✓	✓			

COURSE ARTICULATIONMATRIX

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

CO-5	1	2	2				2							
CO-6	1	2		2										

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

COURSE CONTENT

Contents

UNIT-I **[12 Hrs]**

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-II **[12 Hrs]**

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, and Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, Advantages and Disadvantages of WECS.

UNIT-III **[10 Hrs]**

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-IV **[10 Hrs]**

MHD & Hydrogen Energy: Basic Principle of MHD (magneto-hydrodynamic) 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.

TextBook:
1. Non-Conventional Energy Sources by G.D. Rai, Khanna publishers, 5th edition,2014.
2. Godfrey Boyle, Renewable Energy: Power for a sustainable Future, Alden Oess Limited - Oxford, 1996.
3. G. D. Rai, Solar Energy Utilisation, Khanna Publishers, Delhi, 13th Reprint, 2018.
4. Chetan Singh Solanki, Solar Photovoltaics - Fundamentals, Technologies and Applications, Prentice Hall India Learning Private Limited; 3rd Revised edition (2015).
ReferenceBooks:
1. G.D. Rai. Solar Energy Utilisation, Khanna Publishers, New Delhi, 5th Edition, 2009.
2. D. P. Kothari, K. C. Singal & Rakesh Ranjan, Renewable energy sources and emerging Technologies, Prentice Hall of India pvt. Ltd., New Delhi, 2 nd Edition, 2008.
3. Domkundwar, Solar energy and non-conventional energy resources, Dhanpat Rai & Co. (P) Ltd, New Delhi, 1 st Edition, 2010.
4. Non-Conventional Energy Sources by B.H.Khan, Tata Mc Graw-hill Publishing Company, 2nd edition, 2013.
Journals/Magazines

1. https://ieeeexploe.ieee.orgg

SWAYAM/NPTEL/MOOCs:

1 https://www.coursera.org/learn/renewable-energy-fundamentals
2 https://www.careers360.com/university/indian-institute-of-engineering-science-and-technology-shibpur/courses
2. https://onlinecourses.nptel.ac.in/noc21_ch11/preview

Self-Learning Exercises:
1. Design and implementation of solar panel for home application

<table>
<tr><td>Course Title</td><td colspan="4">ADVANCED CONTROL ENGINEERING</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES701</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td></td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
</table>

	Total	4	5		42	28	50	50

COURSE OVERVIEW

Advanced Control Engineering deals with state variable method of modeling and analysis of control systems. In this course students are taught mathematical modeling of various physical systems like mechanical, electrical systems. The behavior of the given system, its response is determined by representing it in the form of state space model. For the given system state transition matrix, solution of state equation will be calculated, and system will be tested for its controllability and observability. Concept of stability and its improvement by state feedback, design of state observers.

COURSE OBJECTIVES

1. To model any given system using state variable method.
2. To obtain the transfer function from the state model,
3. To obtain Eigen values and Eigen vectors of the given system.
4. To test the controllability of the given system.
5. To test the observability of the given system.
6. To design state observers.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Model the system using state variable approach	1	1-
CO2	Calculate the transfer function,	1,2	2
CO3	Calculate Eigen values and Eigen vectors of the system.	1,2	2
CO4	Realize the controllability of the system.	1,3	2
CO5	Realize the observability of the system.	1,3	2
CO6	Design the state observers to improve the stability of the system.	2,3	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	1	1				
CO2		1		1	1	1
CO3		1		1	1	
CO4		1	1			1
CO5		1		1	1	
CO6		1		1	1	

COURSE ARTICULATION MATRIX

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

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

Unit 1: Modern Control Theory [14 Hours]

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 [14 Hours]

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 [14 Hours]
Concepts of controllability and observability - Kalman's and Gilbert's tests - Controllable and observable phase variable forms.

Unit 4: Pole Placement Design and State Observers [14 Hours]
Introduction, Concept of stability, stability improvements by state feedback. Necessary and Sufficient Conditions for Arbitrary Pole Placement, State Regulator Design, Design of State Observer, Illustrative examples on state observers

Textbooks:

1. Benjamin C. Kuo, 'Automatic Control systems', Pearson Education, New Delhi, 2014 edition.
2. Gopal M, 'Digital Control and State Variable Methods', Tata McGraw-Hill Publishing Company Limited, New Delhi, India, Second Edition, 2003.
3. K. Ogata, 'Modern Control Engineering', 4th edition, PHI, New Delhi, 2002.
4. Syed Hasan Saeed, 'Automatic control systems', publishers of engineering and computer books, new Delhi, 6th edition,2012

Reference Books:

1. M. Gopal, 'Control Systems, Principles and Design', Tata McGraw Hill, New Delhi, 2018.
2. Norman S. Nise, 'Control Systems Engineering', 4th Edition, John Wiley, New Delhi, 2007.
3. Samarajit Ghosh, 'Control systems', Pearson Education, New Delhi, 2004

.
NPTEL:

1.https://nptel.ac.in/courses/108/103/108103007/

Course Title	**Fundamentals of Robotics**			**Course Type**	
Course Code	B20EES 702	**Credits**	**3**	**Class**	**I Semester**

Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory Hours	Practical Hours	CIE	SEE
	-	0	-	-				
	Total	**3**	**4**	**4**	**42**		**50**	**50**

COURSE OVERVIEW

By the end of this course, students will have acquired a broad overview of basic concepts of Robotics architecture, it is very adaptive without any prior knowledge of Robotics. It covers the Fundamental Theory of Robotics, Introduction to Motors (Servo, DC and Stepper). Basic components of robot systems; coordinate frames, homogeneous transformations, kinematics for manipulator, inverse kinematics; manipulator dynamics and robot programming. With this course, students will be able to create a Robotic product. It also includes the operation of controlling simple motors. Students able to easily move on to the advanced Robotics courses. There are various amazing job profiles for people who are aiming for learning Robotics like Robotics Engineer, Robotics Process Automation Developer, Robotics Account Manager.

COURSE OBJECTIVE (S):

1. Classify Robots applications.
2. Classify Robots anatomy applications.
3. Actuators of Robotics.
4. Kinematic of Robotics.
5. Sensors and vision systems used in robots.
6. Robot Programming

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Summarize the basic applications of using robots in the industry.	1-6	1,2
CO-2	Advantages of using robots in the industry.	1-4	1,2
CO-3	Do the robot motion analysis.	1-4	1,2

CO-4	Relate mathematical modeling in robots different types of sensors and cameras	1-5	1,2
CO-5	Recognize the different types of sensors and cameras used in the field of robotics	1-4	1,2
CO-6	Write robot programs	1-5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√	√		
CO-2	√	√	√	√		
CO-3	√	√	√	√		
CO-4	√	√	√	√		√
CO-5	√	√				
CO-6			√	√		√

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENTS

UNIT-1: **Introduction of Robotics:** 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: 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: 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**: 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.

Journals/Magazines

1. https://roboticsbiz.com/top-robotics-magazines-you-should-read/
2. https://www.edx.org/learn/robotics
3. https://mitpress.mit.edu/books/series/intelligent-robotics-and-autonomous-agents-series
4. https://indiafirstrobotics.com/online-courses/
5. https://www.ieee-ras.org/publications/ram

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_me74/preview
2. https://www.udemy.com/topic/robotics/
3. https://www.coursera.org/specializations/robotics

<table>
<tr><td>Course Title</td><td colspan="4">HVDC</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES703</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2">Total Number of Classes Per Semester</td><td colspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td><td colspan="2" rowspan="2">Theory / Practical</td><td colspan="2" rowspan="2">CIE / SEE</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td><td colspan="2">Theory / Practical</td><td colspan="2">CIE / SEE</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

This course is suitable for engineers with a desire to understand the basic principles of HVDC transmission. Presented details cover issues related to technical implementation and exploitation of HVDC systems. Upon successful completion engineers will be able to address HVDC terms, basic arrangements (six pulse and twelve pulse), substation arrangements, operation and protection and voltage control.
This course is intended for use by electrical engineers, design and operational professionals, students and others interested in learning about high voltage transmission lines.

COURSE OBJECTIVE

This course enables graduating students

1. To understand importance and applications of DC transmission
2. To understand operating trends and operating problems of High Voltage Direct Current (HVDC)
3. To identify the types of HVDC converter circuits
4. To understand firing schemes with working
5. To understand HVDC system operation and control
6. To learn power flow in AC/DC system.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	To understand importance and applications of DC transmission	1,2	1,2
CO2	To analyze operating trends and operating problems of High Voltage Direct Current (HVDC)	1,2,4	1,2,3
CO3	To identify the types of HVDC converter circuits	1,2,4	1,2
C04	To analyze firing schemes with working	1,2	1,2
CO5	To analyze HVDC system operation and control	1,2	1,2
CO6	To assess power flow in AC/DC system.	1,2,4	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO3		✓		✓		
C04		✓	✓	✓		
CO5		✓	✓	✓		
CO6		✓	✓	✓		

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT THEORY

UNIT I INTRODUCTION

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

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12pulse converters – Analysis of VSC topologies and firing schemes

UNIT III CONVERTER AND HVDC SYSTEM CONTROL

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

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 Book:

1. K.R. Padiyar, "HVDC Power Transmission System", 2ndEdition, New Age International Publishers, 2012.
2. J Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd, UK.
3. EW Kimbark, "Direct Current Transmission", Wiley-Interscience, New York.
4. S Kamakshaiah, V Kamaraju, "HVDC Transmission",1st Edition, Mcgraw Hill Education, 2011.

Reference Books:

1. SN Singh, "Electric Power Generation, Transmission and Distribution, PHI, New Delhi 2nd edition, 2008.
2. Vijay K. Sood, "HVDC and FACTS Controllers", Springer, Boston, MA,2004

<table>
<tr><td>Course Title</td><td colspan="3">Industrial Instrumentation and</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES704</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>4</td><td>4</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

Industrial Instrumentation and Automation is a fundamental and essential course for Process automation. Instrumentation is the science of automated measurement and control. Applications of this science abound in modern research, industry, and everyday living. From automobile engine control systems to home thermostats to aircraft autopilots to the

manufacture of pharmaceutical drugs, power Plants, Oil and Gas, Refineries etc.. and automation surrounds us.

COURSE OBJECTIVE

1. To enable students to study the different types of transducers for industrial applications.
2. To enable students to use Signal conditioning circuits for signal processing.
3. To Familiarize the students with the methods of monitoring different parameters like speed, vibration of turbines & their control.
4. To enable the students to Know about the tools like PLC, DCS, and SCADA.

COURSE OUTCOMES (COs)

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Course Outcomes	POs	PSOs
CO1	Apply transducers for various physical variables measurement.	1,2,7	1,3
CO2	Design various signal conditioning systems for process automation.	2,3,5,7	1,2
CO3	Understand Processing and Monitoring system.	1,2,7	1,2
CO4	Understand different automation levels.	1,2,7	1,2
CO5	create the programming realization of PLC.	3,4,5,7	1,3

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1			√			
CO-2				√		√
CO-3		√				
CO-4		√				
CO-5				√		√

COURSE ARTICULATION MATRIX

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

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE CONTENTS

Unit 1: Introduction to Process Control : 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. Flow measurement: Hotwire anemometer, Constant current method and constant temperature method. Analog and digital phase detectors

Unit 2: Signal conditioning circuits : Instrumentation amplifiers, Unbalanced bridge. 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. 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 : 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: PLCs - Working, Specifications of PLC,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.

Journals/Magazines
IEEE Journals on Electrical Circuit Theory

SWAYAM/NPTEL/MOOCs:

8. Self-Learning Exercises:
IEEE Journals on Process automation

CourseTitle	Power System Planning and Reliability				CourseType		Theory	
Course Code	B20EES705	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact	Work Load	Total Number of Classes		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory Hours	Practical Hours	CIE	SEE
	-	0	-	-				
	Total	**3**	**3**	**3**	**42**	0	**50**	**50**

COURSE OVERVIEW

This course provides basic knowledge on the generation, transmission and distribution systems. It covers the basic theories and the most important experimental methods of load forecasting. Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability, Reliability planning, system operation planning, Evaluation Techniques. Factors affecting Generation Planning, Generation Sources, Integrated Resource Planning, & Factors affecting to System Planning, National and regional planning, Short Term Planning, Medium Term Planning, Long Term Planning, structure of power system, planning tools, electricity regulation. Objectives of forecasting - Load growth patterns all these things will be covered in this course.

COURSE OBJECTIVE (S):

1. To study the fundamentals of Generation system, transmission system and Distribution system reliability analysis
2. To illustrate the basic concepts of Expansion planning.
3. To introduce the objectives of Load forecasting.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Describe the planning process of the power system.	1-3	1,2

CO-2	Identify the suitable techniques for load forecasting and modeling.	1-3	1,2
CO-3	Identify various measures has to be taken while planning a power system.	1-4	1,2
CO-4	Analyze various optimization techniques.	1-5	1,2
CO-5	Understand the concept of reliability its indices	2-4	1,2
CO-6	Understand the planning of transmission and distribution	3-5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√			
CO-2	√	√	√	√		
CO-3	√	√	√	√		
CO-4	√	√	√	√		
CO-5	√	√	√	√		
CO-6	√	√		√	√	

COURSE ARTICULATIONMATRIX

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

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

COURSE CONTENTS

UNIT-1: **System planning & Load forecasting**

Introduction, Objectives & Factors affecting to System Planning , National and regional planning Short Term Planning, Medium Term Planning, Long Term Planning, structure of power system, planning tools, electricity regulation. Objectives of forecasting - Load growth patterns and their importance in planning, Load Research, Load Growth Characteristics, Classification of Load and Its Characteristics, Load Forecasting Methods - (i) Extrapolation (ii) Co-Relation Techniques, Energy Forecasting, Peak Load Forecasting, Reactive Load Forecasting, Non-Weather sensitive load Forecasting, Weather sensitive load Forecasting, Annual Forecasting, Monthly Forecasting, Total Forecasting.

UNIT-2: Generation Planning and reliability

Objectives & Factors affecting Generation Planning, Generation Sources, Integrated Resource Planning, co-generation / captive power, power pooling and power trading, transmission & distribution planning, power system economics, power sector finance, financial planning, private participation, rural electrification investment, concept of rational tariffs. Generation System Model, Loss of Load (Calculation and Approaches), Outage Rate, Capacity Expansion, Scheduled Outage, Loss of Energy, Evaluation Methods, Interconnected System, and Factors Affecting Interconnection under Emergency Assistance.

UNIT-3: Power Supply Reliability &Expansion Planning

Reliability planning, system operation planning, Evaluation Techniques (i) Markov Process (ii) Recursive Technique, Stochastic Prediction of Frequency and Duration of Long & Short Interruption, Adequacy of Reliability, Reliability Cost. Optimal Power system expansion planning, formulation of least cost optimization problem incorporating the capital, operating and maintenance cost of candidate plants of different types (thermal hydro nuclear Nonconventional etc), Optimization techniques for solution by programming.

UNIT-4: **Transmission & Distribution Planning**

Introduction, Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability. Distribution system-Radial Networks, Network Reconfiguration, Evaluation Techniques, Interruption Indices, Effects of Lateral Distribution Protection, Effects of Disconnects, Effects of Protection Failure, Effects of Transferring Loads, Distribution Reliability Indices.

Text Books

1. R.L. Sullivan, 'Power System Planning', Tata McGraw Hill Publishing Company Ltd, 2012
2. X. Wang & J.R. McDonald, 'Modern Power System Planning', McGraw Hill Book Company, 1994.

Reference Books

1. T. Gonen, 'Electrical Power Distribution Engineering', McGraw Hill Book Company, 1986.
2. Roy Billinton & Ronald N. Allan, 'Reliability Evaluation of Power System', Springer Publication, 1986.
3. A.S.Pabla, 'Electrical Power System Planning', Macmillan India Ltd, 1998
4. B.R. Gupta, 'Generation of Electrical Energy' , S. Chand Publications

Journals/Magazines

1. IEEE Transactions on Power Systems
2. Electrical Power System planning

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/101/108101050/

COMPUTER NETWORKS

COURSE OVERVIEW: Course Description: The main emphasis of this course is on the organization and management of local area networks (LANs). The course description include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and about Open Systems Interconnection (OSI) communication model with TCP/IP protocol; This course provides knowledge of error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing; and local and remote procedures. This course also emphasis on User Datagram

Protocol, TCP Congestion Control; DNS Message Formatting and Remote Login. Protocols.
COURSE OBJECTIVE: The main objectives of this course are: 1. Explain the protocol stacks (OSI and TCP/IP) for data communication 2. Discuss the error detection & correction strategies for data transmission. 3. Design the connection establishment of network computing devices. 4. Illustrate the TCP, UDP protocols and explain Domain Name System.
COURSE OUTCOMES (COs)
On successful completion of this course; the student will be able to:

COURSE OBJECTIVE

COURSE ATTRICULATION MATRIX

COURSE CONTENTS THEORY
Introduction to Data Communication and Networking: Internet history and Internet today, Data Communications, Networks, Network Topologies, Classification of Networks, Protocols & Standards, Introduction
to Network Tools-(WireShark, Packet Tracer, NS3, etc), 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, Physical Layer – Periodic Analog signals, Digital signals, Request bit rate, shanon capacity,
performance, PCM, DM, Parallel transmission, serial transmission, ASK, FSK, PSK, QAM, AM, FM, PM.

Coding: Line Coding and block coding. Multiplexing: FDM, WDM, TDM, FHSS, DSSS. Transmission Media.
Error Detection and Correction: Introduction, cyclic Codes: Cyclic redundancy code generation. Frames, Packets,
Data Link Protocols: HDLC, Point-to-Point Protocol.
MAC Protocols: classification of MAC protocols, Random access (ALOHA, CSMA/CD, CSMA/CA), Controlled Access
(Reservation, Polling, Token passing), Channelization Protocols (FDMA, TDMA, CDMA)
Introduction to Networking Devices: Digital Subscriber line Modems, Cable modems, Repeaters, Hubs, Bridges,
Routers, and High layered switches, Gateways, Virtual LAN.

Standards: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet. IEEE 802.11: Architecture, MAC
Sublayer, Addressing Mechanism. Bluetooth Architecture.
Introduction to Wireless networks WiFi, WiMAX, 4G, 5G, Satellite networks, MPLS,VPN, ATM.

Network Layer: IPv4 addresses, IP Datagram format, ICMP Messages, Mobile IP, IPv6 addresses, IPv6 Packet Format,
Transition from IPv4 to IPv6, Routing algorithms (Distance Vector, Link State and Path vector), Unicast Routing
protocols(RIP, OSPF), Introduction to BGP, Introduction to Multicasting protocols, brief introduction to multicast
protocols such DVMRP, MOSPF, PIM, IGMP.

Transport Layer: Introduction to GoBack-N, Selective repeat N, Piggybacking. Services and port numbers, User
Datagram Protocol (UDP): UDP Segment, Transmission Control. Protocol (TCP): TCP Segment, TCP Connection Set
up, Application of TCP and UDP. TCP flow control, TCP error control, TCP Congestion Control and options.
Introduction to SCTP services and features.
Application Layer: Client server programming using UDP and TCP, Name/Address Mapping, DNS Message Format.

TEXT BOOKS:
1. Behrouz A Forouzan, “Data Communications and Networking”, 5th Edition, McGraw – Hill, 2016.
2. Nader F. Mir, “Computer and Communication Networks”, Pearson Education, 2009.

REFERENCE BOOKS:
1. Alberto Leon-Garcia and Indra idjaja, “Communication Networks – Fundamental Concepts and Key Architectures”, 2nd Edition Tata McGraw – Hill, 2004.
2. Andrew S. Tanenbaum, “Computer Networks”, 4th Edition, Pearson Education, 2005.
3. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A system Approach”, 5th Edition, Elsevier, 2012.
4. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2008.
5. Douglas E. Comer, “Internetworking with TCP/IP”, Vol.1, 6th Edition, Pearson, 1995.

JOURNALS/MAGAZINES:
1. IEEE Transactions on Networking.
2. Elsevier Journal of Computer Networks
3. Springer Journal of communications and Information networks.

SWAYAM/NPTEL/MOOCs:
1. https://www.udemy.com/topic/computer-network/
2. https://www.coursera.org/courses?query=computer%20network

3. https://nptel.ac.in/courses/106/105/106105183/ 4. https://www.edx.org/learn/computer-networking

ADVANCED ELECTRICAL MACHINES

Course description:

In this Course student will be studying about permanent magnet materials, and their application in renewable energy applications and industry. Advanced machines which are sensor based and switched reluctance machines will be discussed with respect to their torque speed characteristics. Stepper motors, bearing less switch reluctance motor, bearing less induction motor, doubly salient permanent magnet motor are also covered to match the industry requirements and get adopted to new technology.

Objectives: The overall objective of the Course are:

a) To understand the concepts of magnetic materials and performance characteristics of magnetic circuit.
b) To learn construction and performance characteristics of brushless DC motor
c) To understand various types of rotor construction and classification of permanent magnet brushless AC motor
d) To understand and draw the phasor diagram of over and under excited PMAC motor
e) To learn construction classification and performance characteristics of stepper motor/ switched reluctance motor
f) To learn construction and characteristics bearingless switched reluctance motor/double salient permanent magnet motor

To learn different Mathematical modelling of bearingless induction motor and their topologies

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	Explain different types of magnetic materials and performance characteristics of Brushless DC Motor	1-6	1,2
CO-2	Explain various types of PMAC motor and draw the phasor diagram for different load conditions.of automotive applications	1-4	1,2
CO-3	Explain construction classification and performance characteristics as applied to stepper motor and switched reluctance motor	1-4	1,2
CO-4	Mathematically model bearing less induction motor and explain construction and operating principles of switched reluctance motor and double salient permanent magnet motor	1-5	1,2

CO-5	Identify the Machines required for grid intregartion of Renewable Energy Sources	1-7	1-3
CO-6	Machine performance analysis and assessment for /commercial purpose use.	1-8	1-3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√	√	√		
CO-2	√	√	√	√		
CO-3	√	√	√	√		
CO-4	√	√	√	√		√
CO-5	√	√	√	√	√	√
CO-6	√	√	√	√	√	√

COURSE ARTICULATION MATRIX

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

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

Course content: (to be furnished unit wise for each course with weighting of marks)

UNIT–I: **[10Hrs]**

Permanent magnet materials and magnetic circuits, permanent magnet brushless DC motors.

UNIT–II: **[10Hrs]**

Permanent magnet brushless AC motor, axial field permanent magnet motors.

UNIT–III: **[10Hrs]**

Stepper motors, switched reluctance motors, new topologies of switched reluctance motors.

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

Bearingless switch reluctance motor, bearingless induction motor, doubly salient permanent magnet motor

Text Books and References

1. T.J.E. Miller , "Brushless PM and Reluctance Motor Drives" , Clarendon Oxford Press 1989
2. Jacek Gierasewing, "P. M. Motor technology", Marcel Dekker, 1996.
3. R. Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control", Prentice Hall, 2001.
4. Kelly, Denis, " Performance and Control of Electrical Machines", McGraw-Hill, 1991
5. P.C. Sen, "Principles of Electrical Machines and Power Electronics", Wiley 2005, 2nd Edition
6. Latest IEEE Transactions (PES/Industry Applications)

Course Title	Advanced Microcontrollers				**Course Type**		**Theory**	
Course Code	B20EES708	**Credits**	**3**		**Class**		**VII sem**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	4	3	3	42	-	50	50

COURSE OVERVIEW

This course describes 16-bit Microcontroller MSP430, ARM-32 bit Microcontroller , ARM Cortex M3 - the details are Architecture, Features, Addressing Modes, Instruction Set, Programming and interfacing, ADC, DAC, PWM, Timers, SPI, I2C etc. Also includes Arduino Hardware, software

tool, Programming and Applications. This course is delivered through lectures, tutorials and assignments.

COURSE OBJECTIVE (S):

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 (COs)

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

CO#	Course Outcomes	POs	PSOs
CO-1	To recognize the architecture MSP430 microcontroller.	1,2	1
CO-2	To program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled	1,2, 3	1,2
CO-3	To develop the ability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller.	1-5	1,2
CO-4	Apply the knowledge gained for Programming Arduino for different applications.	1-5	1,2
CO-5	Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.	1,2	1
CO-6	Apply the knowledge gained for Programming ARM Cortex M3 for different application	1-5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1	√	√				
CO-2	√	√	√			
CO-3	√	√	√			
CO-4	√	√	√	√		
CO-5	√	√				

CO-6	√	√	√			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENTS

UNIT-1: MSP430 Microcontroller

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-2: Arduino Microcontroller

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-3: Arm Microcontroller

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-4: ARM Cortex M3 Instruction Sets and Programming

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

Reference Books

1. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes
2. Design reference notes and data sheets of MSP430 (TI)

Journals/Magazines

1. https://ieeexplore.ieee.org/document/8123929
2. https://www.inderscience.com/jhome.php?jcode=ijes
3. https://www.elektor.com/advanced-programming-with-stm32-microcontrollers

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/courses?query=microcontroller
2. https://www.udemy.com/course/pic-microcontroller-advanced-training-course/
3. https://www.edx.org/learn/microcontrollers

ELECTRICITY STANDARD AND REGULATION

<table>
<tr><td>Course Title</td><td colspan="4">Operation and Control of Power Systems</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES710</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

This course will introduce and explain the concepts of synchronous machine modeling, reference frame transformation, automatic voltage regulation, power system stabilizer, transient stability for multimachine system, automatic generation control under deregulated environment, state estimation, eigenvalue and participation factor analysis. By the end of the course, the students should be able to gather high-quality knowledge on stability, operation and control of power systems.
This course benefits all the power system operators for secure operation of power system in the scenario of continuous load growth, system expansion and multiplying number of organizations.

COURSE OBJECTIVE

This course enables graduating students

1. To understand the knowledge of Automatic generation control
2. To understand AVR in power systems
3. To know the optimal operation of generators needs and importance of unit commitment
4. To learn about factors affecting power system security
5. To learn Basis of power system state estimation (PSSE)
6. To study operation of SCADA system control and electricity market

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	To assess Automatic generation control	1,2	1,2
CO2	To understand AVR in power systems	1,2	1,2
CO3	To know the optimal operation of generators needs and importance of unit commitment	1,2,4	1,2
C04	To learn about factors affecting power system security	1,2	1,2
CO5	To learn Basis of power system state estimation (PSSE)	1,2,3	1,2,3
CO6	To study operation of SCADA system control and electricity market	1,2,3	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT THEORY

Unit-1: Automatic Generation Control

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 AVR, 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
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
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
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
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 Book:

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.

Journals/Magazines

1. International Journal of Electrical Power & Energy Systems
2. Electric Machines & Power Systems

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/104/108104052/
2. https://www.coursera.org/learn/electric-power-systems
3. https://npti.gov.in/power-system-operation
4. http://www.nptelvideos.in/2012/12/power-system-operations-and-control.html
5. https://www.swinburne.edu.au/study/courses/units/Power-System-Operation-and-Control-EEE40007/local

<table>
<tr><td>Course Title</td><td colspan="4">Testing and Commissioning of Electrical Equipment</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20EES711</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII sem</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COUREOVERVIEW:

This course deals with fundamental knowledge of standard specifications, installation test, commissioning test performance test and special test of various electrical equipment like power transformer, distribution transformers, Induction Machines, Synchronous Machines and different switch gears and protecting devices as per BIS and IES. Hence useful for an electrical Engineer on site, while handling projects.

COURSE OBJECTIVE

1. To enable students to understand the standard specifications of various electrical equipment as per BIS & IEC(Bureau of Indian Standard, The International Electro-technical Commission)
2. To enable the students to understand standard tests for installation of various electrical equipment as per BIS & IEC(Bureau of Indian Standard, The International Electro-technical Commission)
3. To enable the students to understand standard commissioning tests various electrical equipment as per BIS & IEC(Bureau of Indian Standard, The International Electro-technical Commission)
4. To enable the students to understand standard performance tests of various electrical equipment as per BIS & IEC(Bureau of Indian Standard, The International Electro-technical Commission)

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Be able to describe the standard specifications of transformer, Synchronous machines, Induction Motor & Circuit Breakers.	1,2, 11	1,
CO2	Be able to describe the standard tests, specifications for installation of(transformer, Synchronous machines, Induction Motor & Circuit Breakers) various electrical equipment	1,2, 11	1,2
CO3	Be able to describe the commissioning tests of (transformer, Synchronous machines, Induction Motor & Circuit Breakers) various equipment	1,2, 11	1,2
CO4	Be able to describe the performance tests of (transformer, Synchronous machines, Induction Motor & Circuit Breakers) various equipment	1,2, 11	1,2
CO5	Be able to describe the causes of heat accumulation in transformer	1,2	1,2
CO6	Be able to describe the necessity of cooling of transformer and different types of cooling of transformer	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO1	✓	✓				
CO2	✓	✓	✓	✓		
CO3	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		
CO5	✓	✓				
CO6	✓	✓	✓			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENTS

Unit 1: Transformers [11hrs]

Specifications: Power and distribution transformers as per BIS &IEC standards.

Installation: Location, site, selection, foundation details (like bolts size, their number, etc.), code of practice for terminal plates, polarity & phase sequence, transformer oil properties, reconditioning of oil on site drying of windings and general inspection.

Commissioning tests: Following tests as per national & International Standards, volt ratio test, earth resistance, oil strength, Bucholz & tap changing gear, insulation test, impulse test, polarizing index, load & temperature rise test. Maintenance of transformer, causes of failures of power transformer.

Specific Tests: Determination of performance curves like efficiency, regulation etc,

Unit 2: Synchronous Machines [10 hrs]
Specifications: As per BIS & IEC 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, SCR,
sudden short circuit tests, transient & sub transient parameters.
Factory tests: Gap length, magnetic eccentricity, balancing vibrations,

Unit 3: Induction Motors [11hrs]
Specifications: As per BIS & IEC standards, different types of motors, selection of Induction motors.
Installation: Location of the motors (including the foundation details), shaft & alignment for various coupling, fitting of pulleys & coupling, drying of windings, Rating plate of Induction Motor.
Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing, dismantling and assembling of bearing on the shaft
Electrical Tests: Insulation test, 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 BIS & IEC code)
Specific Tests: Performance & temperature raise tests, stray load losses, shaft alignment, and re-rating & special duty capability. Abnormal operating conditions of Induction Motor and their causes. Preventive maintenance of electric motors.

Unit 4: Circuit Breakers (Switch Gear & Protective Devices) [10hrs]
Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests

Text Book:
1 S. Rao, (2009) ' Testing & Commissioning Of Electrical Equipment 'Khanna Publication New Delhi
2 B .V. S. Rao, 'Testing & Commissioning of Electrical Equipment'

ReferenceBooks:

1. Relevant Bureau of Indian Standards 2011

2. H. N. S. Gowda, 'A Handbook on Operation and Maintenance of Transformers'
Transformer & Switch Gear Handbook -Transformers-BHEL, J &P, J & P

SEMESTER VIII

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Total	
1	B20XXO8XX	Open Elective 4	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
Practical /Term Work / Sessions								
2	B20EE0801	Major Project Phase-2	HC	1	1	5	7	13
TOTAL				1	1	5	7	**14**
TOTAL SEMESTER CREDITS								**10**
TOTAL CUMULATIVE CREDITS								**160**
TOTAL CONTACT HOURS								**17**

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

BOARD OF STUDIES

Sl. No.	Name of the Member	Designation	Affiliation
1.	Dr. Rajashekar P Mandi	Chairperson	Director, School of EEE, REVA University, Bangalore
2.	Dr. Divakar B.P	Member	Dean (R&I), REVA University, Bangalore
3.	Dr. Santhoshkumar H.	Member	Professor, REVA University, Bangalore
4.	Dr. K. Narayana Swamy,	Member	Professor, School of EEE, REVA University, Bangalore
5.	Dr. Arunachalam	Member	Visiting Professor & Former GM, BHEL, Bangalore
6.	Dr. C.S. Sharma	Member	Director CEPO, Indian Space Research Organization (ISRO), Anthariksh Bhavan, New BEL Road, Bangalore
7.	Dr. D N Gaonkar	Member	Associate Professor, Department of Electrical and Electronics Engineering, NITK, Surathkal
8.	Dr. Nagaraj N.S	Member	Co-founder & CEO, Sensei Technologies Pvt. Ltd., Bangalore
9.	Mr. Nagadev Singh	Member	Manager, EFD-Furnace Pvt. Ltd., Bangalore
10.	Mr. Paramesh K.	Member	Dy. Director, KERC, Bangalore
11.	Dr. Harish Babu G A	Member	Professor, School of Applied Sciences, REVA University, Bangalore
12.	Dr. Manjunath N.	Member	Assistant Professor, School of Applied Sciences, REVA University, Bangalore
13.	Dr. Vishwanath R Hulipalled	Member	Professor, School of Computing and IT, REVA University, Bangalore
14.	Mr. Raghu C.N.	Member	Assistant Professor, School of EEE, REVA University, Bangalore
15.	Mr. Sagar B S	Member	Assistant Professor, School of EEE, REVA University, Bangalore

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.
4. Use of Crackers, explosives and ammunition etc