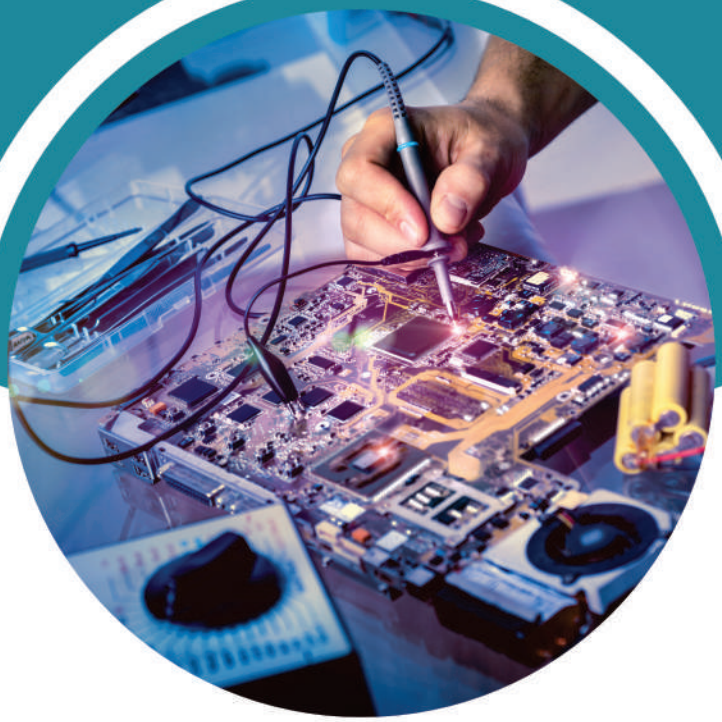
Third Year BE

SCHEME & SYLLABUS

Autonomous Scheme 2021-22

Electrical & Electronics Engineering



ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service and Excellence

VISION

To be a global premier Institution of professional education and research

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular, for quality professional education
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies
- Attract, nurture and retain the best faculty and technical manpower
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities
- Promote all-round personality development of the students through interaction with alumni, academia and industry
- Strengthen the Educational Social Responsibilities (ESR) of the Institution

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution
Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi
NBA – Accredited: B.E.(CSE,ECE,EEE, ME and CIV) & MBA
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS
(With effect from 2021-22)

Electrical & Electronics Engineering

THIRD YEAR

(V and VI Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and MBA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practicing since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

CONTENTS

ABOUT THE DEPARTMENT

The Department of Electrical & Electronics Engineering (EEE) was established in the year 2002. The Department has a team of well qualified and dedicated faculty with wide range of specialization. The BE programme offers a unique mix of electrical, electronics and computer related courses enabling the students to take up a professional career/higher studies in any of these areas. Subjects on Electric Circuit Analysis, Control Systems, EV Technologies, Protection and Power Systems, Electric Power Generation, Transmission and Distribution give the basic exposure to electrical fundamentals, whereas Analog and Digital Electronics, Microcontrollers, Digital Signal Processing, Embedded Systems, Hardware Description Languages(HDL), Advanced CMOS VLSI Design, Advanced Programming Languages make attractive blend of Electrical & Electronics Engineering concepts thereby creating excellent placement opportunities in various fields such as Construction, Power Distribution, Automobile, Aeronautical, Information Technology, Healthcare sectors, Semiconductor Device Design and Fabrication. The students of EEE branch are placed in Electrical & Electronics Engineering related Organizations and Software Companies. With the objective of making graduates Industry ready, Computer labs with modern Software and Hardware labs on Transformers, Motors, Power System Protective Relays, Power Electronics and Drive Systems have been operational and have helped students to improve their Technical Knowledge and Skills. The Department of Electrical & Electronics Engineering at SJEC is one of the few Departments in the region to secure NBA Accreditation since 2013.

DEPARTMENT VISION

Excel in Electrical Engineering Education and Research

DEPARTMENT MISSION

- Provide and maintain an environment designed to ensure quality Electrical Engineering Education.
- Design and deliver add-on curricula to existing syllabus to ensure compatibility with National and Global needs.
- Provide Holistic Personality Development of the students through interaction with Industry, Academia and Alumni.
- Consolidate state-of-art laboratories for Teaching and Research Activities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To develop necessary skills in students for successful careers through rigorous education and appreciation for the life-long learning needed to maintain competency.

2. To provide students with the solid foundation in mathematical, scientific and electrical engineering to analyze data and extract relevant information for application to product design and pursue higher education.

3. To train students with good scientific and engineering breadth, including proficiency in software language and use of latest software tools so as to comprehend, analyze, design and create novel products and solutions to current problems.

4. To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

Electrical & Electronics Engineering Graduates will be able to:
PSO1: Make use of modern simulation software & hardware tools and techniques to analyze, present and solve Electrical Engineering problems.
PSO2: Develop entrepreneurial skills through Industry-Institute interactions by activities related to personality development and financial management.

V Semester (B.E. - EE Engineering)														
Sl. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
						L	**T**	**P**					
1	HSMC	21EEE501	Management and Entrepreneurship	EEE	EEE	3	-	-	03	50	50	100	3
2	PCC	21EEE502	Control Systems (Integrated Course)	EEE	EEE	3	-	2	03	50	50	100	4
3	PCC	21EEE503	Transmission and Distribution	EEE	EEE	2	2	-	03	50	50	100	3
4	PCC	21EEE504	Signals and Digital Signal Processing	EEE	EEE	2	2	-	03	50	50	100	3
5	PCC	21EEE505	Power System Analysis and Stability	EEE	EEE	2	2	-	03	50	50	100	3
6	PCC	21EEL506	Digital Signal Processing Laboratory	EEE	EEE	-	-	2	03	50	50	100	1
7	HSMC	21RMI507	Research Methodology and Intellectual Property Rights	COM	COM	3	-	-	03	50	50	100	3
8	INT	21INT508	Summer Internship - II	COM	COM	-	-	-	03	100	-	100	2
9	MNCC	21ETP509	Emerging Technologies: A Primer	COM	COM	-	-	2	02	50	-	50	-
						15	**6**	**6**	**26**	**500**	**350**	**850**	**22**

Note: BSC: Basic Science Courses; ESC: Engineering Science Courses; HSMC: Humanity, Social Science and Management Courses; MNCC = Mandatory Non-Credit Course. INT: Internship, PCC: Professional Core Course; PEC = Professional Elective Course; OEC = Open Elective Course; UHV: Universal Human Values SDC: Ability Enhancement (Skill Development) Course.

One-hour Lecture (L) per week per semester = 1 Credit; Two-hour Tutorial (T) per week per semester = 1 Credit; Two-hour Practical/Laboratory/Drawing (P) per week per semester = 1 Credit.

VI Semester (B.E. - EE Engineering)													
Sl. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
						L	**T**	**P**					
1	PCC	21EEE601	Computer Techniques in Power System (Integrated Course)	EEE	EEE	3	-	2	03	50	50	100	4
2	PCC	21EEE602	Power Electronics	EEE	EEE	2	2	-	03	50	50	100	3
3	PEC	21EEE603X	Professional Elective - 1	EEE	EEE	2	2	-	03	50	50	100	3
4	OEC	21XXX604X	Open Elective - 1	EEE	EEE	3	-	-	03	50	50	100	3
5	HSMC	21CIV605	Environmental Studies	CIV	CIV	1	-	-	02	50	50	100	1
6	PCC	21EEL606	Power Electronics Laboratory	EEE	EEE	-	-	2	03	50	50	100	1
7	PCC	21EEE607	Hardware Description Language (HDL)	EEE	EEE	3	-	-	03	50	50	100	3
8	SDC	21EEE608	Mini-Project	EEE	EEE	-	-	2	03	100	-	100	2
9	MNCC	21IIP609	Innovation and Intellectual Property	COM	COM	-	-	2	02	50	-	50	-
10	INT	Summer Internship III: Research Internship / Industrial Internship: 24 weeks during the VI to VIII semesters On successful completion, 10 credits will be added in the VIII Semester marks card.											
						14	**04**	**08**	**25**	**500**	**350**	**850**	**20**

Professional Elective - I: Students can select any one of the professional electives offered by the Department.

Professional Elective – I (21XXX603X)					
21EEE6031	Electric Vehicle Technologies	21EEE6033	Sensors and Transducers	21EEE6035	Electrical Machine Design
21EEE6032	Embedded System	21EEE6034	Electromagnetic Field Theory	-	

Open Elective I (21XXX604X)							
Course Code	**CSE**	**AIM**	**CBS**	**ECE**	**EEE**	**MEC**	**CIV**
21XXX6041	Introduction to Database Management System	Neural Networks	Neural Networks	Basics of Analog Circuits	Renewable Energy Sources	Automobile Engineering	Remote Sensing and Geographical Information System
21XXX6042	Introduction to Programming in Java	Introductionto AI and ML	Introductionto AI and ML	Fundamentals of Digital System Design	PLC & SCADA	3D modelling	Numerical Methods and Applications
21XXX6043	Dot Net Programming	Computer Vision	ComputerVision	Microcontroller	Control Systems	Entrepreneurship Development	Sustainability Concepts in Engineering
21XXX6044	Introduction to Python	Predictive Analytics	Predictive Analytics	Programming & Interfacing with Arduino	Electrical Safety Practices	Statistical Quality Control	Occupational Health and Safety
21XXX6045	-	Introduction to Data Science	Introduction to Data Science	Communication Theory	Energy Conservation and Audit	Non-Destructive Testing	-

Note: Open Elective – I: Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (Please refer to the list of open electives). Selection of an open elective shall not be allowed if, (i) the candidate has studied the same course during the previous semesters of the program. (ii) the syllabus content of open elective is similar to that of the Departmental core courses or professional electives. (iii) a similar course, under any category, is prescribed in the higher semesters of the program. Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Research/Industrial Internship - All the students admitted shall have to undergo a mandatory internship of minimum 24 weeks during the VI to VIII semesters. Viva-Voce examination shall be conducted during VIII semester and the prescribed credit shall be included. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.

Research Internship Students have to take up research internships at Centers of Excellence (CoE) / Study Centers established in the same institute and /or out of the institute at reputed research organizations / Institutes. A research internship is intended to give students the flavour of current research going on a particular topic/s. The internships serve this purpose. They help students to get familiarized with the field, the skill needed, the amount and kind of effort required for carrying out research in that field.

AICTE Activity Points to be earned by students admitted to BE/B.Tech/B. Plan day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

V Semester

Management and Entrepreneurship			
Course Code	**21EEE501**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- To discuss principles and functions of management and techniques for project management.
- To explain the need of social responsibilities and support provided by government and non-government institutes for industrial development.
- To explain the role and importance of the entrepreneur in economic development and the concepts of entrepreneurship.
- To discuss the importance of Small Scale Industries and financial management in business.

Module-1 Management & Planning **8 hours**

Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills.

Nature, Importance and Purpose Of Planning, Types of Plans, Steps in Planning.

Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization

Module-2 Directing & Financial Management **8 hours**

Meaning and Nature of Directing-Leadership Styles, Motivation Theories Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination. Controlling – Meaning, Steps in Controlling.

Financial statements, double-entry book keeping. Cash and revenue, price and income etc., cost concepts, volume profit analysis, breakeven analysis – its application/cost in engineering and management decision making.

Module-3 Social Responsibility & Entrepreneurship **8 hours**

Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance.

Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Intrapreneur – An Emerging Class, Comparison between Entrepreneur and Intrapreneur, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.

Module-4 Small Business Enterprise **8 hours**

Role of Small Scale Industries, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Impact of Globalization on SSI, Impact of WTO/GATT on SSIs, Ancillary Industry and Tiny Industry (Definition only).

Introduction to Institutional Support for Business Enterprises, Policies & Schemes of Central–Level Institutions, State-Level Institutions.

Module-5 Project Management **8 hours**

Meaning of Project, Project Objectives & Characteristics, Project Identification- Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Report-Need and Significance of Report, Contents, Formulation, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation.

PERT and CPM, Steps involved in developing the network, Uses and Limitations of PERT and CPM**.**

Course Outcomes: At the end of the course the student will be able to:	
21EEE501.1	Review and Interpret the first principles of management as a manager and planner in an industrial environment.
21EEE501.2	Identify the features of management sciences in organizing & staffing, directing & controlling the resources in an industrial environment.
21EEE501.3	Apply the norms of financial management and business ethics to fulfill social responsibilities of industries through corporate governance.
21EEE501.4	Demonstrate the knowledge of financial management principles in establishing and managing small business enterprise.
21EEE501.5	Demonstrate the understanding of management principles in undertaking projects in multidisciplinary environments.
21EEE501.6	Develop financial management skills through interactions with institutions that provide support for business enterprise.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Principles of Management	P.C. Tripathi, P.N. Reddy	McGraw Hill	6th Edition, 2017
2	Entrepreneurship Development and Small Business Enterprises	Poornima M. Charanthimath	Pearson	2nd Edition, 2014
3	Financial Management	Khan & Jain	Tata McGraw Hill	8th Edition 2022
Reference Books				
1	Dynamics of Entrepreneurial Development and Management	Vasant Desai	Himalaya Publishing House	2007
2	Essentials of Management: An International, Innovation and Leadership perspective	Harold Koontz, Heinz Weihrich	McGraw Hill	10th Edition 2016

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/110/106/110106141/
- https://archive.nptel.ac.in/courses/110/104/110104073/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE501.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE501.2	0	0	0	0	0	0	0	0	0	2	0	0	0	1
21EEE501.3	0	0	0	0	0	2	0	2	0	0	0	1	0	0
21EEE501.4	0	0	0	0	0	0	2	0	0	0	0	1	0	2
21EEE501.5	0	0	0	0	0	0	0	0	2	0	0	0	1	0
21EEE501.6	0	0	0	0	0	0	0	0	0	3	1	0	0	0

1: Low 2: Medium 3: High

Control Systems			
Course Code	**21EEE502**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE Hours	03
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Articulate the importance of the control system and types of feedback
- Apply the concept of mathematical modelling, block diagram and signal flow graph approaches to obtain the transfer function for the linear systems.
- Determine the stability of a system by application of time domain and frequency domain techniques
- To formulate state models and solutions to state equations

Module-1 Mathematical Modelling **8 hours**

Introduction, classification of control systems, procedure for deriving transfer functions for Single input single output systems, Modelling of mechanical system elements, electrical systems, rotational systems, Analogous quantities, Transfer function of armature and filed controlled DC motor.

Module-2 Block Diagram & Signal Flow Graphs **8 hours**

Block diagram of a closed loop system, procedure for drawing block diagram and block diagram reduction to obtain transfer function, basic properties of signal flow graph, signal flow graph algebra, Construction of signal flow graphs and obtain transfer functions.

Module-3 Time Domain Analysis & RH Criterion **8 hours**

Standard test signals, time response of second order systems, steady-state errors and error constants. BIBO stability, Routh stability criterion, Special cases of Routh table, application of Routh stability criterion to linear feedback systems and stability analysis.

Module-4 Graphical Techniques & Controllers **8 hours**

Introduction, root locus concepts, construction of root loci, rules for the construction, frequency response specifications (no derivations), General procedure for constructing bode plots, Bode plots, Nyquist plots and stability analysis

Introduction to P, PI, PD, PID controllers and industrial practice & applications.

Module-5 State Space Model **8 hours**

Basic Concepts of State Space Model, Transformations from transfer functions to state space and vice versa.

PRACTICAL MODULE

1. Determine the transfer function for the given close loop system in the block diagram representation
2. Determine the steady state errors of a given transfer function
3. Simulate and Analyze the time response of a system subjected to standard test signals
4. Analyze the effect of variations of Poles and zeros on unit step response
5. Determine the time response specifications of the second order system (RLC network)
6. Experiment to study the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.
7. Determination of the stability of a system using root locus analysis
8. Determination of the stability of a system using Bode plot analysis
9. Determination of the stability of a system using Nyquist plot analysis
10. Transformation from state space representation to transfer function and vice versa

Course Outcomes: At the end of the course the student will be able to:	
21EEE502.1	Apply the knowledge of Physical Systems Modelling to Electrical, Mechanical and electromechanical systems
21EEE502.2	Apply the Block diagrams reduction techniques and signal flow graphs to obtain the transfer function of a system
21EEE502.3	Assess the effect of pole and zeros and standard input test signals for calculating the errors and determining the stability of a system
21EEE502.4	Recognize the application of Root locus and bode plots techniques to determine the stability of a closed loop system
21EEE502.5	Study the techniques of transfer function to state space models and vice versa by the application of modern simulation tools such as MATLAB
21EEE502.6	Perceive the need for PID controllers in industries for engaging in professional engineering practice learn

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Control Systems	Anand Kumar	Prentice Hall India	2nd Edition, 2014
Reference Books				
1	Automatic Control Systems	Farid Golnaraghi, Benjamin C. Kuo	Wiley	9th Edition, 2010
2	Control System Engineering	Norman S. Nise	Wiley	4th Edition, 2004
3	Modern Control Systems	Richard C Dorf et.al.	Pearson	11th Edition, 2008
4	Control Systems	Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams	Schaums Outlines Series, Tata McGraw Hill, Special Indian Edition	3rd Edition, 2010

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_ee90/preview
- http://ebootathon.com/labs/beta/ec/ControlSystem-I/exp5/simulation.html
- http://vlabs.iitkgp.ernet.in/rcs/exp12/index.html

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE502.1	2	2	2	0	0	0	0	0	1	1	0	0	1	0
21EEE502.2	2	2	2	2	2	0	0	0	0	1	0	1	1	0
21EEE502.3	2	2	2	2	0	0	2	0	0	1	0	0	1	0
21EEE502.4	2	2	2	0	0	0	0	0	0	1	0	1	0	0
21EEE502.5	2	2	2	2	2	0	0	0	1	0	0	1	1	0
21EEE502.6	2	2	2	2	1	0	0	1	0	1	0	1	1	0

1: Low 2: Medium 3: High

Transmission and Distribution			
Course Code	**21EEE503**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Articulate the importance HVAC, EHVAC, UHVAC and HVDC transmission lines.
- Calculate the parameters of the transmission line for different configurations and assess the performance of the line.
- Study underground cables for power transmission and evaluate different types of distribution systems.

Module-1 Power System & Transmission Lines **8 hours**

Generation, transmission and distribution. Advantages of higher voltage transmission: HVAC, EHVAC, UHVAC and HVDC. Interconnection. Feeders, distributors and service mains.

A brief introduction to types of supporting structures and line conductors- Conventional conductors; Aluminium Conductor steel reinforced (ACSR), All – aluminium alloy conductor (AAAC) and All –Aluminium conductor (AAC). High temperature conductors.

Bundle conductor and its advantages. Importance of sag, Sag calculation – supports at same and different levels, effect of wind and ice. Line vibration and vibration dampers. Overhead line protection against lightening; ground wires.

A brief introduction to types of insulators, material used- porcelain, toughened glass and polymer (composite). Potential distribution over a string of suspension insulators. String efficiency, Methods of increasing string efficiency. Arcing horns.

Module-2 Transmission Line Parameters **8 hours**

Introduction to line parameters- resistance, inductance and capacitance. Inductance of composite – conductors, geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines. Capacitance of composite – conductor, geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines.

Module-3 Performance of Transmission Lines **8 hours**

Classification of lines – short, medium and long. Currentand voltage relations, line regulation and Ferranti effect in short length lines, medium length lines considering Nominal T and nominal circuits, and long lines considering hyperbolic form equations. Equivalent circuit of a long line. ABCD constants in all cases.

Module-4 Corona and Underground Cables **8 hours**

Corona phenomena, disruptive and visual critical voltages, corona loss. Advantages and disadvantages of corona. Methods of reducing corona.

Types of underground cables, constructional features, insulation resistance, thermal rating, charging current, grading of cables – capacitance and inter-sheath. Dielectric loss. Comparison between AC and DC cables. Limitations of cables. Specification of power cables

Module-5 Distribution Systems **8 hours**

Primary AC distribution systems–Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated loads. Effect of disconnection of neutral in a 3 phase four wire system.

Introduction to reliability, definition of reliability, failure, probability concepts, limitation of distribution systems, power quality, Reliability aids.

Course Outcomes: At the end of the course the student will be able to:	
21EEE503.1	Identify the importance of different transmission systems.
21EEE503.2	Classify different types of insulators
21EEE503.3	Analyze and compute the parameters of the transmission line for different configurations.
21EEE503.4	Assess the performance of overhead lines and interpret corona.
21EEE503.5	Explain the purpose of underground cables.
21EEE503.6	Classify different types of distribution systems and examine its quality & reliability.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	A Course in Electrical Power	J B Gupta	S K Kataria & Sons	2008
2	Principles of Power System	V.K. Mehta Rohit Mehta	S Chand	1st Edition 2013
Reference Books				
1	Electrical power Generation, Transmission Distribution	S.N. Singh	Prentice Hall India	2nd Edition, 2009
2	Power System Analysis and Design	J. Duncan Glover at el	Cengage Learning	4th Edition 2008

Web links and Video Lectures (e-Resources):

- https://youtu.be/uy9lZCdkQIM

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE503.1	3	0	0	0	0	0	2	0	0	0	0	0	1	0
21EEE503.2	0	3	0	0	0	0	1	0	0	0	0	0	2	0
21EEE503.3	3	0	0	0	0	0	2	0	0	0	0	0	1	0
21EEE503.4	0	1	0	0	0	0	3	0	0	0	0	0	0	0
21EEE503.5	0	2	0	0	0	0	3	0	0	0	0	0	0	0
21EEE503.6	3	1	0	0	0	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Signals and Digital Signal Processing			
Course Code	**21EEE504**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Discuss and explain basic operations on signals
- Explain the use of convolution integral and convolution sum in analyzing the response of linear time invariant systems in continuous and discrete time domains.
- Define and evaluate DFT of various signals.
- Design IIR and FIR filters

Module-1 Signals & Systems **8 hours**

Introduction to signals & systems, Definitions of signals and a system, classification of signals, basic operations on signals, properties of systems.
Time – Domain Representations for LTI Systems, Convolution, impulse response representation, convolution sum and integral. Properties of impulse response representation.

Module-2 Discrete Fourier Transform (DFT) **8 hours**

Introduction to DFT, Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method.

Module-3 Fast Fourier Transform (FFT) **8 hours**

Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and Decimation-in-frequency algorithms.

Module-4 Infinite Impulse Response Filter (IIR) **8 hours**

Characteristics of commonly used analog filters – Butterworth and Chebyshev Type - I filters, analog to analog frequency transformations. Design of Digital IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions: Bilinear transformation method. Implementation of discrete-time systems.

Module-5 Finite Impulse Response Filter (FIR) **8 hours**

Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Hanning and Kaiser windows, FIR filter design using frequency sampling Technique. Implementation of discrete-time systems: Structures for Filters: IIR Filters - direct form I and direct form II, cascade and parallel structures. FIR filters-direct form, cascade and Linear Phase Form.

Course Outcomes: At the end of the course the student will be able to:

21EEE504.1	Explain the generation of signals, behavior of system and the basic operations that can be performed on signals and properties of systems.
21EEE504.2	Apply convolution in both continuous and discrete domain for the analysis of systems given impulse response of a system
21EEE504.3	Apply DFT and IDFT to perform linear filtering techniques on given sequences to determine the output.
21EEE504.4	Apply fast and efficient algorithms for computing DFT and inverse DFT of a given sequence.
21EEE504.5	Design and realize Butterworth and Chebyshev digital filters and FIR filter using different techniques.
21EEE504.6	Develop different structures for IIR and FIR filters.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to Digital Signal Processing	Jhonny R. Jhonson	Pearson	1st Edition, 2016
2	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition 2018
Reference Books				
1	Digital Signal Processing – Principles, Algorithms, and Applications	Jhon G. Proakis Dimitris G. Manolakis	Pearson	4th Edition, 2007
2	Digital Signal Processing	A.NagoorKani	McGraw Hill	2nd Edition, 2012
3	Digital Signal Processing	Shaila D. Apte	Wiley	2nd Edition, 2009
4	Digital Signal Processing	Ashok Amberdar	Cengage	1st Edition, 2007

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/104/108104100/
- https://nptel.ac.in/courses/108101174

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE504.1	3	2	0	0	0	0	0	0	0	0	0	0	0	0
21EEE504.2	0	2	0	0	2	0	0	0	0	0	0	0	2	0
21EEE504.3	0	2	0	0	2	0	0	0	0	0	0	0	2	0
21EEE504.4	1	2	0	0	2	0	0	0	0	0	0	0	2	0
21EEE504.5	0	0	2	0	2	0	0	0	0	0	0	0	2	0
21EEE504.6	1	2	0	0	2	0	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Power System Analysis and Stability			
Course Code	**21EEE505**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Articulate the importance of per unit system, reactance diagram and bus matrices in power system analysis.
- Analyze the **s**ymmetrical fault conditions in power system and to discuss the selection of circuit breakers.
- Apply the knowledge of sequential components to analyze the unbalanced faults in power system.
- Discuss stability and types of stability for a power system and the equal area criterion for the evaluation of stability of a simple system.

Module-1 Representation of power System **8 hours**

Introduction, Single phase representation, One Line Diagram, Per Unit Quantity, Reactance and Impedance Diagram, Steady state model of Synchronous machine, Power Transformer, Transmission line and load.

Module-2 Symmetrical Fault Analysis **8 hours**

Introduction, Transients in RL series circuits, Short-circuit current and reactance's of synchronous machine on no-load, Internal voltage of loaded synchronous machine under transient conditions, symmetric short circuit MVA calculations, Selection of circuit breakers, concept of short circuit capacity of bus.

Module-3 Symmetrical Components **8 hours**

Introduction, Symmetrical Component Transformation, Phase Shift in Star-Delta Transformers, Sequence Impedances & networks of Transmission Lines, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances and Networks of Transformers, Construction of Sequence Networks of a Power System.

Module-4 Unsymmetrical Fault Analysis **8 hours**

Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line-To-Ground (LG) Fault, Line-To-Line (LL) Fault, Double Line-To-Ground (LLG) Fault, Open Conductor Faults.

Module-5 Power System Stability Analysis **8 hours**

Steady-state and Transient stability, Rotor dynamics and the Swing equation, Power angle equation. Equal – Area criterion of stability and its application for transient stability evaluation. Solution of swing equation using point by point method and Runge kutta method (4^{th} order)

Course Outcomes: At the end of the course the student will be able to:	
21EEE505.1	Apply the knowledge of per unit system to construct reactance diagram of power system.
21EEE505.2	Analyze symmetrical three phase faults in power system to determine short circuit kVA.
21EEE505.3	Apply the concept of symmetrical components to calculate sequence components and draw sequence networks
21EEE505.4	Analyze the unsymmetrical faults using symmetrical components to determine fault currents.
21EEE505.5	Analyze dynamics of synchronous machine to evaluate transient stability.

21EEE505.6	Apply the knowledge of numerical methods to evaluate the stability of the system.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Power System Analysis	John J Grainger, William D Stevenson	McGraw-Hill Education	2014
2	Elements of Power System Analysis	W.D Stevenson	McGraw-Hill International	4th Edition, 2001
3	Modern Power System Analysis	I J Nagrath and D P Kothari	Tata McGraw-Hill Education India	4th Edition, 2011
Reference Books				
1	Power System Analysis	Arthur Bergen	Pearson	2nd Edition, 1999

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee77/preview
- https://onlinecourses.nptel.ac.in/noc20_ee88/preview

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE505.1	2	3	0	0	0	0	0	0	1	1	0	0	1	0
21EEE505.2	2	3	0	3	0	0	0	0	1	1	0	0	2	0
21EEE505.3	2	3	0	0	3	0	0	0	1	1	0	0	2	0
21EEE505.4	2	3	0	3	3	0	0	0	1	1	0	0	2	0
21EEE505.5	2	3	0	3	3	0	0	0	1	1	0	0	2	0
21EEE505.6	2	3	0	3	3	0	0	0	1	1	0	0	2	0

1: Low 2: Medium 3: High

Digital Signal Processing Laboratory			
Course Code	**21EEL506**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE Hours	03
Total Hours		Credits	01

Course Learning Objectives: The objective of the course is to

- Explain the use of software tools in conducting the experiments of signal processing laboratory evaluating the DFT and IDFT of given sequence.
- Explain generation of different types of signals both in continuous and discrete time domains
- Design and implementation of IIR and FIR filters for given frequency specifications and realize them
- Explain verification of linear and circular convolutions of given sequences

Sl. No	Experiments
1	Generation of different signals in both continuous and discrete time domains.
2	To perform basic operations on given sequences- Signal folding, evaluation of even and odd signals
3	Evaluation of impulse response of a system.
4	Solution of a difference equation.
5	Evaluation of linear convolution and circular convolution of given sequences.
6	Computation of N- point DFT and IDFT of a given sequence by use of (a) Defining equation; (b) FFT method.
7	Evaluation of circular convolution of two sequences using DFT and IDFT approach.
8	Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject filters).
9	Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using different window functions.
10	Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using frequency sampling technique.
11	Realization of IIR and FIR filters.

Course Outcomes: At the end of the course the student will be able to:	
21EEL506.1	Evaluate the impulse response of a system
21EEL506.2	Perform convolution of given sequences to evaluate the response of a system
21EEL506.3	Compute DFT and IDFT of a given sequence using the basic definition and/or fast methods
21EEL506.4	Provide a solution for a given difference equation
21EEL506.5	Design and implement IIR and FIR filters
21EEL506.6	Develop the structure of IIR and FIR filters

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to Digital Signal Processing	Jhonny R. Jhonson	Pearson	1st Edition, 2016
2	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition 2018

Reference Books				
1	Digital Signal Processing – Principles, Algorithms, and Applications	Jhon G. Proakis Dimitris G. Manolakis	Pearson	4th Edition, 2007
2	Digital Signal Processing	A.NagoorKani	McGraw Hill	2nd Edition, 2012
3	Digital Signal Processing	Shaila D. Apte	Wiley	2nd Edition, 2009
4	Digital Signal Processing	Ashok Amberdar	Cengage	1st Edition, 2007

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee77/preview
- https://onlinecourses.nptel.ac.in/noc20_ee88/preview

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEL506.1	3	2	0	0	0	0	0	0	3	0	0	0	0	0
21EEL506.2	0	2	0	0	2	0	0	0	2	0	0	0	2	0
21EEL506.3	0	2	0	0	2	0	0	0	3	0	0	0	2	0
21EEL506.4	1	2	0	0	2	0	0	0	2	0	0	0	2	0
21EEL506.5	0	0	2	0	2	0	0	0	1	0	0	0	2	0
21EEL506.6	1	2	0	0	2	0	0	0	1	0	0	0	2	0

1: Low 2: Medium 3: High

Research Methodology and Intellectual Property Rights			
Course Code	**21RMI507**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

1. To understand the basic concepts related to research
2. To learn the concept of literature survey, review and technical writing
3. To discuss the basics of intellectual property
4. To explain the patents, copyrights, trademarks, industrial designs and geographical indications.

Module-1 Research Methodology and Literature Survey (8 hours)

Research Methodology: Meaning, objectives, types, significance of research. Research approaches, method versus methodology, research process, Criteria of good research. Defining the research problem: conditions, components, selection, necessity, techniques and illustrations.

Literature Survey, Literature Review: Introduction, process, databases (Google Scholar, Web of Science, Scopus, Science Direct etc) and management tools. Author Metrics and Journal Metrics, Identifying gap areas from literature review. Ethics in research and publications. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

Textbook 1: Ch 1 and 2, Textbook 2: Ch 7-17.

Module-2 Technical Writing and Presentations (8 hours)

Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, referencing and citations, submission and post-submission. Illustrations.

Thesis Writing: Synopsis, Introduction, Literature review, Aim and objectives, Methodology, Time frame, Results and discussions, Conclusions.

Research Proposal Writing: Types of research projects, Major funding agencies in India, Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.

Textbook 2: Ch 20-28, 35.

Module-3 Introduction to IPR and Patents (8 hours)

Introduction to Intellectual Property: Meaning, relevance, Types of IP, Role of International Institutions: The Patent Cooperation Treaty (PCT), TRIPS Agreement, WIPO, IP system in India and National IPR Policy in India.

Patents: Concept, Patents Act 1970 and its amendments, Patentable Subject Matter and Patentability Criteria, Non- Patentable Subject Matter, Procedure for Filing of Patent Application and types of Applications, Patent Search and Databases, Patent Granting Procedure, Rights of Patentee, Patent Infringement, Recent Developments: Patenting of Softwares, Inventions in Biotechnology. Illustrations.

Textbook 3: Lesson 1-10.

Module-4 Copyright and Trademarks (8 hours)

Copyright: Introduction, meaning, nature of copyright protection, Indian copyright law: Classes of work, copyright pertaining to software, Authorship and ownership and rights, Terms of copyright, Assignment, transmission and licensing, Infringement of copyrights: Exceptions and remedies, Copyright societies, Office, board, Registration of copyrights and appeals, Illustrations.

Trademark: Introduction, The Trade Marks Act 1999, Important Definitions, Trade Mark Rules 2017, Procedure of registration of trade mark in India. Duration and renewal, Opposition to registration, Grounds for refusal to registration, Rights conferred by registration, Infringement of registered Trade Mark and Remedies. Illustrations.

Textbook 3: Lesson 11 and 12.

Module-5 Industrial Designs and Geographical Indications (8 hours)
Industrial Designs: Introduction, Need for protection of industrial designs, Registrable and non-registrable designs, Registration of designs, Infringement of Industrial Designs–and Remedies, Illustrations. **Geographical Indications (GIs):** Introduction, Geographical Indications of Goods (Registration & Protection) Act, 1999, Procedure for registration of geographical indications, Infringement of GIs. **Layout – Designs of Integrated Circuits:** Introduction, Procedure for Registration of Layout design under the Semi-Conductor Integrated Circuits Layout-Design Act, 2000, Conditions and Procedures for registration. Infringement and Penalty. **Miscellaneous Topics:** The Protection of Plant Varieties and Farmers' Rights, Protection of Traditional Knowledge and Bio-diversity Act. Textbook 3: Lesson 13-16, Textbook 4: Ch 70.

Course Outcomes: At the end of the course the student will be able :	
21RMI507.1	To conduct literature survey, review and define a research problem.
21RMI507.2	To follow research ethics and develop the art of writing technical papers and reports.
21RMI507.3	To discuss the importance of Intellectual Property Rights in India.
21RMI507.4	To explain the various forms of Intellectual Property and its relevance in Indian context.
21RMI507.5	To explain the legal aspects of patents, copyrights and trademarks in India.
21RMI507.6	To explain the legal aspects of industrial designs, geographical indications and semi-conductor integrated circuits layout-designs in India.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Research Methodology: Methods and Techniques	C R Kothari and Gaurav Garg	New Age International Publishers	4th Edition 2019
2	Academic Writing	Ajay Semalty	B S Publications	2021
3	Intellectual Property Rights – Laws and Practice	The Institute of Company Secretaries of India, New Delhi	Delhi Computer Services, New Delhi	2018
4	Law Relating to Intellectual Property Rights	V K Ahuja	LexisNexis, India	3rd Edition 2017
Reference Books				
1	Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	Sage Publications India Pvt Ld New Delhi	4th Edition 2014
2	Intellectual Property: A Primer for Academia	Prof. Rupinder Tewari and Ms. Mamta Bhardwaj	Publication Bureau, Panjab University, India	2021
Additional Resources: Web links/NPTEL Courses https://ipindia.gov.in/ (Official website of Intellectual Property India) https://dpiit.gov.in/policies-rules-and-acts/policies/national-ipr-policy https://www.icsi.edu/media/webmodules/FINAL_IPR&LP_BOOK_10022020.pdf				

https://corpbiz.io/learning/design-infringement-in-india/
https://nptel.ac.in/courses/121106007 (Introduction to Research (Research Methodology))
https://nptel.ac.in/courses/109105112 (Introduction on Intellectual Property to Engineers and Technologists)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21RMI507.1	-	**2**	-	-	**1**	-	-	-	-	-	-	**2**	-	-
21RMI507.2	-	-	-	-	**1**	-	-	**3**	-	**2**	-	-	-	-
21RMI507.3	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-
21RMI507.4	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-
21RMI507.5	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-
21RMI507.6	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-

1: Low 2: Medium 3: High

Emerging Technologies: A Primer			
Course Code	21ETP509	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	0	Exam Hours	02

Course Learning Objectives:

1. To develop a strong awareness of the ethical and societal implications associated with emerging technologies.
2. To instil practical skills related to AI (Artificial Intelligence), Blockchain, Digital Twins, RPA (Robotic Process Automation), and Cybersecurity.
3. To enable experiences of working on a team project, allowing students to apply their knowledge and skills to a real-world problem and present their findings effectively.

Module-1: AI and Web 3.0 (06 Hours)

Introduction to Emerging Technologies: Overview of the course, Importance of staying updated with emerging technologies, Ethical and societal considerations.

Artificial Intelligence (AI): Definition and history of AI, Machine learning and deep learning, Applications of AI in various industries, In-Class Assignment: AI in Everyday Life, Homework Assignment: Building a Simple Chatbot.

Web 3.0: Blockchain and Metaverse - Introduction to Blockchain technology, Metaverse and its potential, In-Class Assignment: Creating a Simple Smart Contract, Homework Assignment: Exploring a Metaverse Platform.

Module-2: Smart Manufacturing and Robotic Process Automation (06 Hours)

Smart Manufacturing and Digital Twins: The concept of Smart Manufacturing, Role of IoT and sensors, Digital Twins and their applications, In-Class Assignment: Explore the designs of Digital Twins, Homework Assignment: Analysing a Smart Manufacturing Case Study.

Robotic Process Automation: Understanding Robotic Process Automation (RPA), Types of robots and their applications, Human-robot collaboration, In-Class Assignment: Automating a Task with RPA, Homework Assignment: Researching Advances in Robotics.

Module-3: Cybersecurity and Quantum Computing (06 Hours)

Cybersecurity: Importance of cybersecurity in the digital age, Threats and vulnerabilities, Security best practices, In-Class Assignment: Ethical Hacking Simulation, Homework Assignment: Creating a Cybersecurity Plan.

Quantum Computing: Introduction to Quantum Mechanics, Quantum bits (qubits) and quantum gates, Quantum supremacy and real-world applications. Homework Assignment: Exploring Quantum Computing Research.

Module-4: Project Work (06 Hours)

Team Formation, Synopsis submission, Mid-Term Progress Review, Final Project Presentation.

Course Outcomes: At the end of the course the student will be able to:

21ETP509.1	Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills.
21ETP509.2	Apply AI and Web 3.0 concepts to develop practical solutions and explore real-world applications.
21ETP509.3	Apply RPA principles and tools to automate common tasks to boost productivity.
21ETP509.4	Explain common cybersecurity threats and recommend best practices to safeguard digital assets.
21ETP509.5	Explain the fundamentals of quantum computing and its real-world applications.
21ETP509.6	Develop a solution using emerging technologies for a real-world problem in teams.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	Pearson	Fourth Edition, 2020
2	Blockchain Technology	Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan	Universities Press (India) Pvt. Ltd.	First Edition 2020
3	Metaverse and Web 3: A Beginner's Guide: A Beginner's Guide: A Digital Space Powered with Decentralized Technology	Utpal Chakraborty	BPB Publications	First Edition, 2022
4	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath	Alok Mani Tripathi	Packt Publishing	First Edition 2018
5	Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity	Dr. Erdal Ozkaya	Packt Publishing Limited	First Edition 2019
6	Quantum Computing: A Gentle Introduction	Eleanor G. Rieffel, Wolfgang H. Polak.	MIT Press	First Edition 2014
Reference Books				
1	Smart Manufacturing Technologies for Industry 4.0: Integration, Benefits, and Operational Activities	Edited By: Jayakrishna Kandasamy, Kamalakanta Muduli, V. P. Kommula, Purushottam L. Meena	CRC Press	First Edition 2022
2	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems	Tom Taulli	Apress Berkeley, CA	2020
3	The Cyber Security Handbook: Prepare for, respond to and recover from cyber-attacks with the IT Governance Cyber Resilience Framework (CRF)	Alan Calder	IT Governance Publishing	First Edition 2020

Web links/Video Lectures:

Introduction to Emerging Technologies:

1. https://aiethics.princeton.edu/case-studies/case-study-pdfs/
2. https://research.aimultiple.com/ai-ethics/
3. https://news.harvard.edu/gazette/story/2020/10/ethical-concerns-mount-as-ai-takes-bigger-decision-making-role/
4. https://www.sciencedirect.com/science/article/pii/S0268401223000816
5. https://www.youtube.com/watch?v=G2fqAlgmoPo
6. https://www.youtube.com/watch?v=zizonToFXDs

Web 3.0: Blockchain and Metaverse

1. What is Ethereum? | ethereum.org
2. Navigating Remix — Remix - Ethereum IDE 1 documentation (remix-ide.readthedocs.io)

3. Solidity — Solidity 0.6.8 documentation (soliditylang.org)
4. https://www.youtube.com/watch?v=nalMdCI_pv8&t=765s
5. The Decentralized Autonomous Organization and Governance Issues by Usman W. Chohan :: SSRN
6. Ethereum Smart Contract Best Practices (consensys.github.io)
7. https://hackernoon.com/hack-solidity-reentrancy-attack

Smart Manufacturing and Digital Twins:

1. https://www.youtube.com/watch?v=nwFed03fS_s
2. https://www.youtube.com/watch?v=ScmK-bKJ4MI

RPA and Robotics:

1. https://www.youtube.com/watch?v=9URSbTOE4YI
2. https://www.youtube.com/watch?v=UEbw7dIOg0g
3. https://www.uipath.com/resources/automation-case-studies
4. https://www.ibm.com/products/robotic-process-automation/case-studies

Cybersecurity:

1. https://www.getastra.com/blog/security-audit/what-is-vapt/
2. https://owasp.org/www-project-top-ten/
3. https://owasp.org/www-project-mutillidae-ii/
4. https://www.youtube.com/watch?v=JAtwZoW76-I
5. Threat modelling (STRIDE framework): https://learn.microsoft.com/en-us/azure/security/develop/threat-modeling-tool-threats
6. Cyber Kill Chain:https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html

Quantum Computing:

1. https://www.youtube.com/watch?v=e3fz3dqhN44
2. https://quantumai.google/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
21ETP509.1	-	-	-	-		**3**	-	**2**	-	--	-	-
21ETP509.2	-	**2**	-	-	**3**	-	-	-		-	-	**1**
21ETP509.3	-	-	-	**3**	**2**	-	-	-	--	-	-	-
21ETP509.4	-	-	-	-	**3**	-		-	-	-	-	**1**
21ETP509.5	**2**	-	-	-	**3**	-	-	-	-	-	-	-
21ETP509.6	-	-	**2**	-	**3**	-	--	-	**2**	-	-	**1**

1: Low 2: Medium 3: High

VI Semester

Computer Techniques in Power System			
Course Code	**21EEE601**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE Hours	03
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Explain formulation of network models and bus admittance matrix for solving load flow problems.
- Solve power flow problem for simple power systems using numerical methods.
- Explain the use of suitable standard software package for the analysis of power system.
- Explain symmetrical fault analysis and algorithm for short circuit studies.
- Discuss optimal operation of generators on a bus bar and optimum generation scheduling.
- Explain unit commitment of thermal power plants

Module-1 Network Topology **8 hours**

Introduction and basic definitions of Elementary graph theory Tree, cut-set, loop analysis. Formation of Incidence Matrices. Primitive network- Impedance form and admittance form, Formation of Y Bus by Singular Transformation. Y bus by Inspection Method. Illustrative examples.

Module-2 Load Flow Studies **8 hours**

Introduction, Classification of buses, Power flow equation, Operating Constraints, Data for Load flow, Gauss Seidal iterative method. Illustrative examples.

Module-3 Load Flow Studies (Continued) **8 hours**

Newton-Raphson method derivation in Polar form, Fast decoupled load flow method, Flow charts of Load Flow Studies methods. Comparison of Load Flow Methods. Illustrative examples.

Module-4 Economic Operation of Power System **8 hours**

Introduction and Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses, Economic dispatch including transmission losses, Derivation of transmission loss formula. Optimal scheduling of hydrothermal system, reliability considerations, Power system Reliability, Maintenance scheduling, Illustrative examples.

Module-5 Unit Commitment & Symmetrical Fault Analysis **8 hours**

Introduction to unit commitment, Constraints and unit commitment solution by priority list method and dynamic forward DP approach (Flow chart and Algorithm only), constraints.

Z Bus Formulation by Step by step building algorithm without mutual coupling between the elements by addition of link and addition of branch. Illustrative examples. Z bus Algorithm for Short Circuit Studies excluding numerical.

PRACTICAL MODULE

1. Y Bus Formation for Power Systems with and without Mutual Coupling, by Singular Transformation using MATLAB software.
2. Y Bus Formation for Power Systems without Mutual Coupling, by Inspection Method using MATLAB software.
3. Formation of Z Bus (without mutual coupling) using Z-Bus Building Algorithm using MATLAB software.
4. Load Flow Analysis using Gauss Seidel Method for the system with PQ buses only using MATLAB
5. Load Flow Analysis using Gauss Seidel Method, NR Method and Fast Decoupled Method for Both PQ and PV Buses using ETAP software.
6. Formation of Jacobian for a System not Exceeding 4 Buses in Polar Coordinates. Using MATLAB.

7. Determination of Bus Currents, Bus Power and Line Flow for a Specified System Voltage using MATLAB.
8. To Determine Fault Currents and Voltages in a Single Transmission Line System at a Specified Location for different types of faults by simulation using ETAP software.
9. Determination of Power Angle Diagrams, Reluctance Power, Excitation, EMF and Regulation for Salient and Non-Salient Pole Synchronous Machines using MATLAB.
10. To obtain Swing Curve and to Determine Critical Clearing Time, Regulation, Inertia Constant/Line Parameters /Fault Location/Clearing Time/Pre-Fault Electrical Output for a Single Machine connected to Infinite Bus through a Pair of identical Transmission Lines Under 3-Phase Fault On One of the two Lines using MATLAB.
11. Formation for symmetric π /T configuration for Verification of Determination of Efficiency and Regulation.
12. Optimal Generation Scheduling for Thermal power plants by simulation.

Course Outcomes: At the end of the course the student will be able to:	
21EEE601.1	Apply the knowledge of Gauss Seidel method to solve problems related to power flow.
21EEE601.2	Apply the knowledge of Newton Raphson method to solve problems related to power flow.
21EEE601.3	Develop the bus admittance matrix for a given power system using singular and inspection method
21EEE601.4	Develop an optimal schedule for thermal and hydrothermal plants with and without considering losses.
21EEE601.5	Develop the unit commitment of generating plants using different unit commitment algorithms.
21EEE601.6	Apply Thevenins theorem and bus impedance matrix to perform short circuit analysis.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Modern Power System Analysis	I J Nagrath and D P Kothari	Tata McGraw-Hill Education India	4th Edition, 2011
2	Computer Methods in Power Systems Analysis	Glenn W. Stagg, Ahmed H Ei - Abiad	Scientific International	1st Edition 2019
3	Power Generation Operation and Control	Allen J Wood etal	Wiley	2nd Edition, 2016
Reference Books				
1	Computer Techniques in Power System Analysis	M A Pai	McGraw-Hill	2nd Edition, 2012
2	Power System Analysis	Hadi Saadat	McGraw-Hill	2nd Edition, 2002

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108107028
- https://nptel.ac.in/courses/108105067

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE601.1	1	2	1	3	2	0	0	0	0	0	0	0	3	0
21EEE601.2	1	2	1	3	2	0	0	0	0	0	0	0	3	0
21EEE601.3	2	3	0	0	0	0	0	0	0	0	0	0	2	0
21EEE601.4	2	2	3	0	0	1	1	0	0	0	1	0	1	0
21EEE601.5	2	3	0	0	0	0	0	0	0	0	0	0	1	0
21EEE601.6	2	3	0	3	0	0	0	0	1	1	0	0	2	0

1: Low 2: Medium 3: High

Power Electronics			
Course Code	**21EEE602**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain the applications power electronics, different types of power semiconductor devices, their switching characteristics.
- Explain power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
- Explain the techniques for design and analysis of single phase diode rectifier circuits.
- Explain different power transistors, their steady state and switching characteristics and imitations.
- Explain different types of Thyristors, their turn on and turn off methods, gate characteristics and gate control requirements.
- Explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and AC Voltage controllers.

Module-1 Introduction to Power Electronics, Power Diodes and Diode Rectifiers 8 hours

Introduction to Power Electronics**,** Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects, Characteristics and Specifications of Switches.
Introduction to power diodes, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Diode Switched RL Load, Freewheeling Diodes with Switched RL Load.
Introduction to diode rectifiers, Single Phase Full Wave Rectifier with R and RL Load

Module-2 Power Transistors 8 hours

Introduction, Power MOSFETs – Steady State Characteristics, Switching Characteristics, Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits, IGBTs- Steady State Characteristics, Switching Characteristics, MOSFET Gate Drive, BJT Base Drive, Isolation of Gate and Base Drives, Pulse transformers and Opto-Couplers.

Module-3 Thyristors 8 hours

Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dt Protection, dv/dt Protection, DIACs, Thyristor Firing Circuits, Unijunction Transistor Relaxation Oscillator for triggering Thyristor.

Module-4 Controlled Rectifiers and AC Voltage Controllers 8 hours

Introduction to Controlled Rectifiers, Single phase half wave circuit with R load, RL, RLE with and without freewheeling diode. Single Phase Full Converter with RLE load, Single Phase Dual Converters, principle of operation of Three Phase Full Converters and Three Phase Dual Converters.
Introduction to AC Voltage Controllers, principle of phase control and integral cycle control, single phase full wave controllers with R and RL load. Principle of operation of three phase full wave controllers.

Module-5 DC-DC and DC-AC converters 8 hours

Introduction to DC-DC Converters, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification.
Introduction to DC-AC Converters, principle of operation single phase bridge inverters, three phase bridge inverters, voltage control of single phase inverters, Harmonic reductions, Current source inverters.

Course Outcomes: At the end of the course the student will be able to:	
21EEE602.1	Discuss application of power electronics, types of power electronic circuits and switches, their characteristics and specifications.
21EEE602.2	Explain types of power diodes, their characteristics, and the effects of power diodes on RL circuits.
21EEE602.3	Explain steady state, switching characteristics and gate control requirements of different power transistors and their limitations
21EEE602.4	Discuss different types of Thyristors, their operation, turn on and turn off methods, gate characteristics and gate control requirements
21EEE602.5	Explain designing, analysis techniques and characteristics of thyristor controlled rectifiers
21EEE602.6	Discuss the principle of operation of DC – DC converters, single phase and three phase DC -AC converters and AC voltage controllers

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Power Electronics: Circuits Devices and Applications	Mohammad H Rashid	Pearson	4th Edition, 2014
Reference Books				
1	Power Electronics: Converters, Applications and Design	Ned Mohan et al	Wiley	3rd Edition, 2014
2	Power Electronics	Daniel W Hart	McGraw Hill	1st Edition, 2011
3	Elements of Power Electronics	Philip T Krein	Oxford	Indian Edition, 2008

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/102/108102145/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE602.1	3	0	0	0	2	0	0	0	0	0	0	0	2	0
21EEE602.2	0	2	0	0	2	0	0	0	0	0	0	0	3	0
21EEE602.3	3	0	0	0	2	0	0	0	0	0	0	0	2	0
21EEE602.4	0	2	0	0	2	0	0	0	0	0	0	0	2	0
21EEE602.5	3	0	0	0	2	0	0	0	0	0	0	0	0	1
21EEE602.6	0	2	0	0	2	0	0	0	0	0	0	0	0	1

1: Low 2: Medium 3: High

Electric Vehicle Technologies			
Course Code	**21EEE6031**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the fundamental laws and vehicle mechanics.
- Understand working of Electric Vehicles and recent trends.
- Analyze different power converter topology used for electric vehicle application.
- Develop the electric propulsion unit and its control for application of electric vehicles.

Module-1 Electric and Hybrid Electric Vehicles	**8 hours**
Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.	
Module-2 Energy storage for EV and HEV	**8 hours**
Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Supercapacitors.	
Module-3 Electric Propulsion	**8 hours**
EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.	
Module-4 Design of Electric and Hybrid Electric Vehicles	**8 hours**
Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.	
Module-5 Power Electronic Converter for Battery Charging	**8 hours**
Charging methods for battery, charging from grid, Isolated bidirectional DC-DC converter, High-frequency transformer based isolated charger topology, Transformer less topology.	

Course Outcomes: At the end of the course the student will be able to:	
21EEE6031.1	Apply the principles of the roadway fundamentals, laws of motion, and vehicle mechanics for propulsion system design.
21EEE6031.2	Illustrate the architecture of electric vehicle and hybrid electric vehicle using case studies.
21EEE6031.3	Analyze the model of batteries, Fuel cells, PEMFC and super capacitors.
21EEE6031.4	Analyze DC and AC drive topologies used for electric vehicle application.
21EEE6031.5	Develop the electric propulsion unit and its control for application of electric vehicles.
21EEE6031.6	Comprehend the characteristic features of battery management system

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press	2003
2	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design	M. Ehsani, Y. Gao,S.Gay and Ali Emadi	CRC Press	2005
Reference Books				
1	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles	Sheldon S. Williamson	Springer	2013
2	Modern Electric Vehicle Technology	C.C. Chan and K.T. Chau	OXFORD University	2001
3	Hybrid Electric Vehicles Principles andApplications with Practical Perspectives	Chris Mi, M. Abul Masrur, David Wenzhong Gao	Wiley Publication	2011

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108106170

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE6031.1	2	2	0	0	0	0	0	0	0	1	1	0	0	0
21EEE6031.2	2	2	0	0	0	1	1	0	2	0	0	0	2	0
21EEE6031.3	0	0	2	0	2	0	0	0	0	0	0	2	0	0
21EEE6031.4	0	0	2	0	0	0	0	0	0	0	0	0	3	0
21EEE6031.5	0	0	2	0	0	0	2	0	0	1	0	0	0	0
21EEE6031.6	2	0	0	0	0	0	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Embedded System			
Course Code	**21EEE6032**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Understand the different interfacing and I/O devices.
- Describe the hardware software co-design and firmware design approaches.
- Acquire knowledge about different entities of Embedded System Development Environment.
- Understand the basics of Real Time Operating Systems.

Module-1 Embedded System **8 hours**

Introduction to embedded systems, Embedded system versus general computing systems, Classification of embedded systems, Major application areas of embedded systems, Purpose of embedded systems. The typical Embedded System, Characteristics and Quality Attributes of Embedded Systems.

Module-2 System Interfacing **8 hours**

Introduction to PIC microcontroller, ADC interfacing, Communication Interface: I2C Communication, Sensors, Actuators, I/O devices: Relays, Display- 7segment Display, LCD display.

Module-3 Embedded Firmware **8 hours**

Fundamental issues in Hardware-Software Co-design, Computational models in Embedded Design, Introduction to Unified Modeling Language (UML), Embedded Firmware design approaches, Embedded Firmware Development Languages, Programming in Embedded C.

Module-4 Embedded System Development **8 hours**

The Integrated Development Environment (IDE), Types of files generated on Cross Compilation, Disassembler/ Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging.

Module-5 Real Time Operating Systems **8 hours**

Introduction to basic concepts of RTOS- Task, Process &Threads, Interrupt Routines in RTOS, Multiprocessing and Multitasking, Preemptive and Non-Preemptive Scheduling.

Course Outcomes: At the end of the course the student will be able to:	
21EEE6032.1	Explain the basic concepts and applications of embedded system.
21EEE6032.2	Understand the basic concepts of PIC microcontroller.
21EEE6032.3	Discuss the Embedded system development Languages.
21EEE6032.4	Discuss the Integrated Development Environments for embedded firmware.
21EEE6032.5	Explain the concept of Real time operating system.
21EEE6032.6	Understand the basic concepts of interfacing the microcontroller to real world devices.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to Embedded Systems	K.V. Shibu	Tata McGraw	Second Edition, 2022
2	Real Time Systems Theory and Practice	Rajib Mall	Pearson education	First Edition, 2006
3	PIC Microcontroller and Embedded Systems	Muhammad Ali Mazidi, olind D Mckinlay, Danny Causey	Pearson	Second Edition, 2021
Reference Books				
1	Embedded Microcomputer System: Real Time Interfacing	Jonathan W. Valvano	Thomson/Brooks/ Cole	First Edition, 2000

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses/108102045/
- http://nptel.ac.in/courses/108105057/
- http://nptel.ac.in/courses/106105159/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE6032.1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
21EEE6032.2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
21EEE6032.3	0	0	2	0	0	0	0	0	1	1	0	0	0	0
21EEE6032.4	0	2	0	0	0	0	0	0	1	1	0	0	0	0
21EEE6032.5	0	0	0	0	0	1	0	0	0	0	0	0	0	0
21EEE6032.6	0	0	2	0	2	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Sensors and Transducers			
Course Code	**21EEE6033**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Interpret the need and working of different types of transducers and sensors
- Summarize basics of signal conditioning and signal conditioning equipment.
- Outline configuration of Data Acquisition System, data conversion, Data transmission and telemetry.
- Discuss the measurement of various non-electrical quantities.

Module-1 Sensors & Transducers **8 hours**

Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers.

Module-2 Types of Sensors & Transducers **8 hours**

Strain Gauges, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Recent Trends – Smart Pressure Transmitters, Selection of Sensors, Rotary – Variable Differential Transformer, Synchros and Resolvers, Induction Potentiometers, Micro Electromechanical Systems.

Module-3 Signal Conditioning & Data Acquisition **8 hours**

Introduction to signal conditioning, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Optical Amplifiers, Electrical and electronic Amplifiers.
Introduction to data acquisition, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems, Data Conversion.

Module-4 Data Transmission and Telemetry **8 hours**

Data/Signal Transmission, Telemetry, General Telemetering system, Types of Telemetering Systems, Voltage Telemetering System, Current Telemetering System, Position Telemetering System, Radio Frequency Telemetering System, Modulation and Demodulation, Digital modulation Techniques.

Module-5 Measurement of Non-Electrical Quantities **8 hours**

Pressure Measurement, Temperature Measurement, Flow Measurement–Introduction, Electromagnetic Flow meters, Ultrasonic Flow Meters, Thermal Metes, Wire Anemometers. Measurement of Displacement, Measurement of Velocity/Speed, Measurement of Acceleration, Measurement of Force, Measurement of Torque, Measurement of Shaft Power, Measurement of Liquid Level, Measurement of Viscosity.

Course Outcomes: At the end of the course the student will be able to:	
21EEE6033.1	Explain the need for and working of various transducers and sensors.
21EEE6033.2	Outline the recent trends in sensor technology and their selection.
21EEE6033.3	Analyze the signal conditioning and signal conditioning equipment.
21EEE6033.4	Illustrate different configuration of Data Acquisition System and data conversion.
21EEE6033.5	Display the knowledge of data transmission and telemetry.

21EEE6033.6	Explain measurement of non-electrical quantities -temperature, flow, speed, force, torque, power and viscosity.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Electrical and Electronic Measurements and instrumentation	R.K Rajput	S. Chand	3rd Edition, 2013
Reference Books				
1	A Course in Electronics and Electrical Measurements and Instruments	J.B. Gupta	Katson Books	13th Edition, 2008
2	A Course in Electrical and Electronic Measurements and Instrumentation	A. K. Sawhney	Dhanpat Rai	2015

Web links and Video Lectures (e-Resources):

- https://youtu.be/nE1C4ghfvac
- https://youtu.be/1uPTyjxZzyo

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE6033.1	3	0	0	0	0	0	0	0	0	0	0	1	2	0
21EEE6033.2	0	3	0	0	0	0	0	0	0	0	0	2	3	0
21EEE6033.3	3	0	0	0	0	0	0	0	0	0	0	0	2	0
21EEE6033.4	0	2	0	0	3	0	0	0	0	0	0	0	1	0
21EEE6033.5	1	0	0	0	0	0	0	0	0	0	0	3	2	0
21EEE6033.6	0	2	0	0	3	0	0	0	0	0	0	0	1	0

1: Low 2: Medium 3: High

Electromagnetic Field Theory			
Course Code	**21EEE6034**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Study the applications of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
- Evaluate the energy and potential due to a system of charges.
- Study the behavior of electric field across a boundary between a conductor and dielectric.
- Study Force and torque acting on a closed circuit and Magnetic boundary conditions.
- Study the time varying field and propagation of waves in different media.

Module-1 Electrostatics **8 hours**

Introduction -Coulomb's Law and electric field intensity-Field due to continuous line, surface and volume charge distributions - Electric flux density- Gauss' law-Maxwell's equation of Electrostatics - vector operator "del" and divergence theorem-Definition of potential difference and Potential-The potential field of a point charge and system of charges - Potential gradient.

Module-2 Conductors and Dielectrics **8 hours**

Metallic conductors- Concept of conduction and displacement currents, Conductor properties and Electrostatic 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.

Module-3 Magnetostatics **8 hours**

Biot-Savart's law- Ampere's circuital law- applications- concept of Curl- Stokes' theorem-magnetic flux and flux density, scalar and Vector magnetic potentials- Force on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit- Magnetic boundary conditions.

Module-4 Time Varying Fields **8 hours**

Equation of continuity-Maxwell's equation in point and Integral forms-expressions for harmonically varying fields-retarded potentials- Electromagnetic Wave equation, Properties of uniform plane waves.

Module-5 Electromagnetic Wave Propagation **8 hours**

Wave propagation in free space and dielectrics-– Poynting Vector and theorem - propagation in good conductors – skin effect- Reflection of plane waves at normal incidence –Standing wave ratio

Course Outcomes: At the end of the course the student will be able to:	
21EEE6034.1	Analyze the different methods of calculation of Electric field and Electric potential due to various types of charge distribution.
21EEE6034.2	Explain the principles behind different geometries of capacitance, Poisson's and Laplace equations, Electrostatic boundary conditions .
21EEE6034.3	Explain the different methods of calculation of Magnetic field , Magnetic vector potential due to various types of current carrying elements, Magnetostatic boundary conditions
21EEE6034.4	Asses the concepts of time varying fields, derive electromagnetic wave equations and solve related problems using Maxwell's equations.
21EEE6034.5	Analyze the process of wave propagation in different mediums and solve related problems using Poynting theorem.

21EEE6034.6	Asses the force calculation between current carrying wires and torque on closed loops.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Engineering Electromagnetics	William H Hayt Jr. and John A Buck	Tata McGraw-Hill	7th Edition, 2006
2	Field theory	K. A. Gangathar	Khanna Publications	12th Edition, 2010
Reference Books				
1	Electromagnetic waves with Applications	John Krauss and Daniel A Fleisch	McGraw-Hill	5th Edition, 1999
2	Electromagnetic Waves and Radiating Systems	Edward C. Jordan and Keith G Balmain	Prentice – Hall of India / Pearson Education	2nd Edition, 1968. Reprint 2002

Web links and Video Lectures (e-Resources):

- NPTELHRD video Lecture 1: Introduction to EMT (https://youtu.be/G5P6dInMTFg?feature=shared)
- NPTELHRD video Lecture 2: Coulomb's law (https://youtu.be/ckAVB3_NP2Q?feature=shared)
- NPTELHRD video Lecture 3: Scalar field and its Gradient (https://youtu.be/NED2Cl8u9Q0?feature=shared)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE6034.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
21EEE6034.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
21EEE6034.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
21EEE6034.4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
21EEE6034.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
21EEE6034.6	3	3	1	-	-	-	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

Electrical Machine Design			
Course Code	**21EEE6035**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is

- To derive the output equation of DC machine, single phase, three phase transformers, induction motor and synchronous machines.
- To discuss the selection of specific loadings, for various machines.
- To discuss separation of main dimensions for different electrical machines
- To discuss design of field windings for DC machines and synchronous machines. To evaluate the performance parameters of transformer, induction motor.
- To explain design of rotor of squirrel cage rotor and slip ring rotor.
- To define short circuit ratio and discuss its effect on machine performance.

Module-1 Introduction to Design of Machines **8 hours**

Introduction -considerations for the design of electrical machines- limitations - Different types of Materials and insulators used in electrical machines- Output equation, choice of specific loadings of DC Machines- Output equation for single phase and three phase transformers - expression for volts/turn- Output equation and Choice of specific loadings of Synchronous machines Output equation of Induction Machines. – Various software for machine design, Calculation of permissible temperature rise

Module-2 Design of DC Machines **8 hours**

Design of Main dimensions of the DC machines- Design of armature slot dimensions, Commutators and brushes- Magnetic circuit -estimation of ampere turns, design of yoke and pole, field windings – shunt & series.

Module-3 Design of Single and Three Phase Transformers **8 hours**

Determination of main dimensions of the core- types of windings and estimation of numberof turns and cross sectional area of Primary and secondary coils- estimation of no load current- expression for leakage reactance - voltage regulation.

Module-4 Design of Synchronous Machines **8 hours**

Design of main dimensions- armature slots and windings- slot details for the stator of salient and Non salient pole synchronous machines - short circuit ratio- Design of rotor of salient pole synchronous machines- magnetic circuits- design of the field winding- Interpole design.

Module-5 Design of Induction Machines **8 hours**

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, leakage reactance.

Course Outcomes: At the end of the course the student will be able to:

21EEE6035.1	Use research-based methods to analyze and interpret data to design a transformer and DC machine parts.
21EEE6035.2	Use research based methods to analyze and interpret data to design an induction machine and synchronous machine parts.
21EEE6035.3	Demonstrate ethical principles while designing a transformer and DC machine by complying with industrial standards.
21EEE6035.4	Demonstrate ethical principles while designing an induction machine and synchronous machine by complying with industrial standards.

21EEE6035.5	Demonstrate an ability to engage in Designing Machine parts in context of technological change.
21EEE6035.6	Apply the principles of project management while working on multidisciplinary projects on electrical machine design.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	A course in electrical machine design	A. K. Sawhney	Dhanpat Rai & Co (P) Ltd, Delhi.	13th Edition, 2007
2	Design of electrical machines	V. N. Mittle	Prantice Hall of India	4th Edition, 2009
Reference Books				
1	Principles of electrical machine design	Deepak Chowdry	Esteem Publications	6th Edition, 2011

Web links and Video Lectures (e-Resources):

- NPTELHRD video lecture 1: Design of Electric Motor (https://youtu.be/Yp5ADWNQlBU?feature=shared)
- NPTELHRD video lecture 2: Lecture on Output equation of Induction Motor by Prof.S.D.Hirekodi (https://youtu.be/gdq0HXPYEqg?feature=shared)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE6035.1	3	3	3	0	2	0	0	0	0	0	0	0	0	0
21EEE6035.2	3	3	2	0	2	0	0	0	0	0	0	0	0	0
21EEE6035.3	3	3	2	0	2	0	0	0	0	0	0	0	0	0
21EEE6035.4	3	3	2	0	2	0	0	0	0	0	0	0	0	0
21EEE6035.5	3	3	2	0	2	0	0	0	0	0	0	0	0	0
21EEE6035.6	3	3	0	0	2	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Renewable Energy Resources			
Course Code	**21EEE6041**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Open Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is

- To develop an understanding of the energy scenario energy sources and their utilization.
- To explore society's present needs and future demand.
- To provide comprehensive overview of the principles of renewable energy conversion systems
- To provide the engineering students with necessary back ground for understanding various energy conservation methods.

Module-1 Energy **8 hours**

Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications.

Module-2 Solar Thermal Collectors & Solar Cells **8 hours**

Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Application of solar collectors. Solar pond.

Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic panels (series and parallel arrays)

Module-3 Hydrogen, Wind & Geothermal Energy **8 hours**

Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy.

Introduction to Wind Energy, Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.

Introduction to Geothermal Energy, Geothermal Systems, Classifications, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects.

Module-4 Biomass & Tidal Energy **8 hours**

Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier

Introduction to Tidal Energy, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy

Module-5 Sea Wave & Ocean Thermal Energy **8 hours**

Introduction to Sea Wave Energy, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power.

Introduction to Ocean Thermal Energy, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC

Course Outcomes: At the end of the course the student will be able to:	
21EEE6041.1	Summarize the environmental aspects of renewable energy resources.
21EEE6041.2	Describe the use of solar energy and the various components used in the energy production with respect to applications like heating, cooling and power generation.
21EEE6041.3	Explain the conversion principle s of wind and tidal energy.
21EEE6041.4	Illustrate the concept of biomass energy resources.
21EEE6041.5	Acquire the basic knowledge of ocean thermal energy conversion and geothermal energy conversion.
21EEE6041.6	Compare the conventional energy with the nonconventional energy.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Nonconventional Energy Resources	Shobh Nath Singh,	Pearson	1st Edition, 2015
Reference Books				
1	Nonconventional Energy Resources	B.H. Khan	Mc Graw-Hill Education India	3rd Edition, 2017
2	Renewable Energy; Power for a sustainable Future	Godfrey Boyle	Oxford University Press	3rd Edition, 2012

Web links and Video Lectures (e-Resources):

- https://www.pdfdrive.com/non-conventional-energy-sources-e10086374.ht
- https://www.pdfdrive.com/renewable-energy-sources-and-their-applications-e33423592.html

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE6041.1	3	0	0	0	2	0	0	0	0	0	0	0	2	0
21EEE6041.2	0	2	0	0	2	0	0	0	0	0	0	0	3	0
21EEE6041.3	3	0	0	0	2	0	0	0	0	0	0	0	2	0
21EEE6041.4	0	2	0	0	2	0	0	0	0	0	0	0	2	0
21EEE6041.5	3	0	0	0	2	0	0	0	0	0	0	0	0	1
21EEE6041.6	0	2	0	0	2	0	0	0	0	0	0	0	0	1

1: Low 2: Medium 3: High

PLC and SCADA			
Course Code	**21EEE6042**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Open Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Discuss the role of PLC in automation, SCADA and industrial automation.
- Program a PLC using ladder Diagram.
- Programme a PLC Functional Block Diagram.
- Explain Sequential Functions Charts (SFC) and Structured Text (ST) methods using internal relays.
- To Program a PLC Program a PLC using shift registers, data handling Instructions, Timers and controller.

Module-1 PLC	**8 hours**
Introduction to Programmable logic controller (PLC), role in automation (SCADA), advantages and disadvantages, hardware, internal architecture, sourcing and sinking, characteristics of I/O devices, list of input and output devices, examples of applications. I/O processing, input/output units, signal conditioning, remote connections, networks, processing inputs I/O addresses.	
Module-2 PLC Programming	**8 hours**
Instruction list, sequential functions charts & structured text, jump and call subroutines. Ladder programming- ladder diagrams, logic functions, latching, multiple outputs, entering programs, functional blocks, programme examples like location of stop and emergency switches. process, Estimating the critical points and extreme values, vector calculus.	
Module-3 Internal relays	**8 hours**
Ladder programmes, battery- backed relays, one - shot operation, set and reset, master control relay	
Module-4 Timers and Counters	**8 hours**
Types of timers, programming timers, ON and OFF- delay timers, pulse timers, forms of counter, programming, up and down counters, timers with counters, sequencer.	
Module-5 Shift register & data handling	**8 hours**
Shift registers, ladder programs, registers and bits, data handling, Arithmetic functions, temperature control and bottle packing applications. Note: Programming is to be with reference to only Mitsubishi PLC (GIS).	

Course Outcomes: At the end of the course the student will be able to:	
21EEE6042.1	Apply the engineering knowledge to analyse various control functions using PLC ladder programming
21EEE6042.2	Use modern tools & technique for PLC based operation on internal relays, timers &counters, shift registers, controller.
21EEE6042.3	Use modern tools & technique for PLC based operation on controllers.
21EEE6042.4	Realize the importance of programmable logic controller in automation, Hardware & Internal architecture and Input/output devices for lifelong learning.
21EEE6042.5	Analyze higher order linear differential equations as linear homogeneous, linear non homogeneous, with constant & variable coefficients and solve them.
21EEE6042.6	Realize the importance learning Internal architecture and Input/output devices of programmable controller for lifelong learning.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Programmable Logic Controllers	W. Bolton	Elsevier Newnes publication	5th Edition, 2014
Reference Books				
1	Programmable Logic Controller	Frank D. Petruzella	McGraw Hill	4th Edition, 2011
2	Programmable Logic Controller	John W. Webb and Ronald A. Reis	Prentice – Hall India Publication	5th Edition, 2008

Web links and Video Lectures (e-Resources):

- http://library.automationdirect.com/plc-handbook/n
- https://www.coursera.org/learn/intelligentmachining/lecture/fGz3r/programmable-logic-controllers-plc
- https://www.udemy.com/plc-programming-from-scratch
- http://nptel.ac.in/courses/112102011
- http://nptel.ac.in/courses/112103174

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE6042.1	3	0	0	0	0	1	0	0	0	0	0	0	0	0
21EEE6042.2	1	3	0	0	1	0	0	0	0	0	0	0	0	0
21EEE6042.3	1	2	3	0	1	0	0	0	0	0	0	0	0	0
21EEE6042.4	1	2	3	0	1	0	0	0	0	0	0	0	0	0
21EEE6042.5	1	2	3	0	1	2	0	0	0	0	0	0	0	0
21EEE6042.6	0	0	0	0	0	0	0	0	0	0	0	3	0	0

1: Low 2: Medium 3: High

Control Systems			
Course Code	**21EEE6043**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Open Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Articulate the importance of the control system and types of feedback
- Apply the concept of mathematical modelling, block diagram and signal flow graph approaches to obtain the transfer function for the linear systems.
- Determine the stability of a system by application of time domain and frequency domain techniques
- To formulate state models and solutions to state equations

Module-1 Mathematical Modelling	**8 hours**
Introduction, classification of control systems, procedure for deriving transfer functions for Single input single output systems, Modelling of mechanical system elements, electrical systems, rotational systems, Analogous quantities.	
Module-2 Block Diagram & Signal Flow Graphs	**8 hours**
Block diagram of a closed loop system, procedure for drawing block diagram and block diagram reduction to obtain transfer function, basic properties of signal flow graph, signal flow graph algebra, Construction of signal flow graphs and obtain transfer functions.	
Module-3 Time Domain Analysis & RH Criteria	**8 hours**
Standard test signals, time response of second order systems, steady-state errors and error constants. BIBO stability, Routh stability criterion, Special cases of Routh table, application of Routh stability criterion to linear feedback systems and stability analysis.	
Module-4 Graphical Techniques & Controllers	**8 hours**
Introduction, root locus concepts, construction of root loci, rules for the construction, frequency response specifications (no derivations), General procedure for constructing bode plots, Bode plots, Nyquist plots and stability analysis Introduction to P, PI, PD, PID controllers and industrial practice & applications	
Module-5 State Space Model	**8 hours**
Basic Concepts of State Space Model, Transformations from transfer functions to state space and vice versa.	

Course Outcomes: At the end of the course the student will be able to:	
21EEE6043.1	Apply the knowledge of Physical Systems Modelling to Electrical, Mechanical and electromechanical systems
21EEE6043.2	Apply the Block diagrams reduction techniques and signal flow graphs to obtain the transfer function of a system
21EEE6043.3	Assess the effect of pole and zeros and standard input test signals for calculating the errors and determining the stability of a system
21EEE6043.4	Recognize the application of Root locus and bode plots techniques to determine the stability of a closed loop system
21EEE6043.5	Study the techniques of transfer function to state space models and vice versa by the application of modern simulation tools such as MATLAB
21EEE6043.6	Perceive the need for PID controllers in industries for engaging in professional engineering practice learn

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Control Systems	Anand Kumar	Prentice Hall India	2nd Edition, 2014
Reference Books				
1	Automatic Control Systems	Farid Golnaraghi, Benjamin C. Kuo	Wiley	9th Edition, 2010
2	Control System Engineering	Norman S. Nise	Wiley	4th Edition, 2004
3	Modern Control Systems	Richard C Dorf et.al.	Pearson	11th Edition, 2008
4	Control Systems	Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams	Schaums Outlines Series, Tata McGraw Hill, Special Indian Edition	3rd Edition, 2010

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_ee90/preview
- https://www.mooc-list.com/course/dynamics-and-control-edx
- https://www.mooc-list.com/course/robotics-computational-motion-planning-coursera
- https://www.mooc-list.com/course/dynamic-systems-controls-saylororg

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE6043.1	2	2	2	0	0	0	0	0	1	1	0	0	1	0
21EEE6043.2	2	2	2	2	2	0	0	0	0	1	0	1	1	0
21EEE6043.3	2	2	2	2	0	0	2	0	0	1	0	0	1	0
21EEE6043.4	2	2	2	0	0	0	0	0	0	1	0	1	0	0
21EEE6043.5	2	2	2	2	2	0	0	0	1	0	0	1	1	0
21EEE6043.6	2	2	2	2	1	0	0	1	0	1	0	1	1	0

1: Low 2: Medium 3: High

Electrical Safety Practices			
Course Code	**21EEE6044**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Open Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Articulate the importance of Electrical Safety, effects of Shocks and their Prevention
- Illustrate the electrical safety in residential, commercial and agricultural installations using case studies
- Understand various techniques of first aid and life support

Module-1 Electrical Safety, Shocks and Prevention **8 hours**

Terms and definitions, Objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, approaches to prevent accidents, scope of subject electrical safety.

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ spark overs, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, and residential buildings.

Module-2 First AID **8 hours**

Introduction, Removal of contact with Live Conductor, First Principles of Actions After Electric Shock, Artificial Respiration, Schafer's Prone Pressure Method, Silvester's Method, Nielson's Arm-lift Back pressure method, Mouth to Mouth method, Use of Artificial Resuscitator, External Cardiac Massage, Cardiac Pulmonary Resuscitation, Chocking, Poisoning, Open wounds, Burns and Scalds.

Module-3 Electrical Safety in Residential, Commercial and Agricultural Installations 8 hours

Wiring and Fittings, Domestic appliances, Case Studies on Shocks due to water tap, wet wall and ceiling fan. Multi-storeyed buildings, temporary installations, agricultural pump installation, Do's and Don'ts for safety in the use of domestic electrical appliances.

Module-4 Electrical Safety in Hazardous Areas **8 hours**

Introduction, Hazardous zones, sparks flashover and corona discharge, Functional requirements and specifications, classification of equipment enclosures for hazardous gases and vapours, classification of equipment/enclosures for hazardous locations.

Module-5 Safety Management **8 hours**

Principles of Safety management, management's safety policy, safety organization, safety auditing, motivation to managers, supervisors and employees.

Objectives and scope of IE Act and IE rules, ground clearance and section clearance, Rules regarding First Aid and Fire Fighting Facility, Electrical safety general requirements.

Course Outcomes: At the end of the course the student will be able to:	
21EEE6044.1	Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention
21EEE6044.2	Outline the electrical safety procedures in hazardous zones
21EEE6044.3	Illustrate the electrical safety in residential, commercial and agricultural installations using case studies
21EEE6044.4	Describe the various techniques of first aid and life support
21EEE6044.5	Analyze the policies and rules governing electrical safety management.
21EEE6044.6	Apply the principles of safety management in electrical installations and process plants

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Electrical Safety, Fire Safety Engineering and Safety Management	S. Rao, R.K.Jain, Prof. H.L Saluja	Khanna Publishers	2nd Edition 2022
Reference Books				
1	Electrical safety Engineering	Cooper.W.F	Newnes-Butterworth Company	1978
2	Electrical safety hand book	John Codick	McGraw Hill Inc	2000

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/103106071

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE6044.1	3	2	0	0	2	2	0	2	0	0	0	0	2	2
21EEE6044.2	1	2	0	0	1	2	0	0	0	0	0	0	0	0
21EEE6044.3	3	2	0	0	2	1	0	0	0	0	0	0	2	1
21EEE6044.4	2	1	0	0	2	2	0	0	0	0	0	0	2	0
21EEE6044.5	2	2	0	0	3	1	0	0	0	0	0	0	0	2
21EEE6044.6	3	1	0	0	3	1	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Energy Conservation and Audit			
Course Code	**21EEE6045**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Open Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the current energy scenario and importance of energy conservation.
- Understand the methods of improving energy efficiency in different electrical systems.
- Realize energy auditing.
- Explain about various pillars of electricity market design.
- To explain the scope of demand side management, its concept and implementation issues and strategies

Module-1 Energy Scenario **8 hours**

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Module-2 Energy Efficiency in Electrical Systems **8 hours**

Electricity billing, Electrical load management and maximum demand Control, Maximum demand controllers; Power factor improvement, Automatic power factor controllers, efficient operation of transformers, energy efficient motors, Soft starters, Variable speed drives; Performance evaluation of fans and pumps, Flow control strategies and energy conservation opportunities in fans and pumps, Electronic ballast, Energy efficient lighting and measures of energy efficiency in lighting system.

Module-3 Energy auditing **8 hours**

Introduction, Elements of energy audits, different types of audit, energy use profiles, measurements in energy audits, presentation of energy audit results.
Energy audit instruments-Instruments for audit and monitoring energy and energy savings, types and accuracy. Energy Flow Diagram(Sankey Diagram)

Module-4 Electricity as a Commodity **8 hours**

Distinguishing features of electricity as a commodity, Four pillars of market design: Imbalance, Scheduling and Dispatch, Congestion Management, Ancillary Services. Framework of Indian power sector and introduction to the availability based tariff (ABT).

Module-5 Energy Audit Applied to Buildings **8 hours**

Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings. Demand side Management: Scope of DSM, Evolution of DSM concept, DSM planning and Implementation, Load management as a DSM strategy, Applications of Load Control, End use energy conservation, Tariff options for DSM

Course Outcomes: At the end of the course the student will be able to:	
21EEE6045.1	Analyze about energy scenario nationwide and worldwide, also outline Energy Conservation Act and its features.
21EEE6045.2	Discuss load management techniques and energy efficiency.
21EEE6045.3	Understand the need of energy audit and energy audit methodology.
21EEE6045.4	Understand various pillars of electricity market design

21EEE6045.5	Conduct energy audit of electrical systems and buildings.
21EEE6045.6	Show an understanding of demand side management and energy conservation.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Energy Management Handbook	W.C. Turner	CRC Press	6th Edition 2006
2	Energy Efficient Electric Motors and Applications	H.E. Jordan	Plenum Pub. Corp	2nd Edition, 1994
3	Energy Management	W. R. Murphy, G. Mckay	Butterworths	2007
Reference Books				
1	Energy Science Principles, Technologies and Impact	J. Andrews, N. Jelley	Oxford University Press	4th Edition, 2022
2	Market operations in power systems: Forecasting, Scheduling, and Risk Management	Shahedepour M.,Yamin H., Zuyi Li.	Wiley-IEEE Press	1st Edition 2002
3	Energy Conservation	Diwan Parag and Dwivedi Prasoom	Pentagon Energy Press, New Delhi	2008

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/112105221

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE6045.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE6045.2	3	2	0	0	0	0	0	0	0	0	0	0	0	0
21EEE6045.3	3	0	0	0	0	1	2	2	0	0	0	0	0	0
21EEE6045.4	2	2	0	0	0	2	2	2	0	0	0	0	0	0
21EEE6045.5	3	3	0	0	0	0	2	2	0	0	0	0	0	0
21EEE6045.6	3	2	0	0	0	0	2	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Environmental Studies			
Course Code	**21CIV605**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	1:0:0	SEE Hours	02
Total Hours	15 hours Theory	Credits	01

Course Learning Objectives: This course will enable

- To create environmental awareness among the students.
- To gain knowledge on different types of pollution in the environment.

Module-1 Introduction to Ecology **3 hours**

Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic and Lake. Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Module-2 Energy Systems and Natural Resources **3 hours**

Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.

Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, case studies, and Carbon Trading.

Module-3 Environmental Pollution and Public Health **3 hours**

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.

Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module-4 Environmental Concerns **3 hours**

Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module-5 Environmental Management **3 hours**

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Field work: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

Course Outcomes: At the end of the course the student will be able to:

21CIV605.1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale
21CIV605.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
21CIV605.3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic component.
21CIV605.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
21CIV605.5	Address problems related to waste management and public health aspects
21CIV605.6	Understand about the Standards and latest tools to mitigate pollution.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Environmental studies	Benny Joseph	Tata McGraw-Hill	Edition 3, 2018
2	Environmental Studies –From Crisis to Cure	R Rajagopalan	Oxford Uni-Press	Edition 3, 2020
Reference Books				
1	A Basic Course in Environmental Studies	Surinder Deswal, Anupama Deswal	DhanpatRai Publishing Co. (P) Ltd	2017
2	Text book of Environmental Studies for Undergraduate Courses	Bharucha Erach	Universities Press	Edition 2, 2017
3	Environmental Studies	Ranjit R. J Daniels, Jagdish Krishnaswamy	John Wiley & Sons Inc.	2010
4	Perspective in Environmental Studies	Anubha Kaushik, C P Kaushik	New Age International Pvt. Ltd	Edition 3, 2009

Web links and Video Lectures (e-Resources):

- Coursera Course: Introduction to Environmental Science Specialization - https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc
- NPTEL: Environmental Studies - https://onlinecourses.swayam2.ac.in/cec22_ge22/preview
- Directory of Open Access Books (DOAB) -Environmental Leadership Capacity Building in Higher Education: Experience and Lessons from Asian Program for Incubation of Environmental Leaders : http://link.springer.com/openurl?genre=book&isbn=978-4-431-54339-8
- Lec 31: Environmental Management Systems (EMS) - https://youtu.be/BYqLRGawoH0
- ISO 14001:2015 Training - Environmental Management - https://youtu.be/2f4pBIvXkBs

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21CIV605.1	0	0	0	0	0	1	3	0	0	0	0	0	0	0
21CIV605.2	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.3	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.4	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.5	0	0	0	0	0	2	3	1	0	0	0	0	0	0
21CIV605.6	0	0	0	0	1	0	0	2	0	0	0	0	0	0

1: Low 2: Medium 3: High

Power Electronics Laboratory			
Course Code	**21EEL606**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE Hours	03
Total Hours	12 Lab slots	Credits	01

Course Learning Objectives: The objective of the course is to

- To conduct experiments on semiconductor devices to obtain their static characteristics.
- To study different methods of triggering the SCR
- To study the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
- To control the speed of a DC motor, universal motor and stepper motors.
- To study single phase full bridge inverter connected to resistive load.

SL. No	Experiments
1	Static Characteristics of SCR
2	Static Characteristics of MOSFET and IGBT
3	Characteristics of TRIAC
4	SCR Turn On Circuit Using Synchronized UJT Relaxation Oscillator
5	SCR Digital triggering Circuit for a Single Phase Controlled Rectifier and AC Voltage Regulator.
6	Single Phase Full Wave Controlled Rectifier With R and RL Load.
7	Speed Control of DC Motor Using Single Phase Semi-converter.
8	AC Voltage Controller Using TRIAC and DIAC Combination Connected to R and RL Load.
9	Speed Control of Stepper Motor
10	Speed Control of Separately Excited DC Motor Using an IGBT or MOSFET Chopper.
11	Speed Control of Universal Motor Using an AC Voltage Regulator.
12	MOSFET or IGBT Based Single Phase Full Bridge Inverter Connected to R Load.

Course Outcomes: At the end of the course the student will be able to:	
21EEL606.1	Obtain the Characteristics of Semiconductor Devices to Discuss their Performance.
21EEL606.2	Trigger the SCR by Different Methods
21EEL606.3	Verify the Performance of Single Phase Controlled Full Wave Rectifier and AC Voltage Controller with R and RL Loads
21EEL606.4	Control the Speed of a DC Motor, Universal Motor and Stepper Motor
21EEL606.5	Verify the Performance of AC Voltage Controller with R and RL Loads
21EEL606.6	Verify the Performance of Single Phase Full Bridge Inverter Connected to Resistive load

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Power Electronics: Circuits Devices and Applications	Mohammad H Rashid,	Pearson	4th Edition, 2014

Reference Books				
1	Power Electronics: Converters, Applications and Design	Ned Mohan et al	Wiley	3rd Edition, 2014
2	Power Electronics	Daniel W Hart	McGraw Hill	1st Edition, 2011
3	Elements of Power Electronics	Philip T Krein	Oxford	Indian Edition, 2008

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/102/108102145/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEL606.1	3	2	0	0	0	0	0	0	2	0	0	0	0	0
21EEL606.2	0	2	2	0	0	0	0	0	2	0	0	0	0	0
21EEL606.3	0	2	2	1	0	0	0	0	2	0	0	0	0	0
21EEL606.4	2	0	2	0	2	0	0	0	2	0	0	0	2	0
21EEL606.5	0	2	2	1	1	0	0	0	2	0	0	0	1	0
21EEL606.6	3	0	2	0	1	0	0	0	2	0	0	0	1	0

1: Low 2: Medium 3: High

Hardware Description Language (HDL)			
Course Code	**21EEE607**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Hours	03
Total Hours	40	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the structure Hardware Description Language and the modeling concepts.
- Familiarize the different levels of abstraction in Verilog.
- Learn the design of gate level, data flow and behavioral modeling of digital circuits.
- Understand the concept of procedures and functions.
- Know the design synthesis using VHDL.

Module-1 Hierarchical Modelling Concepts	**8 hours**
A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block.	
Module-2 Modules & Ports	**8 hours**
Module definition, port declaration, connecting ports, hierarchical name Referencing. Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors. Programming examples.	
Module-3 Behavioral Modelling	**8 hours**
Modelling using basic gate primitives, description of and/or and buf/not type gates. Programming examples. Introduction to Behavioural modelling**,** Structure of HDL behavioural modelling, structured procedures-initial and always.	
Module-4 Behavioral Modelling	**8 hours**
Conditional statements, Multiway branching, loops, sequential and parallel blocks, Programming examples. Highlights of Procedures, tasks, and Functions, differences between tasks and functions.	
Module-5 VHDL	**8 hours**
Introduction to VHDL, Using VHDL for Design Synthesis, comparison of VHDL and verilog. Introduction to Entities and Architectures, A simple design, Design entities, Identifiers, Data objects, Data types, and Attributes.	

Course Outcomes: At the end of the course the student will be able to:	
21EEE607.1	Explain the fundamentals of Hardware Description Language and the modeling concepts.
21EEE607.2	Define modules and develop gate level models for a given digital circuit.
21EEE607.3	Develop data flow models for a given digital circuit.
21EEE607.4	Understand the case statement, branching & loops in behavioral modeling of digital circuits and know the differences between tasks & functions.
21EEE607.5	Understand basic concepts of VHDL and its entities.
21EEE607.6	Write verilog programs in gate level, data flow and behavioral modeling level for the digital circuits.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Verilog HDL: A Guide to Digital Design and Synthesis	Samir Palnitkar	Pearson Education	Second Edition, 2006
2	VHDL for Programmable Logic	Kevin Skahill	PHI/Pearson education	2006
Reference Books				
1	Digital Design: Introduction to the Verilog HDL	M. Morris Mano, Michael D. Ciletti	Pearson	5th Edition, 2016
2	The Verilog Hardware Description Language	Donald E. Thomas, Philip R. Moorby	Springer Science + Business Media, LLC	Fifth Edition, 2010
3	Design through Verilog HDL	Padmanabhan, Tripura Sundari	Wiley	2016

Web links and Video Lectures (e-Resources):

- https://youtube.com/playlist?list=PLUtfVcb-iqn-EkuBs3arreilxa2UKIChl
- https://youtube.com/playlist?list=PL3pGy4HtqwD15wr99U4CBhYqiZIwWbl12

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE607.1	2	1												
21EEE607.2			2											
21EEE607.3			2											
21EEE607.4	2		1											
21EEE607.5	2													
21EEE607.6					1									

1: Low 2: Medium 3: High

Innovation and Intellectual Property			
Course Code	**21IIP609**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE	2 Hours
Total Hours	20 Hrs	Credits	-

Course Learning Objectives:

1. Learn how to use online databases and search tools for conducting patent searches.
2. Develop skills in analyzing patent documents and identifying relevant prior art.
3. Gain proficiency in evaluating the patentability criteria for engineering inventions.
4. Understand the principles of technology gap analysis and patentability search.
5. Understand the patent drafting and patent prosecution.

Module-1 Basics of Intellectual Property Rights (4 Hours)

Creativity, Invention, and Innovation – Introduction to Intellectual Property Rights-types and Importance – Overview of Patent Law – Intellectual Property Management and Commercialization – Emerging Issues in Intellectual Property – Case Studies and Practical Examples – Ethical and Social Considerations.

Activity: Trademark Design Challenge – IP Case Study Analysis

Module-2 Patent Landscape Analysis – Technology Gap Analysis (4 Hours)

Overview of Patent Databases and Search Tools – Keyword Searching, Classification Searching, and Citation Searching – Methods for Analyzing Patent Data: Patent Counts, Citation Analysis, and Patent Mapping – Technology Gap Analysis – Patent Portfolios – Portfolio Strength Assessment – Identification of Key Players – Competitive Intelligence and Market Analysis.

Activity: Conduct Patent Landscape Analysis for the Proposed Capstone Project.

Module-3 Patentability Assessment (6 Hours)

Significance of Patentability Assessment – Patentability Criteria: Novelty, Non-obviousness (Inventive Step), and Industrial Applicability/Utility – Prior Art Searching and Analysis (Keyword Searching, Classification Searching, and Citation Searching) – Non-Patent Literature Search and Other sources of Prior Art – Patentability Reports and Assessments – Case Studies and Practical Examples.

Activity: Conduct a Patentability Search for the Proposed Capstone Project.

Module-4 Patent Drafting and Prosecution (6 Hours)

Significance of Patent Drafting and Prosecution – Structure and Components of a Patent Application – Drafting of Patent Specifications, Claims, and Drawings – Overview of Patent Prosecution Process

Activity: Prepare a Patent Draft for the Proposed Capstone Project.

Course Outcomes: At the end of the course, the student will be able to:	
21IIP609.1	Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches.
21IIP609.2	Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature.
21IIP609.3	Demonstrate a comprehensive understanding of the patentability criteria, including novelty, non-obviousness, and utility.

21IIP609.4	Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches.
21IIP609.5	Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution.
21IIP609.6	Apply the acquired knowledge and skills in conducting practical activities, such as conducting patent landscape analysis, patentability searches, and drafting patent applications, to solve real-world problems and challenges in the field of intellectual property rights.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books/Sources				
1	Intellectual Property- A Primer for Academia (For Module 1)	Rupinder Tewari Mamtha Bhardway	Publication Bureau, Panjab University Chandigarh India	2021
2	Patent Landscape Reports (For Module 2)	WIPO - World Intellectual Property Organization		https://www.wipo.int/patentscope/en/programs/patent_landscapes/
3	Guidelines for Preparing Patent Landscape Reports (For Module 2)	Anthony Trippe, Patinformatics, LLC	World Intellectual Property Organization (WIPO)	2015
4	Patent Searching - Tools and Techniques (For Module 3)	David Hunt	John Wiley & Sons Inc	First edition 2007
5	The Complete Patent Book_ Everything You Need to Obtain Your Patent (For Module 4)	James L. Rogers	Sphinx Publishing	First Edition 2003

Additional Resources:

1. WIPO Patent Drafting Manual - Second Edition 2023, https://www.wipo.int/edocs/pubdocs/en/wipo-pub-867-23-en-wipo-patent-drafting-manual.pdf
2. Patent Drafting for Beginners - https://elearn.nptel.ac.in/shop/nptel/patent-drafting-for-beginners/?v=c86ee0d9d7ed
3. The Office of the Controller General of Patents, Designs and Trade Marks, Government of India - https://www.ipindia.gov.in/
4. Copyright Office, Government of India - https://copyright.gov.in/
5. United States Patent and Trademark Office - https://www.uspto.gov/
6. Espacenet – patent search - https://worldwide.espacenet.com/
7. The Lens - Free & Open Patent and Scholarly Search - https://www.lens.org/
8. WIPO PATENTSCOPE - https://patentscope.wipo.int/search/en/search.jsf

Course Articulation Matrix

Course Outcomes (Cos)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21IIP609.1	2	-	-	-	3	-	-	-	-	-	-	1	-	-
21IIP609.2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
21IIP609.3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
21IIP609.4	2	-	3	-	-	-	-	-	-	-	-	-	-	-
21IIP609.5	1	3	-	-	-	-	-	-	-	-	-	2	-	-
21IIP609.6	-	-	-	-	2	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

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Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R &D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi
Accredited by NAAC with A+ Grade
B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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