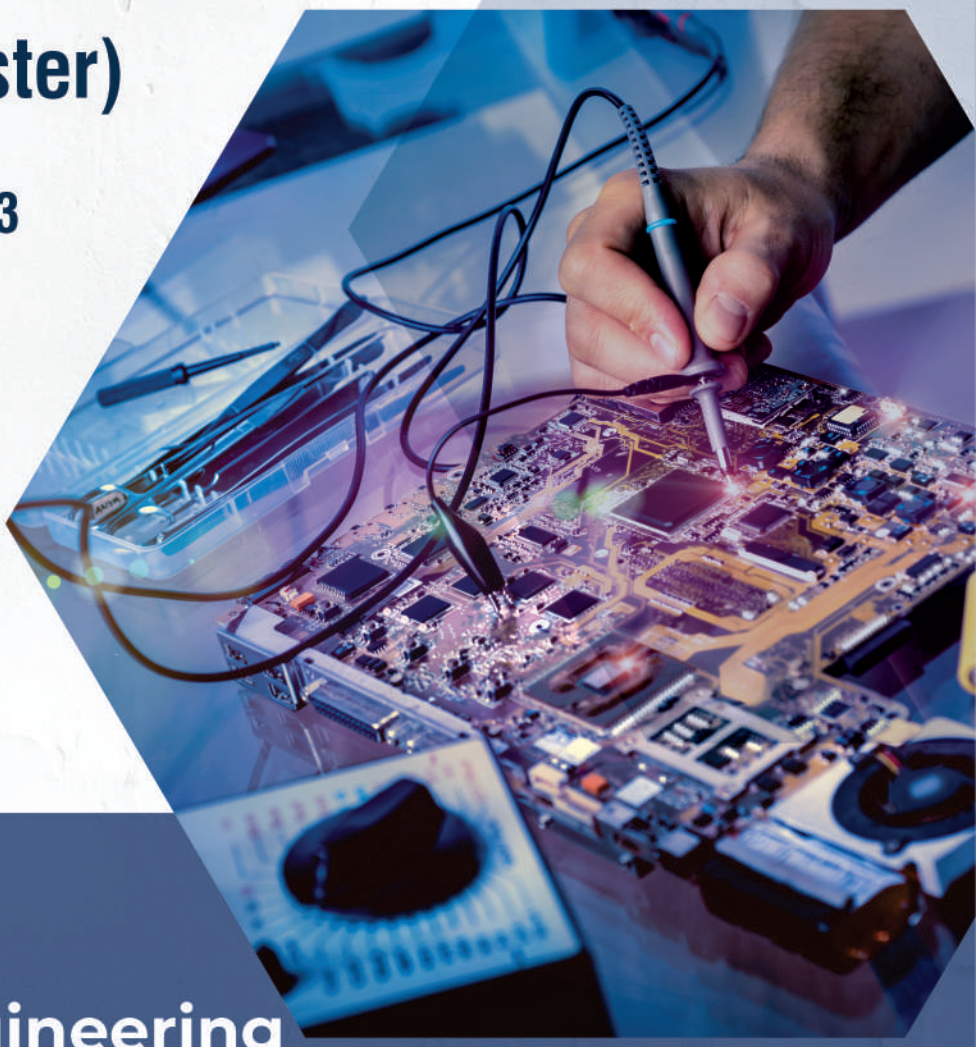
BE SCHEME & SYLLABUS

Third Year
(V and VI Semester)

With effect from 2022-23



Electrical and Electronics Engineering

ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service & 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) & PG (MBA and MCA)
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS
(With effect from 2022-23)

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 two of the PG programs namely, MBA and MCA 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. - Electrical & Electronics Engineering)													
SI. 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 Marks**	
						L	**T**	**P**					
1	HSMC	22EEE51	Engineering Management and Entrepreneurship	EEE	EEE	3	-	-	03	50	50	100	3
2	IPCC	22EEE52	Control System (Integrated)	EEE	EEE	2	2	2	03	50	50	100	4
3	IPCC	22EEE53	Fundamentals of HDL (Integrated)	EEE	EEE	3	-	2	03	50	50	100	4
4	PCC	22EEE54	Power Electronics	EEE	EEE	2	2	-	03	50	50	100	3
5	PCCL	22EEE55L	Power Electronics Lab	EEE	EEE	-	-	2	03	50	50	100	1
6	PEC	22EEE56X	Professional Elective - I	EEE	EEE	3	-	-	03	50	50	100	3
7	AEC/ SDC	22RMI57	Research Methodology and Intellectual Property Rights	EEE	EEE	2	-	-	03	50	50	100	2
8	AEC/ SDC	22ETP58	Emerging Technologies: A Primer	COM	COM	-	-	2	03	100	-	100	1
					Total	**15**	**4**	**8**	**24**	**450**	**350**	**800**	**21**

22EEE56X : Professional Elective I			
22EEE561	Electrical Estimation & Costing	22EEE563	Electric Vehicle Technologies
22EEE562	Embedded System	22EEE564	Advanced Electrical Machines

VI Semester (B.E. - Electrical & Electronics Engineering)													
SI. 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 Marks**	
						L	**T**	**P**					
1	IPCC	22EEE61	Digital Signal Processing (Integrated)	EEE	EEE	2	2	2	03	50	50	100	4
2	IPCC	22EEE62	Computer Aided Electrical Drawing (Integrated)	EEE	EEE	2	2	2	03	50	50	100	4
3	PCC	22EEE63	Power System Analysis	EEE	EEE	3	-	-	03	50	50	100	3
4	PEC	22EEE64X	Professional Elective -II	EEE	EEE	3	-	-	03	50	50	100	3
5	OEC	22EEE65X	Open Elective -I	EEE	EEE	3	-	-	03	50	50	100	3
6	PRJ	22EEE66	Major Project Phase - I	EEE	EEE	-	-	4	03	100	-	100	2
7	HSMC	22CIV67	Environmental Studies	CIV	CIV	1	-	-	02	50	50	100	1
8	AEC/SDC	22IIP68	Innovation and Intellectual Property	COM	COM	-	-	2	03	100	-	100	1
Total						**14**	**4**	**10**	**23**	**500**	**300**	**800**	**21**

22EEE64X : Professional Elective II			
22EEE641	Utilization of Electrical Power	22EEE643	Energy Storage Devices
22EEE642	PLC & SCADA	22EEE644	Electrical Machine Design

22EEE65X : Open Elective I			
22EEE651	Fundamentals of Electric Vehicles	22EEE653	Energy Conservation & Audit
22EEE652	Sensors & Transducers	22EEE654	Electrical Safety Practices

V Semester

Engineering Management and Entrepreneurship			
Course Code	**22EEE51**	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

Discuss principles and functions of management and techniques for project management.

Explain the need of social responsibilities and support provided by government and non-government institutes for industrial development.

Explain the role and importance of the entrepreneur in economic development and the concepts of entrepreneurship.

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. 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).

Industry policy resolution (1948-1991)

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. 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:	
22EEE51.1	Review and Interpret the first principles of management as a manager and planner in an industrial environment.
22EEE51.2	Identify the features of management sciences in organizing & staffing, directing & controlling the resources in an industrial environment.

22EEE51.3	Apply the norms of financial management and business ethics to fulfill social responsibilities of industries through corporate governance.
22EEE51.4	Demonstrate the knowledge of project management principles in establishing and managing small business enterprise.
22EEE51.5	Demonstrate the understanding of management principles in undertaking projects in multidisciplinary environments.
22EEE51.6	Develop financial entrepreneurial 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	TMH	15th Edition 2022
Reference Books				
1	Dynamics of Entrepreneurial Development and Management	Vasant Desai	Himalaya Publishing House	6th Edition 2011
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://nptel.ac.in/courses/110106141 (Entrepreneurship)
- https://archive.nptel.ac.in/courses/110/104/110104073/ (Project Management)
- https://youtu.be/TtbImDfUt4c?feature=shared (Lecture 1: Introduction to Management – I)
- https://youtu.be/KWy_m6QfFhw?feature=shared (Lecture 09 : Planning - I)
- https://youtu.be/Ug0ORs3R4WQ?feature=shared (Lecture 18 : Decision Making - I)
- https://youtu.be/DTGekoI7Dug?feature=shared (Lecture 47 : Leadership Styles of Managers - I)
- https://youtu.be/DcKL4ldQ_PI?feature=shared (Mod-39 Lec-48 Starting a New Company and Small - scale Industrial Undertakings)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE51.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
22EEE51.2	0	0	0	0	0	0	0	0	0	2	0	0	0	1
22EEE51.3	0	0	0	0	0	2	0	2	0	0	0	1	0	0
22EEE51.4	0	0	0	0	0	0	2	0	0	0	0	1	0	2
22EEE51.5	0	0	0	0	0	0	0	0	2	0	0	0	1	0
22EEE51.6	0	0	0	0	0	0	0	0	0	3	1	0	0	0

1: Low 2: Medium 3: High

Control System			
Course Code	**22EEE52**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:2	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 techniques.
- Determine the stability of a system by application of frequency domain techniques.

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 Criterion	**8 hours**
Standard test signals, time response of second order systems(no derivations), steady-state errors and error constants, Routh stability criterion, special cases of Routh table, application of Routh stability criterion to linear feedback systems and stability analysis.	
Module-4 Root Locus & Controllers	**8 hours**
Introduction, root locus concepts, construction of root loci, rules for the construction, Introduction to P, PI, PD, PID controllers, industrial practice of controllers & applications.	
Module-5 Frequency domain & Stability Analysis	**8 hours**
Frequency response specifications (no derivations), General procedure for constructing Bode plots, Bode plots, Nyquist plots and stability analysis.	

PRACTICAL MODULE

1. Determine the transfer function for the given closed 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. Application of virtual toolbox to determine the variation of controller parameters on system stability.

Course Outcomes: At the end of the course the student will be able to:	
22EEE52.1	Apply the knowledge of physical systems modelling to electrical and mechanical systems.
22EEE52.2	Apply the block diagram reduction techniques and signal flow graphs to obtain the transfer function of a system.
22EEE52.3	Assess the effect of poles, zeros and standard input test signals for calculating the errors and determining the stability of a system.
22EEE52.4	Evaluate the root locus techniques for stability analysis.
22EEE52.5	Analyze the Bode and Nyquist plot techniques to determine the stability of a closed-loop system.
22EEE52.6	Perceive the need for PID controllers in industries for engaging in professional engineering practice.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Control Systems	Anand Kumar	PHI	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	Tata McGraw Hill	3rd Edition, 2010

Web links and Video Lectures (e-Resources):

- https://www.edx.org/learn/robotics/university-of-pennsylvania-robotics-dynamics-and-control
- https://www.coursera.org/learn/robotics-motion-planning
- https://ocw.mit.edu/courses/6-241j-dynamic-systems-and-control-spring-2011/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE52.1	2	2	2	0	0	0	0	0	1	1	0	0	1	0
22EEE52.2	2	2	2	2	2	0	0	0	0	1	0	1	1	0
22EEE52.3	2	2	2	2	0	0	2	0	0	1	0	0	1	0
22EEE52.4	2	2	2	0	0	0	0	0	0	1	0	1	0	0
22EEE52.5	2	2	2	2	0	0	0	0	1	0	0	1	0	0
22EEE52.6	2	2	2	2	1	0	0	1	0	1	0	1	1	0

1: Low 2: Medium 3: High

Fundamentals of HDL			
Course Code	22EEE53	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	Credits	04

Course Learning Objectives: The objective of the course is to

- Illustrate the structure of Hardware Description Language and the modeling concepts.
- Demonstrate various Verilog HDL design modeling techniques.
- Design and analyze combinational and sequential circuits using Verilog HDL.
- Experiment with synthesis of combinational and sequential circuits.
- Make use of FPGA board to implement Verilog HDL Designs.

Module-1 Introduction to Design Methodology **8 hours**

Introduction: Evolution of computer-aided digital design, emergence of HDLs, typical design flow.

Hierarchical modeling concepts: Top-down and bottom-up design methodologies, modules, instances, components of a simulation design methodology.

Module-2 Data Flow Modelling **8 hours**

Modules and ports: Module definition, port declaration, connecting ports, hierarchical name referencing.

Data –flow descriptions: Highlights of data-flow descriptions, structure of data-flow description, data type – vectors. Programming examples.

Module-3 Structural and Behavioral Modelling **8 hours**

Gate-level modeling: Modeling 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 Tasks and Functions **8 hours**

Behavioural modelling: Conditional statements, multiway branching, loops, sequential and parallel blocks, programming examples.

Procedures, tasks, and functions: Highlights of procedures, tasks, and functions, differences between tasks and functions.

Module-5 Logic Synthesis **8 hours**

Synthesis of combinational and sequential logic: Introduction to synthesis, synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of sequential logic with flip-flops.

PRACTICAL MODULE

1. Write a Verilog code to realize all the logic gates using Gate Level modelling. Verify the design using Verilog Test Bench Code.
2. Write a Verilog code to realize all the universal logic gates using Dataflow modelling. Verify the design using Verilog Test Bench Code.
3. Write a Verilog code for 8 to 3 Priority Encoder using Gate Level modelling. Verify the design using Verilog Test Bench Code.
4. Write a Verilog code for 4 Bit Comparator using Dataflow modelling. Verify the design using Verilog Test Bench Code.
5. Write a Verilog code for 4-bit Ripple Carry Adder using Full Adders. Ensure that the Full Adder is designed using Half Adder. Verify the designs using Verilog Test Bench Code.
6. Write a Verilog code for 8:1 Multiplexer using 4:1 Multiplexers. Make use of 2:1 Multiplexers to design 4:1 Multiplexer. Verify the designs using Verilog Test Bench Code.
7. Write a Verilog code to realize SR, JK, D and T Flipflops using Behavioral modeling. Verify the design using Verilog Test Bench Code. Implement any two of the design on a Nexys 4

DDR FPGA Board.

8. Write a Verilog code to implement 4 bit Binary and BCD with Synchronous reset and Asynchronous reset to implement any sequence (up, down or both) using Behavioral modeling. Verify the design using Verilog Test Bench Code. Implement any two of the design on a Nexys 4 DDR FPGA Board.
9. Write a Verilog code to Display Messages on the seven-segment display of the Nexys 4 DDR FPGA Board.

Course Outcomes: At the end of the course the student will be able to:	
22EEE53.1	Illustrate the fundamentals of hardware description language and the modeling concepts.
22EEE53.2	Define modules and develop data flow models for a given digital circuit.
22EEE53.3	Develop verilog descriptions of digital systems using verilog gate and behavioural modeling.
22EEE53.4	Illustrate the need of behavioral modeling, tasks and functions in verilog.
22EEE53.5	Examine the need of synthesis process in combinational and sequential digital systems.
22EEE53.6	Make use of EDA and FPGA board to design, simulate and implement verilog HDL codes.

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	2nd Edition, 2014
2	Advanced Digital Design with the Verilog HDL	Michael D. Ciletti	PHI Learning	2nd Edition, 2010
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	5th Edition, 2010
3	Design through Verilog HDL	Padmanabhan, Tripura Sundari	Wiley	Student Edition 2019
4	Fundamentals of Digital Logic with Verilog Design	Stephen Brown and Zvonko Vranesic	McGraw – Hill Edition	2nd Edition, 2013

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/103/108103179/ (System Design Through VERILOG)
- https://archive.nptel.ac.in/courses/106/105/106105165/ (Hardware modelling using Verilog)
- http://www.asic-world.com/verilog/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
22EEE53.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
22EEE53.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
22EEE53.3	1	0	1	0	0	0	0	0	0	0	0	0	0	0
22EEE53.4	1	0	1	0	0	0	0	0	0	0	0	0	0	0
22EEE53.5	0	0	1	1	0	0	0	0	0	0	0	0	0	0
22EEE53.6	0	0	0	0	1	0	0	0	1	0	0	0	2	0

1: Low 2: Medium 3: High

Power Electronics			
Course Code	**22EEE54**	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 with their switching characteristics.
- Analyze power diode, power transistors and thyristor characteristics.
- Discuss performance of diode rectifier circuits.
- Analyze the 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: Applications of power electronics, types of power electronic circuits, peripheral effects, characteristics and specifications of switches.

Power diodes: Introduction, 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.

Diode rectifier: introduction, single phase full wave rectifier with R and RL load

Module-2 Power Transistors 8 hours

Power transistors: 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, requirements of thyristor firing circuits, unijunction transistor relaxation oscillator for triggering thyristor.

Module-4 Controlled Rectifiers and AC Voltage Controllers 8 hours

Controlled rectifiers: Introduction, 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.

AC voltage controllers: Introduction, 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

DC-DC converters: Introduction, principle of step down and step-up chopper with R, RL load, performance parameters, DC-DC converter classification.

DC-AC converters: Introduction, 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:	
22EEE54.1	Explain application area of power electronics, types of power electronic circuits with their applications.
22EEE54.2	Explain types of power diodes, their characteristics, and the effects of power diodes on RL circuits, diode rectifier circuits with RL loads.
22EEE54.3	Analyze steady state, switching characteristics and gate control requirements of

	different power transistors with their limitations.
22EEE54.4	Analyze different types of thyristors, their operation, turn on and turn off methods.
22EEE54.5	Explain designing, analysis techniques and characteristics of thyristor controlled rectifiers.
22EEE54.6	Analyze 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
2	Power Electronics	P.S. Bhimbhra	Khanna Publishers	5th Edition,2012
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

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/102/108102145/ (Power Electronics)
- https://www.coursera.org/specializations/power-electronics

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE54.1	3	0	0	0	0	2	0	0	0	0	0	0	0	0
22EEE54.2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE54.3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE54.4	0	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE54.5	0	2	0	0	0	2	0	0	0	0	0	0	2	0
22EEE54.6	0	2	0	0	0	2	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Power Electronics Lab			
Course Code	**22EEE55L**	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	24 hours	Credits	01

Course Learning Objectives: The objective of the course is to

- Conduct Experiments on Semiconductor Devices to Obtain Static Characteristics.
- Study Different Methods of Triggering the SCR.
- Study the Performance of Single Phase Controlled Full Wave Rectifier and AC Voltage Controller with R and RL Loads.
- Control the Speed of a DC Motor, Universal Motor and Stepper Motors.
- Study the Performance of Single Phase Full Bridge Inverter Connected to Resistive Load.

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 Semiconverter.
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:

22EEE55L.1	Obtain the Characteristics of Semiconductor Devices to Discuss their Performance.
22EEE55L.2	Trigger the SCR by Different Methods.
22EEE55L.3	Verify the Performance of Single Phase Controlled Full Wave Rectifier and AC Voltage Controller with R and RL Loads.
22EEE55L.4	Control the Speed of a DC Motor, Universal Motor and Stepper Motor.
22EEE55L.5	Verify the Performance of Single Phase Full Bridge Inverter Connected to Resistive load.
22EEE55L.6	Control the Power Output of a Lamp 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
2	Power Electronics	P.S. Bhimbhra	Khanna Publishers	5th Edition,2012
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

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/102/108102145/ (Power Electronics)
- https://www.coursera.org/specializations/power-electronics

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE55L.1	3	0	0	0	0	2	0	0	0	0	0	0	0	0
22EEE55L.2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE55L.3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE55L.4	0	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE55L.5	0	2	0	0	0	2	0	0	0	0	0	0	2	0
22EEE55L.6	0	2	0	0	0	2	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Electrical Estimation & Costing			
Course Code	**22EEE561**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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 market survey, estimates, purchase enquiries, tenders, comparative statement and payment of bills and Indian electricity act and some of the rules.
- Discuss distribution of energy in a building, wiring and methods of wiring, cables used in internal wiring, wiring accessories, fittings and fuses.
- Discuss design of lighting points and its number, total load, sub-circuits, size of conductor.
- Discuss different types of service mains and estimation of power circuits.
- Discuss main components of a substation, their graphical representation and preparation of single line diagram of a substation.

Module-1 Principles of Estimation **8 hours**

Introduction to estimation and costing, electrical schedule, catalogues, market survey and source selection, recording of estimates, determination of required quantity of material, labour conditions, determination of cost material and labour, contingencies, overhead charges, profit, purchase system, purchase enquiry and selection of appropriate purchase mode, comparative statement, purchase orders, payment of bills, tender form, general idea about IE rule, Indian electricity(IE) act and IE rules -29,30,45,46,47,50,51,54,55,77 and 79.

Module-2 Wiring **8 hours**

Introduction, distribution of energy in a building, PVC casing and capping, conduit wiring, desirability of wiring. Types of cables used in internal wiring, multi strand cables, voltage grading and specification of cables. Main switch and distribution board, conduits and its accessories and fittings. Lighting accessories and fittings, types of fuses, size of fuse, fuse units, earthing conductor. **Internal wiring**: general rules for wiring, design of lighting points (refer to seventh chapter of the text book), number of points, determination of total load, number of sub –circuits, ratings, main switch and distribution board and size of conductor, current density, layout.

Module-3 Service Mains **8 hours**

Introduction, types, estimation of underground and overhead service connections, introduction to design and estimation of power circuits, important considerations regarding motor installation wiring, input power, input current to motors, rating of cables, rating of fuse, size of conduit, distribution board main switch and starter.

Module-4 Estimation of Overhead Transmission and Distribution Lines **8 hours**

(Review of line supports, conductor materials, size of conductor for overhead transmission line, types of insulators) [no question shall be set from the review portion]. Cross arms, pole brackets and clamps, guys and stays, conductors configuration spacing and clearances, span lengths, lightning arrestors, phase plates, danger plates, anti-climbing devices, bird guards, beads of jumpers, muffs, points to be considered at the time of erection of overhead lines, erection of supports, setting of stays, fixing of cross arms, fixing of insulators, conductor erection. Repairing and jointing of conductors, dead end clamps, positioning of conductors and attachment to insulators, jumpers, tee-offs, earthing of transmission lines, guarding of overhead lines, clearances of conductor from ground, spacing between conductors, important specifications.

Module-5 Estimation of Substations **8 hours**

Main electrical connection, graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, single line diagram of typical substations, equipment for substation, substation auxiliaries supply, substation earthing.

Course Outcomes: At the end of the course the student will be able to:	
22EEE561.1	Implement wiring methods, cables used, design of lighting points and sub-circuits, internal wiring, wiring accessories and fittings, fuses and types.
22EEE561.2	Implement estimation of service mains.
22EEE561.3	Implement estimation of power circuits.
22EEE561.4	Implement estimation of overhead transmission system.
22EEE561.5	Implement estimation of overhead distribution system.
22EEE561.6	Discuss types of substation, main components and estimation of substation.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	A Course in Electrical Installation Estimating and Costing	J. B. Gupta	Katson Books	9th Edition, 2012
Reference Books				
1	Electrical Design Estimating and Costing.	K.B.Raina &K. Battacharya.	New Age International Pvt Ltd	2nd Edition, 2017
2	Electrical Estimating and costing.	Surjit Singh	Dhanpat Rai company.	2016

Web links and Video Lectures (e-Resources):

- http://www.electricaltechnology.org/2015/05/earthing-and-electrical-grounding-types of earthing.
- http://www.cpwd.gov.in/Publication/Internal2013.pdf
- http://bescom.org/wp-content/uploads/2013/01/PDFFILE1.pdf
- http://mptransco.nic.in/tender_files/volume-v.pdf

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE561.1	2	0	2	0	0	2	2	2	2	0	2	2	0	0
22EEE561.2	2	2	2	0	0	2	0	2	2	0	2	0	0	0
22EEE561.3	2	2	2	0	0	2	0	2	2	0	2	0	0	0
22EEE561.4	2	2	2	0	0	2	0	2	2	0	2	0	0	0
22EEE561.5	2	2	2	0	0	2	0	2	2	0	2	0	0	0
22EEE561.6	2	2	2	0	0	2	0	2	2	0	2	0	0	0

1: Low 2: Medium 3: High

Embedded System			
Course Code	**22EEE562**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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

- Describe 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.
- Illustrate 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 Introduction to Embedded Systems **8 hours**

Introduction to embedded systems, embedded system versus general computing systems, classification of embedded systems, the typical embedded system, characteristics and quality attributes of embedded systems. Major application areas of embedded systems, purpose of embedded systems.

Module-2 System Interfacing **8 hours**

Introduction to PIC microcontroller, ADC interfacing, communication Interface: I2C communication, 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.

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.

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:	
22EEE562.1	Describe the basic concepts and applications of embedded system.
22EEE562.2	Understand the basic concepts of PIC microcontroller
22EEE562.3	Discuss the Embedded system development Languages.
22EEE562.4	Discuss the Integrated Development Environments for embedded firmware.
22EEE562.5	Explain the concept of Real time operating system.
22EEE562.6	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	2nd Edition,2022
2	Real time systems theory and practice	Rajib Mall	Pearson education	1st Edition, 2006

3	PIC Microcontroller and Embedded Systems	Muhammad Ali Mazidi, olind D Mckinlay, Danny Causey	Pearson	2nd Edition, 2021
Reference Books				
1	Embedded Microcomputer System: Real Time Interfacing	Jonathan W. Valvano	Thomson/Brooks/ Cole	1st Edition, 2000

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses/108102045/ (Embedded Systems, IIT Delhi)
- http://nptel.ac.in/courses/108105057/ (Embedded Systems, IIT Kharagpur)
- http://nptel.ac.in/courses/106105159/ (Embedded Systems Design, IIT Kharagpur)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE562.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
22EEE562.2	1	0	0	0	0	0	0	0	0	0	0	0	2	0
22EEE562.3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
22EEE562.4	0	1	0	0	0	0	0	0	0	0	0	0	2	0
22EEE562.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0
22EEE562.6	1	0	0	0	0	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Electric Vehicle Technologies			
Course Code	**22EEE563**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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

- Understand working of Electric Vehicles and recent trends.
- Explain various propulsion drives for electric vehicles.
- Explain different energy storage devices used for electric and hybrid electric vehicles.
- Understand the concept of braking employed in electric vehicles.
- Analyze the design aspects of hybrid electric vehicles.

Module-1 Introduction to Electric and Hybrid Electric Vehicles **8 hours**

Electric Vehicles: configuration of electric vehicles, performance of electric vehicles, traction motor characteristics, tractive effort and transmission requirement, energy consumption.
Hybrid Electric Vehicles: concept of hybrid electric drive trains, architecture of hybrid electric drive trains, series hybrid electric drive trains, configuration of parallel hybrid electric drive trains.

Module-2 Electric Propulsion **8 hours**

Function of typical propulsion system, classification of electric motor drives for EV and HEV application.
DC motor drive: principal of operation and performance, combined armature voltage and field control.
Induction motor drive: principal of operation, steady state performance, torque-slip characteristics of induction motor, general configuration of constant volt/hertz control, power electronic control.
Permanent magnet BLDC motor drive: basic principles, advantages and disadvantages, construction and classification, speed control of BLDC motor drives.

Module-3 Energy storage for EV and HEV **8 hours**

Battery Technologies: lead acid battery, nickle based batteries, lithium based batteries.
Ultracapacitors: features of ultracapacitors, basic principles of ultracapacitors.
Flywheels: basic structure and operation principles of flywheels.
Hybridization of energy storage: concepts of hybrid energy storage, passive and active hybrid energy storage with battery and ultracapacitor.

Module-4 Braking **8 hours**

Fundamentals of braking: braking energy consumed in urban driving, braking energy versus vehicle speed, braking energy versus braking power, braking power versus vehicle speed, braking energy versus vehicle deceleration rate, braking energy on front and rear axles, basics of regenerative braking.
Brake system: brake system of EV and HEV, parallel hybrid brake system (exclude design).

Module-5 Design Aspects of Hybrid Electric Vehicles **8 hours**

Series hybrid electric drive train design: operation patterns, control strategies- max. SOC of PPS control strategy, engine on-off control strategy, design principles of a series (electrical coupling) hybrid drive train- electrical coupling devices, power rating design of traction motor.
Parallel hybrid electric drive train design: configuration of parallel torque coupling hybrid drivetrain and design objectives, control strategies- max. SOC-of-PPS control strategy, engine on-off control strategy.

Course Outcomes: At the end of the course the student will be able to:	
22EEE563.1	Explain the working of electric vehicles and recent trends.
22EEE563.2	Explain the architecture of hybrid electric vehicles.
22EEE563.3	Analyze braking system in an EV.
22EEE563.4	Explain various energy storage system for electric vehicles.

22EEE563.5	Explain the control strategy for a Hybrid Drive Train.
22EEE563.6	Explain the propulsion system in electric vehicles.

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

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spodUH7Q69wQ3uRm5thr (NPTEL video on Introduction to EV)
- https://www.youtube.com/watch?v=V004WUdpHeA&list=PLlYm0AHZdZRLYSylFinxkspWmcgNvbtl (EV Overview of types of EVs and its Challenges)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE563.1	2	2	0	0	1	0	0	0	0	0	0	0	0	0
22EEE563.2	2	0	0	0	1	0	0	3	0	0	0	0	0	0
22EEE563.3	2	0	0	0	0	2	0	0	0	0	0	0	0	0
22EEE563.4	2	0	0	0	0	0	0	0	0	0	0	0	0	0
22EEE563.5	1	0	2	0	0	2	0	0	0	0	0	0	0	0
22EEE563.6	1	0	0	0	0	2	0	0	0	2	0	0	0	0

1: Low 2: Medium 3: High

Advanced Electrical Machines			
Course Code	**22EEE564**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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

- Impart knowledge on the Construction, principle of operation, control and performance of stepping motors.
- Impart knowledge on the Construction, principle of operation, control and performance of switched reluctance motors and permanent magnet brushless D.C. motors.
- Impart knowledge on the Construction, principle of operation and performance of permanent magnet synchronous motors and synchronous reluctance motor.
- Impart knowledge on single phase special machines and servo motors.
- Impart knowledge on Linear electrical machine and permanent magnet axial flux machines.

Module-1 Stepper Motors **8 hours**

Introduction, variable reluctance stepper motor, permanent magnet stepper motor, hybrid stepper motor, other types of stepper motor, windings in stepper motors, torque equation, characteristics of stepper motor, open loop control of stepper motor, closed loop control of stepper motor, microprocessor based control of stepper motor, applications of stepper motor.

Module-2 SRM & PM Motors **8 hours**

Switched Reluctance Motor (SRM): construction, principle of working, basics of SRM analysis, constraints on pole arc and tooth arc, torque equation and characteristics, power converter circuits, control of SRM, rotor position sensors, current regulators, microprocessor – based control of SRM, sensorless control of SRM.

Permanent magnet dc motor and brushless permanent magnet DC motor: permanent magnet dc (PMDC) motor, brushless permanent magnet dc (BLDC) motors.

Module-3 PM Synchronous Motors **8 hours**

Permanent magnet synchronous motor (PMSM): construction, principle of operation, Emf equation, torque equation, phasor diagram, circle diagram, comparison of conventional and PMSM, control of PMSM, applications.

Synchronous reluctance motor (SyRM): construction of SyRM, working, phasor diagram and torque equation, control of SyRM, advantages and applications.

Module-4 Special Electrical Machines **8 hours**

AC series motor, repulsion motor, hysteresis motor, single phase reluctance motor, universal motor. DC servo motors, AC servo motors.

Module-5 Linear Motors & PMAF Machines **8 hours**

Linear electric machines: linear induction motor, linear synchronous motor, DC linear motor, linear reluctance motor, linear levitation machines.

Permanent magnet axial flux (PMAF) machines: comparison of permanent radial and axial flux machines, construction of PMAF machines, armature windings, torque and emf equations of PMAF, phasor diagram, output equation, applications of PMAF.

Course Outcomes: At the end of the course the student will be able to:	
22EEE564.1	Explain the performance and control of stepper motors, and their applications.
22EEE564.2	Explain theory of operation and control of switched reluctance motor and permanent magnet brushless D.C. motors.
22EEE564.3	Explain theory of operation and control of permanent magnet synchronous motors and synchronous reluctance motor.
22EEE564.4	Explain operation of single phase special machines and servo motors.

22EEE564.5	Explain operation of linear electrical machine and permanent magnet axial flux machines.
22EEE564.6	Explain operation & application of permanent magnet axial flux machines.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Special Electrical Machines	E.G. Janardanan	PHI	1st Edition 2014.
Reference Books				
1	Special Electrical Machines	K Venkataratham	University Press	2009
2	Brushless Permanent Magnet and Reluctance Motor Drives	T J E Miller	Clerendon Press, Oxford	1989
3	Permanent Magnet and Brushless DC Motors	Kenjo T and Nagamori S	Clerendon Press, Oxford	1985
4	Stepping Motors and their Microprocessor Control	KenjoT	Clerendon Press Oxford	1984
5	Switched Reluctance Motor Drives Modeling, Simulation Design and Applications	Krishan R	CRC	2001

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=x4KTNlNfefw

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE564.1	3	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE564.2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE564.3	2	3	0	0	0	0	0	0	0	0	0	0	0	0
22EEE564.4	2	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE564.5	3	2	0	0	0	0	0	0	0	0	0	0	0	0
22EEE564.6	2	2	0	0	0	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Research Methodology and Intellectual Property Rights			
Course Code	**22RMI57**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:0:0	SEE	3 Hours
Total Hours	25 hours	Credits	02

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 (5 hours)

Research Methodology: Meaning, Objectives, Types of research, Method versus methodology, Research process, Criteria of good research.

Literature Survey, Literature Review: Introduction, process, databases and management tools. Identifying gap areas from literature review. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

Textbook 1: Chapter 1 , Textbook 2: Ch 7-9, 14-17.

Module-2 Technical Writing and Presentations (5 hours)

Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, Illustrations.

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

Research Proposal Writing: Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.

Textbook 2: Chapter 20-22, 26-28, 35.

Module-3 Introduction to IPR and Patents (5 hours)

Introduction to Intellectual Property: Types of IP, Role of IP in the economic and cultural development of the society, IP governance, IP as a global indicator of innovation, National IPR Policy in India. Textbook 3: Chapter 1,

Patents: Conditions for patent, Non-patentable matters, Inventions Eligible for Patenting**,** Salient features of the Indian Patent 1970**,** Process of patenting**,** Types of patent applications**,** Patent infringements**.** Case examples. Textbook 3: Chapter 2: 2.1.

Module-4 Copyright and Trademarks (5 hours)

Copyright: Classes of copyrights, Salient features of the Indian Copyright Act 1957, Criteria for copyright, Copyrights of the author, Copyright Infringements, Non-Copyright Work, Process of copyright registration. Copyright cases.

Trademark: Eligibility Criteria, Classification, Trade Mark Rules 2017, Advantages of registration, Types of trademark registered in India, Process for Trademarks Registration, Case examples.

Textbook 3: Chapter 2: 2.2 and 2.3.

Module-5 Industrial Designs and Geographical Indications (5 hours)

Industrial Designs: Introduction, Eligibility criteria, Famous industrial designs, Features of Design Act 2000, Non-Protectable industrial designs in India, Procedure for Registration of Industrial Designs, Case examples.

Geographical Indications (GIs): Introduction, Rights granted to holders, Popular GIs registered in India, salient features of Geographical Indications of Goods (Registration & Protection) Act, 1999, Non-Registerable GI, Procedure for GI Registration**,** Case examples.

Textbook 3: Chapter 2: 2.4 and 2.5.

Course Outcomes: At the end of the course the student will be able :	
22RMI57.1	To conduct literature survey, review and define a research problem.
22RMI57.2	To follow research ethics and develop the art of writing technical papers and reports.
22RMI57.3	To discuss the role of Intellectual Property and Patents in India.
22RMI57.4	To explain the various aspects of Copyright and Trademark in Indian context.
22RMI57.5	To explain legal aspects of Industrial Designs and Geographical Indications in India.
22RMI57.6	To discuss the case studies related to the different Intellectual Property.

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: A Primer for Academia	Prof. Rupinder Tewari and Ms. Mamta Bhardwaj	Publication Bureau, Panjab University, India	2021
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 Rights – Laws and Practice	The Institute of Company Secretaries of India, New Delhi	Delhi Computer Services, New Delhi	2018

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)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22RMI57.1	-	2	-	-	1	-	-	-	-	-	-	2	-	-
22RMI57.2	-	-	-	-	1	-	-	3	-	2	-	-	-	-
22RMI57.3	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.4	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.5	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.6	-	-	-	-	-	2	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Emerging Technologies: A Primer			
Course Code	22ETP58	CIE Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	-
Credits	1	Exam Hours	03

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:

22ETP58.1	Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills.
22ETP58.2	Apply AI and Web 3.0 concepts to develop practical solutions and explore real-world applications.
22ETP58.3	Apply RPA principles and tools to automate common tasks to boost productivity.
22ETP58.4	Explain common cybersecurity threats and recommend best practices to safeguard digital assets.
22ETP58.5	Explain the fundamentals of quantum computing and its real-world applications.
22ETP58.6	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**
22ETP58.1	-	-	-	-		3	-	2	-	--	-	-
22ETP58.2	-	2	-	-	3	-	-	-		-	-	1
22ETP58.3	-	-	-	3	2	-	-	-	--	-	-	-
22ETP58.4	-	-	-	-	3	-		-	-	-	-	1
22ETP58.5	2	-	-	-	3	-	-	-	-	-	-	-
22ETP58.6	-	-	2	-	3	-	--	-	2	-	-	1

1: Low 2: Medium 3: High

VI Semester

Digital Signal Processing			
Course Code	**22EEE61**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:2	SEE Hours	03
Total Hours	30 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Understand the basic concepts of signals and its basic operations.
- Evaluate the Z transform of LTI systems.
- Evaluate DFT of various signals using properties of DFT.
- Explain the evaluation of DFT and inverse DFT using fast and efficient algorithms
- Design infinite impulse response digital filters using impulse invariant and bilinear transformation techniques.
- Discuss direct, cascade and parallel methods of realizing a digital IIR filter.
- Discuss windowing technique of designing FIR filter and realizing a digital FIR filter.

Module-1 Digital Signals and Systems **8 hours**

Definitions of signals and a system, classification of signals, basic operations on signals and properties of systems, convolution sum, impulse response, properties.

Module-2 Z Transforms **8 hours**

Definition of Z-transform, properties of ROC, properties of Z-transforms, inversion of Z-transform methods Z- Transform analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform.

Module-3 Discrete Fourier Transforms **8 hours**

Definitions, properties-linearity, shift, symmetry properties- circular convolution – periodic convolution, use of tabular arrays, circular arrays, Stock ham's method, linear convolution – two finite duration sequence, one finite & one infinite duration, overlap add and save methods.

Module-4 Fast Fourier Transforms Algorithms **8 hours**

Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithms, inverse radix – 2 algorithms.

Module-5 Design of IIR and FIR Digital Filters **8 hours**

Introduction, impulse invariant transformation, bilinear transformations, all pole analog filters-Butterworth & Chebyshev filters, design of digital Butterworth filter by impulse invariant transformation and bilinear transformation. Realization of IIR digital systems: direct form, cascade form and parallel form.

Windowing, rectangular, modified rectangular, hamming, hanning, Blackman window, design of FIR digital filters by use of windows, realization of FIR systems: direct form, cascade form and linear phase form.

PRACTICAL MODULE

1. To perform linear convolution of given sequences using direct method
2. Computation of N - point DFT and to plot the magnitude and phase spectrum
3. To perform Linear convolution using DFT and IDFT (Stockham's) method
4. To perform circular convolution using DFT and IDFT (Stockham's) method
5. Calculation of DFT & IDFT by FFT
6. Evaluation of impulse response of a system
7. FIR Filter design using window functions
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 frequency sampling technique.
10. Realization of IIR and FIR filters.

Course Outcomes: At the end of the course the student will be able to:	
22EEE61.1	Apply DFT and IDFT to perform linear filtering techniques on given sequences to determine the output.
22EEE61.2	Apply fast and efficient algorithms for computing DFT and inverse DFT of a given sequence.
22EEE61.3	Design and realize infinite impulse response Butterworth and Chebyshev digital filters using impulse invariant and bilinear transformation techniques.
22EEE61.4	Develop a digital IIR filter by direct, cascade, parallel, ladder and FIR filter by direct, cascade and linear phase methods of realization.
22EEE61.5	Design and realize FIR filters by use of window function and frequency sampling method.
22EEE61.6	Use modern software tools to analyze and solve signal processing problems.

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 Education Pvt. Ltd.	1st Edition, 2016
Reference Books				
1	Digital Signal Processing	A.NagoorKani	Tata McGraw Hill	2nd Edition, 2012
2	Digital Signal Processing	Shaila D. Apte	Wiley, New Delhi	2nd Edition, 2009
3	Digital Signal Processing	Ashok Amberdar	Cengage	1st Edition, 2007
4	Digital Signal Processing	Tarun Kumar Rawat	Oxford	1st Edition, 2015

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/104/108104100/ (Principles of Signals & Systems)
- https://nptel.ac.in/courses/108101174 _ (Digital Signal Processing and its Applications)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE61.1	3	2	0	0	2	0	0	0	0	2	0	0	2	0
22EEE61.2	3	2	0	0	2	0	0	0	0	2	0	0	2	0
22EEE61.3	3	2	0	0	2	0	0	0	0	2	0	0	2	0
22EEE61.4	3	2	0	0	2	0	0	0	0	2	0	0	2	0
22EEE61.5	3	2	0	0	2	0	0	0	0	2	0	0	2	0
22EEE61.6	0	0	0	0	0	0	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Computer Aided Electrical Drawing			
Course Code	**22EEE62**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:2	SEE Hours	03
Total Hours	30 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to:

- Develop armature winding diagram for DC and AC machines.
- Develop a Single Line Diagram of Generating Stations and substation using the standard symbols.
- Construct sectional views of core and shell types transformers using the design data.
- Construct sectional views of assembled DC and AC machine and their parts using the design data or the sketches.

Module-1 DC and AC Machine Winding diagrams **8 hours**

Winding diagrams:

(a) Develop winding diagrams of D.C. machines: simplex double layer lap and wave windings.

(b) Develop winding diagrams of A.C. machines: integral and fractional slot double layer three phase lap and wave windings.

Module-2 Single Line Diagram of Power systems **8 hours**

Single line diagrams of generating stations and substations covering incoming circuits, outgoing circuits, busbar arrangements (single, sectionalized single, main and transfer, double bus double breaker, sectionalized double bus, one and a half circuit breaker arrangement, ring main), power transformers, circuit breakers, isolators, earthing switches, instrument transformers, surge or lightning arresters, communication devices (power- line carrier) and line trap.

Module-3 Transformer Assembly Drawings **8 hours**

Transformer assembly drawings using design data, sketches or both: transformers - sectional views of single and three phase core and shell type transformers.

Module-4 D.C. Generator/Motor Assembly **8 hours**

D.C. generator/motor **assembly drawings using design data, sketches or both:** sectional views of yoke with poles, armature and commutator dealt separately.

Module-5 Alternator Assembly **8 hours**

Alternator assembly drawings using design data, sketches or both: sectional views of stator and rotor dealt separately.

PRACTICALMODULE

PART – A

Draw winding diagram for the given DC machine using AutoCAD (a)Lap winding and (b)Wave winding

PART – B

Draw winding diagram for the given AC machine using AutoCAD

PART – C

Draw the single line diagram for the given Substation/ Generating station using AutoCAD

PART D

Draw the sectionalized view of Transformers, DC machines, Alternators using AutoCAD

Course Outcomes: At the end of the course the student will be able to:	
22EEE62.1	Develop armature winding diagram for DC and AC machines.
22EEE62.2	Develop a Single Line Diagram of Generating Stations and substation using the standard symbols.

22EEE62.3	Construct sectional views of core and shell types transformers using the design data.
22EEE62.4	Construct sectional views of assembled DC machine and their parts using the design data or the sketches.
22EEE62.5	Construct sectional views of assembled machine and their parts using the design data or the sketches.
22EEE62.6	Draw sectional views of assembled alternator or its parts using the design data or the sketches.

Question paper pattern:

- The question paper will have two parts, PART – A and PART – B.
- Each part is for 50 marks.
- Part A is for Modules 1 and 2.
- Questions 1 and 2 of PART - A will be only on DC windings or only on AC windings. Students have to answer any one of them. The marks prescribed is 25.
- Question 3 of PART – A covering module 2 is compulsory. The marks prescribed is 25.
- Part B is for Modules 3, 4 and 5.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Electrical Drafting	S F Devalapur	EBP	2009
Reference Books				
1	A course in Electrical Machine design	A. K. Sawhney,	Dhanpat Rai& Sons	6th Edition, 2013
2	The performance and Design of DC Machines	A.E. Clayton and N.N Hancocok.	CBS PUBLISHERS	2018

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=EgKc9L7cbKc
- https://www.youtube.com/playlist?list=PLp6ek2hDcoNCOQduaaLYTBE9GqTdMbNUC

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE62.1	3	2	0	1	0	0	0	0	0	0	0	0	0	0
22EEE62.2	0	3	2	0	2	0	0	0	0	0	0	0	0	1
22EEE62.3	0	2	3	0	0	0	0	0	0	0	0	0	0	0
22EEE62.4	3	2	0	0	0	0	0	0	0	0	0	0	0	2
22EEE62.5	3	2	0	0	0	0	0	0	0	0	0	0	0	2
22EEE62.6	0	3	0	0	0	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Power System Analysis			
Course Code	**22EEE63**	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:

- Articulate the importance of per unit system, reactance diagram and bus matrices in power system analysis.
- Analyze the symmetrical 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 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:	
22EEE63.1	Apply the knowledge of per unit system to construct reactance diagram of power system.
22EEE63.2	Analyze symmetrical three phase faults in power system to determine short circuit MVA.
22EEE63.3	Apply the concept of symmetrical components to calculate sequence components and draw sequence networks of the power system.
22EEE63.4	Analyze the unsymmetrical faults using symmetrical components to determinefault currents.
22EEE63.5	Analyze dynamics of synchronous machine to evaluate transient stability.
22EEE63.6	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 SystemAnalysis	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 DP Kothari	Tata McGraw-Hill EducationIndia	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 (Power system analysis)
- https://onlinecourses.nptel.ac.in/noc20_ee88/preview (Computer Aided Power System Analysis)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE63.1	2	3	0	0	0	0	0	0	0	0	0	0	1	0
22EEE63.2	2	3	0	2	0	0	0	0	0	0	0	0	1	0
22EEE63.3	2	3	0	0	1	0	0	0	0	0	0	0	1	0
22EEE63.4	2	3	0	2	1	0	0	0	0	0	0	0	2	0
22EEE63.5	2	3	0	1	1	0	0	0	0	0	0	0	2	0
22EEE63.6	2	3	0	1	1	0	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Utilization of Electrical Power			
Course Code	**22EEE641**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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 electric heating, air-conditioning and electric welding.
- Explain laws of electrolysis, extraction and refining of metals and electrodeposition.
- Explain the terminology of illumination, laws of illumination, construction and working of electric lamps. Design of interior and exterior lighting systems- illumination levels for various purposes light fittings, types of lighting systems.
- Discuss systems of electric traction, speed time curves and mechanics of train movement, motors used for electric traction and their control, braking of electric motors, traction systems and power supply and other traction systems.
- Give awareness of technology of electric and hybrid electric vehicles.

Module-1 Heating ,Welding and Electrolytic Process **8 hours**

Heating and welding: Electric heating, resistance ovens, radiant heating, induction heating, high frequency eddy current heating, dielectric heating, the arc furnace, heating of buildings, air conditioning, electric welding, and modern welding techniques.

Electrolytic metallurgical process: Ionization, Faraday's laws of electrolysis, definitions, extraction of metals, refining of metals, electrodeposition. Textbook : 1

Module-2 Illumination **8 hours**

Introduction, radiant energy, definitions, laws of illumination, polar curves, photometry, measurement of mean spherical candle power by integrating sphere, illumination photometer, energy radiation and luminous efficiency, electric lamps, cold cathode lamp, lighting fittings, illumination for different purposes, requirements of good lighting. Textbook : 1

Module-3 Electric Traction **8 hours**

Electric traction: Speed - time curves and mechanics of train movement: introduction, systems of traction, systems of electric traction, speed - time curves for train movement, mechanics of train movement, train resistance, adhesive weight, coefficient of adhesion.

Motors for electric traction: Introduction, series and shunt motors for traction services, two similar motors (series type) are used to drive a motor car, tractive effort and horse power, ac series motor, three phase induction motor.

Control of motors: Control of DC motors, tapped field control or control by field weakening, multiple unit control, control of single phase motors, control of three phase motors. Textbook: 1

Module-4 Electric Braking and Traction Systems **8 hours**

Braking: Introduction, regenerative braking with three phase induction motors, braking with single phase series motors, mechanical braking, magnetic track brake, electro – mechanical drum brakes.

Electric traction systems and power supply: System of electric traction, AC electrification transmission lines to sub - stations, sub – stations, feeding and distribution system of ac traction feeding and distribution system for dc tramways, electrolysis by currents through earth, negative booster, system of current collection, trolley wires.

Trams, trolley buses and diesel – electric traction: Tramways, the trolley bus, diesel electric traction.

Textbook: 1

Module-5 Electric Vehicles **8 hours**

Electric Vehicles: Configurations of electric vehicles, performance of electric vehicles, tractive effort in normal driving, energy consumption.

Hybrid Electric Vehicles: Concept of hybrid electric drive trains, architectures of hybrid electric drive trains. Textbook : 2

Course Outcomes: At the end of the course the student will be able to:	
22EEE641.1	Discuss the various techniques of electric heating and welding.
22EEE641.2	Discuss the fundamentals of electrolytic process, terminologies, and their application.
22EEE641.3	Illustrate the laws of illumination, terminologies, classification of light sources and design of various lighting systems.
22EEE641.4	Discuss different traction systems, speed-time curves, mechanism of train movement.
22EEE641.5	Explain the motors used for electric traction, braking of electric motors and traction systems.
22EEE641.6	Explain the working and structure of electric and hybrid electric vehicles.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Utilisation of Electric Power and Electric Traction	J B Gupta	S K Katariaya and sons	2001
2	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals Theory, and Design (Chapters 04 and 05 for module 5)	Mehrdad Ehsani et al	CRC Press	1st Edition, 2005
Reference Books				
1	Utilization, Generation and Conservation of Electrical Energy	Sunil S Rao	Khanna Publishers	1st Edition, 2011
2	Utilization of Electric Power and Electric Traction	G.C. Garg	Khanna Publishers	9th Edition, 2014

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108105060 (Introduction to illumination Engineering)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE641.1	0	1	0	1	0	0	1	0	0	0	0	0	0	0
22EEE641.2	0	0	0	0	0	0	1	0	0	0	0	0	0	0
22EEE641.3	0	1	0	1	0	2	0	0	0	0	0	0	0	0
22EEE641.4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
22EEE641.5	0	0	0	1	0	2	0	0	0	0	0	0	0	0
22EEE641.6	0	0	0	0	0	0	1	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

PLC & SCADA			
Course Code	**22EEE642**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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.
- Program a PLC Functional Block Diagram.
- Explain Sequential Functions Charts (SFC) and Structured Text (ST) methods using internal relays.
- Program a PLC using shift registers, data handling Instructions, Timers and controller.
- Learn interfacing PLC with other technologies like SCADA, HMI, etc.

Module-1 Basics of PLC **8 hours**

Introduction about programmable logic controller, history of PLC, architecture of PLC CPU, IO modules, power supply and communications input and output devices. Need of PLC for industrial automation. Advantages and disadvantages of PLC, applications of PLC. Introduction to SCADA and advantages and its disadvantages, application of SCADA.

Module-2 Programming in PLC **8 hours**

Instruction list, sequential functions charts & structured text, jump and call subroutines, example programmes.
Ladder programming- ladder diagrams, logic functions, latching, multiple outputs, entering programs, functional blocks, example programmes, simulation using Virtual lab.

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 and 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:	
22EEE642.1	Apply the engineering knowledge to analyse various control functions using PLC ladder programming.
22EEE642.2	Use modern tools & technique for PLC based operation on internal relays, timers &counters, shift registers, controller.
22EEE642.3	Use modern tools & technique for PLC based operation on controllers.
22EEE642.4	Realize the importance of programmable logic controller in automation, Hardware & Internal architecture and Input/output devices for lifelong learning..
22EEE642.5	Explain importance of SCADA.
22EEE642.6	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. Petrusella	McGraw Hill	6th Edition, 2023
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/
- 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 (Automation & Controls)
- http://nptel.ac.in/courses/112103174 (Mechatronics and Manufacturing Automation)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE642.1	1	0	0	0	0	2	0	0	0	0	0	0	0	0
22EEE642.2	1	1	0	0	1	0	0	0	0	0	0	0	0	0
22EEE642.3	1	1	1	0	1	0	0	0	0	0	0	0	0	0
22EEE642.4	1	1	1	0	1	0	0	0	0	0	0	0	0	0
22EEE642.5	1	1	1	0	1	0	0	0	0	0	0	0	0	0
22EEE642.6	0	0	0	0	0	2	0	0	0	0	0	1	3	0

1: Low 2: Medium 3: High

Energy Storage Devices			
Course Code	**22EEE643**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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

- Introduce the Importance and Application of Energy Storage Systems
- Familiarize with different energy storage technologies
- Understand the operation and basic technical characteristics of the various energy storage systems
- Study methods of energy storage and efficiency in installations that require continuous power supply
- Study methods of energy storage and efficiency in energy systems with RES, interconnected and non-interconnected

Module-1 Overview of Energy Storage Systems **8 hours**

Energy storage systems overview - scope of energy storage, needs and opportunities in energy storage, technology overview and key disciplines, comparison of time scale of storages and applications, energy storage in the power and transportation sectors, importance of energy storage systems in electric vehicles, current electric vehicle market.

Module-2 Thermal storage system **8 hours**

Thermal storage system-heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems.

Module-3 Electromagnetic storage systems **8 hours**

Electromagnetic storage systems, double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems.

Module-4 Electrochemical storage system **8 hours**

Batteries: Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery.

Super capacitors: Working principle of super capacitor, types of super capacitors, cycling and performance characteristics, difference between battery and super capacitors, introduction to hybrid electrochemical super capacitors.

Fuel cell: Principle of operation of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-super capacitor systems.

Module-5 Battery design **8 hours**

Mechanical design and packaging of battery packs for electric vehicles, advanced battery-assisted quick charger for electric vehicles, charging optimization methods for lithium-ion batteries, thermal run-away for battery systems, thermal management of battery systems, state of charge and state of health estimation over the battery lifespan, recycling of batteries from electric vehicles.

Course Outcomes: At the end of the course the student will be able to:	
22EEE643.1	Identify the role of energy storage in power systems.
22EEE643.2	Identify thermal storage technologies and their applications.
22EEE643.3	Compare Electrochemical and Electromagnetic storage technologies.
22EEE643.4	Analyze the appropriate storage technologies for different applications.
22EEE643.5	Analyze the management and design of battery systems.
22EEE643.6	Explore the alternate energy storage technologies.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Energy Storage – Fundamentals, Materials and Applications	Robert Huggins	Springer	2nd Edition, 2016
2	Energy Storage Devices for Renewable Energy-Based Systems	Nihal Kularatna, Kosala Gunawardane	Academic Press	2nd Edition, 2021
3	Energy Storage Systems: An Introduction	Dr. Satyender Singh	Nova Science Publishers	December 14, 2020
Reference Books				
1	Principles of Energy Storage Systems	P. Jayarama Reddy	B S Publications	Jan 2022
2	Energy Storage Devices	M Taha Demirkan & Adel Attia	Intechopen Limited	2019

Web links and Video Lectures (e-Resources):

- https://youtu.be/0FSEKHc-COA?feature=shared (Thermal energy storage systems: Part I)
- https://youtu.be/yar51GJVqgg?feature=shared (Lec 33: Energy storage systems)
- https://youtu.be/nh2xbyOaERw?feature=shared (Electrochemical Energy Storage (Batteries))
- https://youtu.be/2tp5qi_UXZk?feature=shared (Different types of energy storage technologies)
- https://youtu.be/NYg9dNDNSaA?feature=shared (Lec 33: Fundamentals and analysis of electro chemical energy storage system)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE643.1	1	1	1	0	0	0	1	0	0	0	0	0	0	0
22EEE643.2	1	1	1	0	0	0	1	0	0	0	0	0	0	0
22EEE643.3	1	1	1	0	0	0	1	0	0	0	0	0	0	0
22EEE643.4	1	1	1	0	0	0	1	0	0	0	0	0	0	0
22EEE643.5	3	1	1	0	0	0	1	0	0	0	0	0	0	0
22EEE643.6	1	1	1	0	0	0	1	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Electrical Machine Design			
Course Code	**22EEE644**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional 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

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

Module- 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 ofspecific 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 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:

22EEE644.1	Use research-based methods to analyze and interpret data to design a transformer and DC machine parts.
22EEE644.2	Use research-based methods to analyze and interpret data to design an induction machine and synchronous machine parts.
22EEE644.3	Demonstrate ethical principles while designing a transformer and DC machine by complying with industrial standards.
22EEE644.4	Demonstrate ethical principles while designing an induction machine and synchronous machine by complying with industrial standards.
22EEE644.5	Demonstrate an ability to engage in Designing Machine parts in context of technological change.
22EEE644.6	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	Dhanbahtrai &Sons, 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):

- https://www.youtube.com/watch?v=qmcriUdYBW0&list=PL59861DBF8EC85491
- https://www.youtube.com/watch?v=mTaznSfo0uQ&list=PL59861DBF8EC85491&index=11

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE644.1	3	3	3	0	2	0	0	0	0	0	0	0	0	0
22EEE644.2	3	3	2	0	2	0	0	0	0	0	0	0	0	0
22EEE644.3	3	3	2	0	2	0	0	0	0	0	0	0	0	0
22EEE644.4	3	3	2	0	2	0	0	0	0	0	0	0	0	0
22EEE644.5	3	3	2	0	2	0	0	0	0	0	0	0	0	0
22EEE644.6	3	3	0	0	2	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Fundamentals of Electric Vehicles			
Course Code	**22EEE651**	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

- 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 Vehicle Fundamentals	**8 hours**
Vehicle mechanics: roadway fundamentals, laws of motion, vehicle kinetics, dynamics of vehicle motion, propulsion power, force-velocity characteristics, maximum gradability, velocity and acceleration, constant FTR	
Module-2 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.	
Module-3 Hybrid Electric Vehicles	**8 hours**
Concept of hybrid electric drive trains, architecture of hybrid electric drive trains, series hybrid electric drive trains, parallel hybrid electric drive trains.	
Module-4 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, modelling of PEMFC, supercapacitors.	
Module-5 Energy Management Strategies	**8 hours**
Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.	

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

22EEE651.1	Explain the working of electric vehicles and recent trends.
22EEE651.2	Explain the architecture of hybrid electric vehicles and recent trends.
22EEE651.3	Analyze different energy storage used for electric vehicle.
22EEE651.4	Analyze the energy management system in a better way.
22EEE651.5	Design the battery parameters for electric vehicles.
22EEE651.6	Analyze the fundaments of a vehicle.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design	M. Ehsani, Y. Gao, S.Gay and Ali Emadi	CRC Press	1st Edition 2004
2	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press	2nd Edition 2010
Reference Books				
1	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles	Sheldon S. Williamson	Springer	1st Edition 2013

2	Modern Electric Vehicle Technology	C.C. Chan and K.T. Chau	OXFORD University	1st Edition 2001
3	Hybrid Electric Vehicles Principles And Applications With Practical Perspectives	Chris Mi, M. Abul Masrur, David Wenzhong Gao	Wiley Publication	1st Edition 2011

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr (NPTEL video on Introduction to EV)
- https://www.youtube.com/watch?v=V004WUdpHeA&list=PLlYm0-AHZdZRLYSylFinxkspWmcgNvbtl (EV Overview of types of EVs and its Challenges)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE651.1	2	2	0	0	0	0	0	0	0	1	1	0	0	0
22EEE651.2	2	2	0	0	0	1	1	0	2	0	0	0	2	0
22EEE651.3	0	0	2	0	2	0	0	0	0	0	0	2	0	0
22EEE651.4	0	0	2	0	0	0	0	0	0	0	0	0	3	0
22EEE651.5	0	0	2	0	0	0	2	0	0	1	0	0	0	0
22EEE651.6	2	0	0	0	0	0	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Sensors and Transducers			
Course Code	**22EEE652**	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 need of transducers, their classification, advantages and disadvantages and working of different types of transducers and sensors.
- Discuss recent trends in sensor technology and their selection.
- Discuss basics of signal conditioning and signal conditioning equipment.
- Discuss configuration of Data Acquisition System and data conversion.
- Discuss the basics of Data transmission and telemetry.
- Explain measurement of various non-electrical quantities.

Module-1 Introduction to Sensors and 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.

Textbook 1: chapter 7

Module-2 Overview of Sensor Types and Technologies **8 hours**

Stain 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.

Textbook 1: chapter 7

Module-3 Signal Conditioning and Data Acquisition Systems **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 systems, objectives and configuration of data acquisition system, data acquisition systems, data conversion.

Textbook 1: chapter 8 and chapter 9

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

Data transmission: Data/signal transmission, mechanical transmission, hydraulic transmission, pneumatic transmission, magnetic transmission, electric type of transmitters, converters.

Telemetry: General telemetering system, types of telemetry system, voltage and current telemetering system, position telemetering system, radio frequency telemetry system, introduction to types of signals and transmission paths, modulation and demodulation, frequency modulation telemetry system, pulse amplitude modulation telemetry system, pulse code modulation telemetry system.

Textbook 1: chap 10

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

Pressure measurement, temperature measurement, flow measurement – introduction, electromagnetic flow meters, ultrasonic flow meters, thermal meters, 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.

Textbook 1: chapter 12

Course Outcomes: At the end of the course the student will be able to:	
22EEE652.1	Describe the need for transducers and explain the working of different types of electrical transducers.
22EEE652.2	Discuss the selection of sensors and various types of sensors.
22EEE652.3	Distinguish types of signal conditioning equipments, data acquisition systems.
22EEE652.4	Display the knowledge of data transmission and telemetry.
22EEE652.5	Explain different configuration of data conversion and measurement of non-electrical quantities
22EEE652.6	Write effective reports after conducting experiments to design transducers.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	A 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	2nd Edition 2015

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/108/108108147/ (Sensors and actuators)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE652.1	0	0	0	1	0	0	0	0	0	0	1	0	0	0
22EEE652.2	0	0	0	1	0	0	0	0	0	0	1	0	0	0
22EEE652.3	0	0	0	0	0	2	1	0	0	0	0	0	0	0
22EEE652.4	0	0	0	0	0	0	1	0	0	0	0	0	0	0
22EEE652.5	0	0	0	0	0	2	1	0	0	0	0	0	0	0
22EEE652.6	0	0	0	1	0	0	0	0	0	0	1	0	0	0

1: Low 2: Medium 3: High

Energy Conservation & Audit			
Course Code	**22EEE653**	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

- Identify the demand supply gap of energy in Indian scenario.
- Carry out energy audit of an industry/Organization.
- Draw the energy flow diagram of an industry and identify the energy wasted or a waste stream.
- Identify appropriate energy conservation method to reduce the wastage of energy.
- Evaluate the techno economic feasibility of the energy conservation technique adopted.

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.

Module-4 Electricity and Other Commodities **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 Application of Energy Audit **8 hours**

Energy audit applied to buildings: 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:	
22EEE653.1	Analyze about energy scenario nationwide and worldwide , also outline energy conservation act and its features.
22EEE653.2	Discuss load management techniques and energy efficiency.
22EEE653.3	Explain the need of energy audit and energy audit methodology.
22EEE653.4	Draw the energy flow diagram of an industry.
22EEE653.5	Conduct energy audit of electrical systems and buildings.
22EEE653.6	Illustrate 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 John Wiley and Sons	Prentice Hall PTR	3rd Edition 1997
2	Energy Efficient Electric Motors and Applications	H.E. Jordan Plenum	Kluwer Academic/Plenum Publishers	2nd Edition 1994
3	Energy Management	W. R. Murphy, G. Mckay	Butterworth Heinemann Ltd	1 November 1981
Reference Books				
1	Energy Science Principles, Technologies and Impact	J. Andrews, N. Jelley	Oxford University Press.	3rd Edition 2017
2	Energy Conservation	Diwan	P. Pentagon Press	30 May 2009

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=8eKpfjnT0ro
- https://www.youtube.com/watch?v=YolBP0-vkBU
- https://onlinecourses.swayam2.ac.in/nou23_es05/preview

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE653.1	1	1	0	0	0	0	0	0	2	1	0	0	0	0
22EEE653.2	0	1	1	1	0	0	1	0	0	0	0	0	0	2
22EEE653.3	1	1	0	1	0	0	0	0	0	1	1	0	0	0
22EEE653.4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
22EEE653.5	1	1	0	1	0	2	0	0	1	0	1	0	0	0
22EEE653.6	1	0	1	1	1	0	1	0	0	1	0	1	3	0

1: Low 2: Medium 3: High

Electrical Safety Practices			
Course Code	**22EEE654**	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 objectives of safety and security measures, hazards associated with electric current and voltage.
- Discuss the electrical safety measures in residential, commercial and agricultural installations.
- Understand the preliminary preparations, safe sequence and risk of plant and equipment.
- Analyze the hazardous zones and electrical safety in the hazardous areas.
- Understand the application of fire extinguishers.

Module-1 Fundamentals and Safety Measures in Electrical Systems **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. 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 over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shop.

Module-2 Safety in Domestic and Agricultural settings **8 hours**

Wiring and fitting domestic appliances, water tap giving shock from wet wall fan firing shock multi-storied building temporary installations agricultural pump installation do's and don'ts for safety in the use of domestic electrical appliances.

Module-3 Safety Procedures and Precautions in Plant Operations **8 hours**

Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions – safeguards for operators –safety.

Module-4 Electrical Equipment for Hazardous Zones **8 hours**

Hazardous zones –class 0, 1 and 2 – spark, flashovers and corona discharge and functional requirements – specifications of electrical plants, equipment's for hazardous locations – classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

Module-5 Fire Safety Fundamentals and Systems **8 hours**

Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO_2 and Halogen gas schemes; foam schemes.

Course Outcomes: At the end of the course the student will be able to:	
22EEE654.1	Analyze the impact of electric shocks and preventive measures to overcome electric shock hazards
22EEE654.2	Outline the electrical safety during installation, testing and commissioning procedure.
22EEE654.3	Classify hazardous zones based on IEC standards.
22EEE654.4	Distinguish various fire extinguishers and their classification.
22EEE654.5	Analyze electrical safety measures in residential, commercial, agriculture areas.
22EEE654.6	Examine the various types of enclosures and protective equipments used in hazardous locations.

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	Rao, S. and Saluja, H.L	Khanna Publishers	2022 (4th Edition)
Reference Books				
1	Electrical safety Engineering	Cooper.W.F	Newnes Butterworth Company	3rd Edition 1998
2	Electrical safety hand book	John Codick	McGraw Hill Inc	1st Edition 2000

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GeKBDv2lSfM
- https://www.youtube.com/watch?v=jFDWlKayrTc&list=PLbRMhDVUMngdXebaRB59KdKwstzuAovua
- https://www.youtube.com/watch?v=-XRu7BSouvY

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22EEE654.1	0	0	1	0	0	0	3	0	0	0	0	0	0	0
22EEE654.2	0	0	0	0	0	3	0	0	0	0	0	0	0	1
22EEE654.3	0	0	0	0	0	3	0	3	0	0	0	0	0	0
22EEE654.4	0	0	0	0	0	0	0	0	0	0	0	1	0	0
22EEE654.5	0	0	0	0	0	3	2	0	2	0	0	0	0	0
22EEE654.6	2	0	0	0	0	0	0	3	0	0	0	0	0	0

1: Low 2: Medium 3: High

Major Project Phase I			
Course Code	**22EEE66**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:4	SEE	-
Total Hours	48 hours	Credits	02

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Selection

- **Relevance**: Projects should align with the students' specialization and current industry trends.
- **Innovation**: Projects that offer innovative solutions to existing problems or explore new ideas are encouraged.
- **Feasibility**: The project should be achievable within the given timeframe and resources.
- **Team Composition**: Students can work in teams, typically comprising maximum 4 members.

2. Project Proposal

- **Submission**: Students must submit a detailed project proposal (project synopsis) outlining the problem statement, objectives, methodology, expected outcomes, and a work plan.
- **Approval**: The proposal should be reviewed and approved by the Department Project Evaluation Committee (DPEC).

3. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

4. Mid-term Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

5. Report Submission

- **Report**: The project report should include an abstract, introduction, literature review, methodology, completed portion of the project work with the available results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.

- **Demonstration**: If possible, include a live demonstration of the project or show relevant simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

7. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the project report, presentation, and the ability to answer questions.

8. Plagiarism Check

- **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources.
- **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).

9. Mentorship and Feedback

- **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback.
- **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 100 marks)**
1. Project Synopsis Evaluation	Beginning of the 6th Semester	20 marks
2. Project Progress Evaluation	Middle of the 6th Semester	30 marks
3. Project Report Evaluation (Phase I)	End of the 6th Semester	50 marks
Marks given for the Project Report shall be the same for all project team members, However, marks may differ for presentations and viva-voce depending upon the individual student performance.		
Semester End Examinations (SEE)		
4. There is No SEE component for Major Project Phase I.		

Course Outcomes: At the end of the course the student will be able to :	
22EEE66.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
22EEE66.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
22EEE66.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
22EEE66.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
22EEE66.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.

22EEE66.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22EEE66.1	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22EEE66.2	**-**	**-**	**3**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22EEE66.3	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22EEE66.4	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**2**	**2**	**-**	**-**	**-**
22EEE66.5	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
22EEE66.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**

1: Low 2: Medium 3: High

Environmental Studies			
Course Code	**22CIV67**	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	2 Hours
Total Hours	15 hours	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): Groundwater depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problems 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. Fieldwork: A visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; thought to be Followed by an understanding of the process and its brief documentation (Optional).

Course Outcomes: At the end of the course the student will be able to:	
22CIV67.1	Identify the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
22CIV67.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
22CIV67.3	Demonstrate ecology knowledge of a complex relationship between a biotic and abiotic component.
22CIV67.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
22CIV67.5	Address problems related to waste management and public health aspects
22CIV67.6	List 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	Dhanpat Rai 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):

1. **Coursera Course: Introduction to Environmental Science Specialization -** https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc
2. **NPTEL: Environmental Studies -** https://onlinecourses.swayam2.ac.in/cec22_ge22/preview
3. **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**
4. **Lec 31: Environmental Management Systems (EMS) - https://youtu.be/BYqLRGawoH0**
5. **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
22CIV67.1	-	-	-	-	-	1	3	-	-	-	-	-	-	-
22CIV67.2	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.3	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.4	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.5	-	-	-	-	-	2	3	1	-	-	-	-	-	-
22CIV67.6	-	-	-	-	1	-	-	2	-	-	-	-	-	-

1: Low 2: Medium 3: High

Innovation and Intellectual Property			
Course Code	**22IIP68**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	Exam Hours	3 Hours
Total Hours	20 Hrs	Credits	01

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:	
22IIP68.1	Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches.
22IIP68.2	Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature.
22IIP68.3	Demonstrate a comprehensive understanding of the patentability criteria, including novelty, non-obviousness, and utility.
22IIP68.4	Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches.
22IIP68.5	Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution.
22IIP68.6	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**
22IIP68.1	2	-	-	-	3	-	-	-	-	-	-	1	-	-
22IIP68.2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
22IIP68.3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
22IIP68.4	2	-	3	-	-	-	-	-	-	-	-	-	-	-
22IIP68.5	1	3	-	-	-	-	-	-	-	-	-	2	-	-
22IIP68.6	-	-	-	-	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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