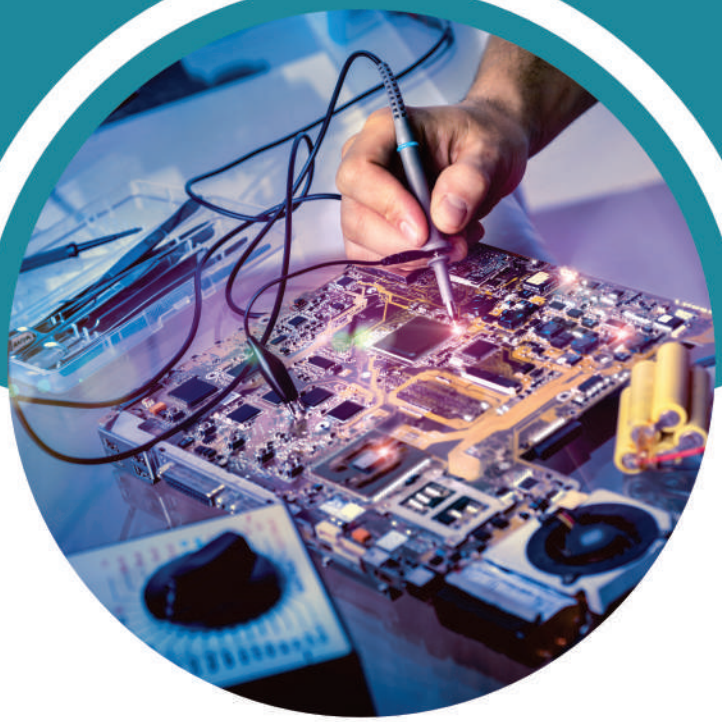
Fourth Year BE

SCHEME & SYLLABUS

Autonomous Scheme 2021-22

Electrical & Electronics Engineering



ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service and Excellence

VISION

To be a global premier Institution of professional education and research

MISSION

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

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution
Vamanjoor, Mangaluru - 575028

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

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

Electrical & Electronics Engineering

FOURTH YEAR

(VII and VIII 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.

VII Semester (B.E. – Electrical and 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**	
						L	**T**	**P**					
1	PCC	21EEE701	Power System Protection (Integrated)	EEE	EEE	1	2	2	03	50	50	100	3
2	PCC	21EEE702	Power System Operation and Control	EEE	EEE	2	2	-	03	50	50	100	3
3	PEC	21EEE703X	Professional Elective - 2	EEE	EEE	3	-	-	03	50	50	100	3
4	PEC	21EEE704X	Professional Elective - 3	EEE	EEE	3	-	-	03	50	50	100	3
5	OEC	21EEE705X	Open Elective - 2	EEE	EEE	3	-	-	03	50	50	100	3
6	SDC	21EES706	Technical Seminar	EEE	EEE	-	-	2	-	100	-	100	1
7	SDC	21EEP707	Major Project Work (Phase I & II)	EEE	EEE	-	-	6	03	50	50	100	5
					Total	**12**	**04**	**10**	**18**	**400**	**300**	**700**	**21**

21EEE703X : Professional Elective II					
21EEE7031	Utilization of Electrical Power	21EEE7033	PLC and SCADA	21EEE7035	Advanced Power Electronics
21EEE7032	Solar and Wind Energy	21EEE7034	ANN with Applications to Power Systems		
21EEE704X : Professional Elective III					
21EEE7041	Industrial Drives and Applications	21EEE7043	HVDC and FACTS	21EEE7045	CMOS VLSI Design
21EEE7042	Electrical Safety Practices	21EEE7044	Computer Aided Electrical Drawing		

21EEE705X : Open Elective II					
21EEE7051	Fundamentals of Electric Vehicles	21EEE7053	Nuclear Reactors and Safety	21EEE7055	Industrial Servo Control Systems
21EEE7052	Energy Storage Devices	21EEE7054	Sensors and Transducers		

VIII Semester (B.E. – Electrical and 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**	
						L	T	P					
1	SDC	21AEC801	MOOC	Any MOOC topic (Choices are given by respective Department) with minimum 8 weeks to be completed between III Sem to VIII Sem								100	2
2	SDC	21EEP802	Major Project Work (Final Presentation and Report Submission)	EEE		-	-	-	03	50	50	100	5
3	INT	21INT803	Research / Industry Internship			-	-	-	03	50	50	100	10
					Total	-	-	-	**06**	**100**	**100**	**300**	**17**

Research Internship / Industry Internship is to be carried out during the 8th semester for 15 weeks.

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

VII Semester

Power System Protection			
Course Code	**21EEE701**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	1:2:2	SEE Hours	03
Total Hours	30 hours Theory + 10 Lab slots	Credits	03

Course Learning Objectives: The objective of the course is to

- Discuss conduction and breakdown in gaseous, liquid and solid dielectrics.
- Discuss generation and measurement of high voltages and currents.
- Discuss non-destructive testing of insulating materials and electrical apparatus.
- Discuss the construction, operating principles and performance characteristics of protective devices.
- Discuss the different protection schemes used in power system apparatus.
- Discuss protection against over voltages, insulation coordination in electric power systems and Gas Insulated Substation (GIS).
- Conduct the experiment by applying High voltages for checking the breakdown phenomenon and dielectric strength in different types of insulations.
- Conduct experiments and verify the characteristics of electromechanical and microprocessor based relays.
- Verify the operation of motor protection for different faults.

Module-1 Conduction and Breakdown **8 hours**

Introduction to high voltage engineering, advantages, limitations and applications.
Introduction to conduction and breakdown in gases, ionization processes, Townsend's current growth equation and it's criterion for breakdown, streamer theory of breakdown in gases, Paschen's law.

Module-2 High Voltages and Currents **8 hours**

Generation of high direct current voltages, high alternating voltages, impulse voltages and impulse currents. Measurement of high direct current voltages, high AC and impulse voltages, high currents of direct, alternating and impulse.

Module-3 Relays **8 hours**

Need for protective schemes, types of fault and it's effects, essential qualities of protection, primary and backup protection, construction and operating principles of relay, electromechanical relays, static relays, merits and demerits of static relays.
Introduction to overcurrent protection, time–current characteristics, current setting, time setting, directional relay, protection of parallel feeders and ring mains, earth fault, phase fault protection and combined earth and phase fault protective scheme, static overcurrent relays, numerical overcurrent relays.

Module-4 Differential Relays **8 hours**

Introduction to distance protection, impedance relay, reactance relay, mho relay. Introduction to pilot relaying schemes, wire pilot protection. Introduction to differential protection, differential relays, percentage differential relay, balanced voltage differential protection. Protection of generators. Transformer protection, bus zone protection.

Module-5 Circuit Breakers **8 hours**

Introduction to circuit breakers, arc voltage, arc interruption, restriking voltage and recovery voltage, current chopping. Air circuit breakers, SF6 circuit breakers, vacuum circuit breakers, rating of circuit breakers, testing of circuit breakers.

PRACTICAL MODULE

1. Over Current Relay: (a) Inverse Definite Minimum Time (IDMT) Non - Directional Characteristics (b) Directional Features (c) IDMT Directional.
2. IDMT Characteristics of Over Voltage or Under Voltage Relay (Solid State or Electromechanical type).

3. Operation of Negative Sequence Relay.
4. Operating Characteristics of Microprocessor Based (Numeric) Over –Current Relay.
5. Operating Characteristics of Microprocessor Based (Numeric) Distance Relay.
6. Operating Characteristics of Microprocessor Based (Numeric) Over/Under Voltage Relay.
8. **7.** Measurement of HVAC and HVDC using Standard Spheres as per IS 1876 :2005.

Course Outcomes: At the end of the course the student will be able to:	
21EEE701.1	Apply the knowledge of dielectric property for insulation, it's performances as per standards and high voltage application in power system equipment's
21EEE701.2	Analyze the circuits of high voltages, high currents in generation and measurements
21EEE701.3	Analyze the spark over characteristics using high voltages for checking the breakdown phenomenon and dielectric strength of dielectric materials
21EEE701.4	Experimentally verify the characteristics of over current, over voltage, under voltage using electromagnetic, static, distance and impedance relays.
21EEE701.5	Discuss the construction, operating principles and performances of circuit breakers, protection of generators, motors, transformers and bus zone protection.
21EEE701.6	Apply relays to the power system protection.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	High Voltage Engineering	M. S. Naidu and Kamaraju	McGraw Hill Education	5th Edition, 2017
2	Power System Protection and Switchgear	Badri Ram, D.N. Vishwakarma	McGraw Hill	2nd Edition 2017
Reference Books				
1	High Voltage Engineering Fundamentals	E.Kuffel and W.S. Zaengl	Elsevier Press	2nd Edition, 2000
2	High Voltage Engineering	C.L.Wadhwa	New Age International Private limited	3rd Edition, 2012
3	Protection and Switchgear	Bhavesh et al	Oxford	1st Edition, 2011
4	Power System Switchgear and Protection	N. Veerappan, S.R. Krishnamurthy	S. Chand	1st Edition, 2009

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/105/108105167/ (Power System Protection)
- https://archive.nptel.ac.in/courses/108/104/108104048/# (High Voltage Engineering)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE701.1	0	2	2	1	0	0	2	0	0	0	0	0	0	0
21EEE701.2	2	0	2	2	2	0	0	0	0	0	0	0	2	0
21EEE701.3	0	0	2	2	1	0	0	0	0	0	0	0	1	0
21EEE701.4	0	2	2	0	2	0	0	0	0	0	0	0	2	0
21EEE701.5	2	3	1	0	0	0	0	0	0	0	0	0	0	0
21EEE701.6	0	2	3	0	1	0	0	0	0	0	0	0	1	0

1: Low 2: Medium 3: High

Power System Operation and Control			
Course Code	**21EEE702**	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

- Describe various levels of controls in power systems and the vulnerability of the system.
- Explain components, architecture and configuration of SCADA.
- Explain basic generator control loops, functions of automatic generation control, speed governors and mathematical models of automatic load frequency control
- Explain automatic generation control, voltage and reactive power control in an interconnected power system.
- Explain reliability and contingency analysis, state-estimation and related issues.

Module-1 Overview of Power System Operation and SCADA Technology **8 hours**

Power System Operation: operating states of power system, objectives of control, key concepts of reliable operation, preventive and emergency controls, energy management centers.
SCADA Technology: Introduction to SCADA, components, application in power system, basic functions and advantages. Building blocks of SCADA system, components of RTU, communication subsystem, IED functional block diagram, classification of SCADA system.

Module-2 Automatic Generation Control (AGC) **8 hours**

Introduction to AGC, schematic diagram of load frequency and excitation voltage regulators of turbo generators, load frequency control (single area case), turbine speed governing system, model of speed governing system, turbine model, generator load model, complete block diagram of representation of load frequency control of an isolated power system, steady state analysis, control area concept, proportional plus integral controller.

Module-3 Automatic Generation Control in Interconnected Power system **8 hours**

Two area load frequency control, optimal (Two area) load frequency control by state variable, automatic voltage control, load frequency control with generation rate constraints (GRCs), speed governor dead band and its effect on AGC, digital LF controllers, decentralized control.

Module-4 Control of Voltage and Reactive Power **8 hours**

Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, methods of voltage control: i). Injection of reactive power, shunt capacitors and reactors, series capacitors, synchronous compensators, series injection. ii). Tap changing transformers. combined use of tap changing transformers and reactive power injection, booster transformers, phase shift transformers, voltage collapse.

Module-5 Power System Security **8 hours**

Introduction, factors affecting power system security, security levels of system, functions of power system security, contingency analysis, linear sensitivity factors, AC power flow methods, contingency selection and ranking.

Course Outcomes: At the end of the course the student will be able to:	
21EEE702.1	Describe various levels of controls in power systems and functions of energy management center.
21EEE702.2	Describe architecture, configuration and classification of SCADA.
21EEE702.3	Analyze the effect of automatic voltage regulator and automatic generation control on load frequency control of single area system.
21EEE702.4	Analyze the effect of automatic voltage regulator and automatic generation control on load frequency control of interconnected systems.
21EEE702.5	Discuss the control of voltage, reactive power and voltage collapse.

21EEE702.6	Analyze the various factors affecting the security power system for contingency ranking.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Power System Operation and Control	K. Uma Rao	Wiley	1st Edition, 2012
2	Modern Power System Analysis	I J Nagrath and D P Kothari	Tata McGraw-Hill Education India	4th Edition, 2011
3	Power Generation, Operation And Control	Wood & B A J F Woollenberg	John Wiley and Sons	2nd Edition,1996
Reference Books				
1	Power System SCADA and Smart Grid	Mini S Thom and John D. McDonald	CRC Press	1st Edition, 2015
2	Electric Power Systems	B M Weedy, B J Cory	Wiley	4th Edition, 2012

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/104/108104052/ (Power System operation and control)
- https://nptel.ac.in/courses/108105133 (Power System Dynamics, Control and Monitoring)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE702.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE702.2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE702.3	2	2	3	0	0	0	0	0	0	0	0	1	1	0
21EEE702.4	2	2	3	0	0	0	0	0	0	0	0	1	0	0
21EEE702.5	2	2	3	0	0	0	0	0	0	0	0	1	1	0
21EEE702.6	2	3	0	0	0	0	0	0	0	0	0	0	1	0

1: Low 2: Medium 3: High

Utilization of Electrical Power			
Course Code	**21EEE7031**	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 the types and working of various heating and welding equipment's.
- Familiarize with the electrolysis process and its control using electrical power.
- Introduce illumination, its requirements and study the construction & working of different types of lamps.
- Explain design of interior and exterior lighting systems- illumination levels for various purposes light fittings, factory lighting, flood lighting, street lighting.
- Discuss systems of electric traction, speed time curves and mechanics of train movement.
- Introduce electric, hybrid vehicles and associated technologies.

Module-1 Electric Heating, Welding & Electrolytic Process **8 hours**

Electric heating, resistance ovens, radiant heating, induction heating, high frequency eddy current heating, dielectric heating, the arc furnace, heating of buildings, electric welding, modern welding techniques, control device and welding equipment, comparison between A.C. and D.C. welding. Fundamental principles of electrolytic process, extraction, refining of metals, electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

Module-2 Illumination **8 hours**

Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps, incandescent, fluorescent, vapor and CFL and their working, basic principles of light control, types and design of lighting and flood lighting, glare and its remedy.

Module-3 Electric Traction **8 hours**

System of traction, speed time curve, tractive effort at co-efficient of adhesions, selection of traction motors, method of speed control, energy saving by series parallel control. AC series motor, characteristics, regenerative braking, linear induction motor and their use. AC traction, diesel electric equipment, train lighting system, specific energy, factors affecting specific energy consumption. 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.

Module-4 Traction Systems & Power Supply **8 hours**

AC electrification, transmission lines to 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. Tramways, the trolley – bus, diesel electric traction.

Module-5 Electric Vehicles **8 hours**

Configurations of electric vehicles, performance of electric vehicles, tractive effort in normal driving, energy consumption. Concept of hybrid electric drive trains, architectures of hybrid electric drive trains.

Course Outcomes: At the end of the course the student will be able to:	
21EEE7031.1	Discuss different methods of electric heating & welding.
21EEE7031.2	Discuss the laws of electrolysis, extraction, refining of metals and electro deposition process.
21EEE7031.3	Discuss the laws of illumination, different types of lamps, lighting schemes and design of lighting systems.
21EEE7031.4	Analyze systems of electric traction, their control & braking and power supply system used for electric traction, speed time curves and mechanics of train movement.

21EEE7031.5	Analyze the characteristics of AC traction motors, train lighting system and compute specific energy consumption.
21EEE7031.6	Discuss on configurations of electric vehicles.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	A Text Book on Power System Engineering	A. Chakrabarti et al	Dhanpat Rai & Co	3rd Edition, 2008
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
3	Utilization of Electric Energy	E.O. Taylor, Rao V V L	Orient Blackswan Pvt Ltd, New Delhi	-
Reference Books				
1	A Course in Electrical Power	Soni Gupta and Bhatnager	Dhanapat Rai & sons	2013
2	Utilization, Generation and Conservation of Electrical Energy	Sunil S Rao	Khanna Publishers	1st Edition, 2011
3	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/108104140 (Fundamentals of Electric Drives)
- https://nptel.ac.in/courses/108106170 (Fundamentals of Electric Vehicles: Technology & Economics)
- https://nptel.ac.in/courses/113106087 (Welding Process)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7031.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7031.2	3	2	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7031.3	3	0	0	0	0	1	0	0	0	0	0	0	0	0
21EEE7031.4	2	2	0	0	0	2	2	0	0	0	0	0	0	0
21EEE7031.5	3	3	0	0	0	0	2	0	0	0	0	0	0	0
21EEE7031.6	3	2	0	0	0	0	2	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Solar and Wind Energy			
Course Code	**21EEE7032**	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 increasing role of renewable energy, energy management, energy audit, energy efficiency, energy intensity.
- Discuss the characteristics and distribution of solar radiation, measurement of components of solar radiation and analysis of collected solar radiation data.
- Discuss the operation of solar cell and the environmental effects on electrical characteristics of solar cell
- Discuss basic Principles of wind energy conversion and to compute the power available in the wind.
- Discuss classification of WEC Systems, its advantages and disadvantages of WECS, and Types of Wind Machines (Wind Energy Collectors).

Module-1 Energy Concepts **8 hours**

Introduction to fundamentals of energy science and technology, energy, economy and social development, classification of energy sources, importance of non -conventional energy sources, salient features of non-conventional energy sources, world energy status, energy status in India. Introduction to energy conservation and efficiency, important terms and definitions, important aspects of energy conservation, global efforts, achievements and future planning, energy conservation/efficiency scenario in India, energy audit, energy conservation opportunities.

Module-2 Solar Energy **8 hours**

The sun as source of energy, the earth, sun, earth radiation spectrum, extraterrestrial and terrestrial radiations, spectral power distribution of solar radiation, depletion of solar radiation, measurement of solar radiation, solar radiation data, solar time, solar radiation geometry, solar day length, extraterrestrial radiation on horizontal surface, solar radiation on inclined plane surface.
Introduction to solar thermal systems, solar collectors, solar water heater, solar passive space heating and cooling systems, solar industrial heating systems.

Module-3 Solar Photovoltaic Systems **8 hours**

Introduction, solar cell fundamentals, solar cell characteristics, solar cell classification, solar cell technologies, solar cell, module, and array construction, maximizing the solar PV output and load matching, maximum power point tracker, balance of system components, solar PV systems, solar PV applications.

Module-4 Wind Energy **8 hours**

Basic principles of wind energy conversion, history of wind energy, wind energy scenario – world and India. The nature of the wind, the power in the wind, forces on the blades, wind energy conversion, wind data and energy estimation, site selection considerations, environment and economics environmental benefits and problems of wind energy.

Module-5 Wind Energy Conversion System **8 hours**

Basic components of a wind energy conversion(WEC) system, classification of WEC systems, advantages and disadvantages of WECS, types of wind machines (wind energy collectors), analysis of aerodynamic forces acting on the blade, performance of wind- machines, generating systems, energy storage, applications of wind energy.

Course Outcomes: At the end of the course the student will be able to:	
21EEE7032.1	Discuss the importance of the role of renewable energy, the concept of energy storage and the principles of energy storage devices.

21EEE7032.2	Discuss the concept of solar radiation data and solar PV system fabrication, operation of solar cell, sizing and design of PV system.
21EEE7032.3	Describe the process of harnessing solar energy and its applications in heating and cooling.
21EEE7032.4	Explain basic Principles of wind energy conversion, collection of wind data, energy estimation and site selection.
21EEE7032.5	Discuss the performance of wind-machines, energy storage, applications of wind energy and environmental aspects.
21EEE7032.6	Communicate effectively on the world scenario of renewable energy sources and write effective reports on operation of solar and wind power plants.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Non-Conventional Energy Resources	B. H. Khan	McGraw Hill	2nd Edition, 2017
2	Non-Conventional Sources of Energy	Rai G. D	Khanna Publishers	4th Edition, 2009
Reference Books				
1	Non-Conventional Energy Resources	Shobh Nath Singh	Pearson	1st Edition, 2015
2	Solar Energy – Principles of Thermal Collections and Storage	S.P. Sukhatme J.K.Nayak	McGraw Hill	3rd Edition, 2008
3	Wind Turbine Technology	Ahmad Hemami	Cengage	1st Edition, 2012

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/115/103/115103123/ (Solar Energy Engineering and Technology)
- https://archive.nptel.ac.in/courses/103/103/103103206/ (Renewable Energy Engineering)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE7032.1	1	2	0	0	1	0	0	0	0	1	0	0	1	0
21EEE7032.2	0	0	2	1	1	0	0	0	0	0	0	1	1	0
21EEE7032.3	2	3	0	0	1	0	0	0	0	1	0	0	1	0
21EEE7032.4	1	2	0	0	0	0	0	0	0	0	0	1	0	0
21EEE7032.5	1	2	0	0	0	0	0	0	0	0	0	2	0	0
21EEE7032.6	1	2	0	0	0	0	0	0	0	3	0	0	0	0

1: Low 2: Medium 3: High

PLC and SCADA			
Course Code	**21EEE7033**	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.

Module-1 Essentials of Programmable Logic Controllers (PLCs) in Automation **8 hours**

Introduction to Programmable logic controller (PLC), role in automation (SCADA), advantages and disadvantages, hardware, internal architecture, sourcing and sinking, characteristics of I/O devices, list of input and output devices, examples of applications. I/O processing, input/output units, signal conditioning, remote connections, networks, processing inputs I/O addresses.

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

Programming languages, instruction list, sequential functions charts & structured text, jump and call subroutines.

Ladder programming, ladder diagrams, logic functions, latching, multiple outputs, entering programs, functional blocks, programme examples like location of stop and emergency switches.process, estimating the critical points and extreme values, vector calculus.

Module-3 Internal Relays **8 hours**

Ladder programmes, battery- backed relays, one - shot operation, set and reset, master control relay

Module-4 Timers and Counters **8 hours**

Types of timers, programming timers, ON and OFF delay timers, pulse timers, forms of counter, programming, up and down counters, timers with counters, sequencer.

Module-5 Shift Register & Data Handling **8 hours**

Shift registers, ladder programs, registers and bits, data handling, arithmetic functions, temperature control and bottle packing applications.

Note: Programming is to be with reference to only Mitsubishi PLC (GIS).

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

21EEE7033.1	Apply the engineering knowledge to analyse various control functions using PLC ladder programming
21EEE7033.2	Use modern tools & technique for PLC based operation on internal relays, timers &counters, shift registers, controller.
21EEE7033.3	Use modern tools & technique for PLC based operation on controllers.
21EEE7033.4	Realize the importance of programmable logic controller in automation, hardware & internal architecture and input/output devices for lifelong learning.
21EEE7033.5	Explain the importance of SCADA.
21EEE7033.6	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	5th Edition, 2019
2	Programmable Logic Controller	John W. Webb and Ronald A. Reis	Prentice – Hall India Publication	5th Edition, 2008

Web links and Video Lectures (e-Resources):

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

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7033.1	3	0	0	0	0	1	0	0	0	0	0	0	0	0
21EEE7033.2	1	3	0	0	1	0	0	0	0	0	0	0	0	0
21EEE7033.3	1	2	3	0	1	0	0	0	0	0	0	0	0	0
21EEE7033.4	1	2	3	0	1	0	0	0	0	0	0	0	0	0
21EEE7033.5	1	2	3	0	1	2	0	0	0	0	0	0	0	0
21EEE7033.6	0	0	0	0	0	0	0	0	0	0	0	3	0	0

1: Low 2: Medium 3: High

ANN with Applications to Power Systems			
Course Code	**21EEE7034**	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 the fundamental concepts and models of artificial neural systems.
- Understand neural processing, learning and adaptation, neural network learning rules.
- Analyze multilayer feed forward networks.
- Develop various ancillary techniques applied to power system and control of power systems.

Module-1 Fundamentals of Artificial Neural Systems and Networks **8 hours**

Fundamental concepts and models of artificial neural systems, biological neurons and their artificial models – biological neuron, McCulloch-Pitts neuron model, neuron modeling for artificial neural systems. Models for artificial neural networks – feed forward network, feedback network.

Module-2 Neural Processing and Learning Rules in Neural Networks **8 hours**

Neural processing, learning and adaptation – learning as approximation or equilibria encoding, supervised and unsupervised learning. Neural network learning rules – Hebbian learning rule, perceptron learning rule, delta learning rule, Widrow-Hoff learning rule, correlation learning rule, winner-take-all learning rule, Outstar learning rule, summary of learning rules.

Module-3 Multilayer Feedforward Networks **8 hours**

Feedforward recall, error back-propagation training, training errors and multilayer feedforward networks as universal approximators (excluding examples). Learning factors – initial weights, cumulative weight adjustment versus incremental updating, steepness of the activation function, learning constant, momentum method, network architectures versus data representation, and necessary number of hidden neurons.

Module-4 Neural Network and its Ancillary Techniques **8 hours**

Introduction, learning versus memorization, determining the best net size, network saturation, feature extraction, inversion of neural networks, alternative training method: genetic based neural network, fuzzified neural network.

Module-5 Control of Power Systems **8 hours**

Introduction, background, neural network architectures for modeling and control, supervised neural network structures, diagonal recurrent neural network based control system, convergence and stability. ANNs application in power system subjects: load forecasting; fault diagnosis & location; economic dispatch; security assessment.

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

21EEE7034.1	Develop neural network and apply elementary information processing tasks that neural network can solve.
21EEE7034.2	Develop neural network and apply powerful, useful learning techniques.
21EEE7034.3	Develop and analyze multilayer feed forward network for mapping provided through the first network layer and error back propagation algorithm.
21EEE7034.4	Analyze the learning factors in multilayer feed forward networks.
21EEE7034.5	Analyze and apply algorithmic type problems to tackle problems for which algorithms are not available.
21EEE7034.6	Develop and analyze supervised/unsupervised, learning modes of neural network for different applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to Artificial Neural Systems	Jacek M. Zurada	JAICO Publishing House	Digitized, Nov 2007
2	Artificial Neural Networks with Applications to Power Systems	Mohamed El – Sharkawi and Dagmar Niebur	IEEE Inc	1st Edition , Nov 2022
Reference Books				
1	Introduction to Neural Networks Using Matlab 6.0	S Sivanandam , S Sumathi	McGraw Hill Education	1st Edition (1 July 2017)
2	Application of Artificial Neural Network in Power System Analysis	Dr.Gitanjali Saha, Dr. Kabir Chakraborty	Book Rivers	1st Edition, Dec 1996

Web links and Video Lectures (e-Resources):

- https://youtu.be/xbYgKoG4x2g
- https://youtu.be/vbNDNkvzzuk
- https://youtu.be/Zxs-f4HsTDk
- https://youtu.be/nz3NYD73H6E
- https://youtu.be/3vSiMdG9mJY
- https://youtu.be/jTzJ9zjC8nU
- https://www.researchgate.net/publication/277298374 (Application_of_Neural_Networks_in_Power_Systems_A_Review)
- D. P. Kothari, "Application of neural networks to power systems," *Proceedings of IEEE International Conference on Industrial Technology 2000 (IEEE Cat. No.00TH8482)*, Goa, India, 2000, pp. 621-626 vol.2, doi: 10.1109/ICIT.2000.854240

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7034.1	3	2	0	0	1	1	0	0	0	0	0	0	2	0
21EEE7034.2	3	2	0	0	1	1	0	0	0	0	0	0	2	0
21EEE7034.3	3	2	0	0	1	1	0	0	0	0	0	0	2	0
21EEE7034.4	2	1	0	0	1	1	0	0	0	0	0	0	2	0
21EEE7034.5	2	2	0	0	1	1	0	0	0	0	0	0	2	0
21EEE7034.6	2	2	0	0	1	1	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Advanced Power Electronics			
Course Code	**21EEE7035**	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

- Study switching mode regulators and Boost converters, Resonant Pulse Inverters and multilevel inverters.
- Analyze the techniques for design and analysis of dc –dc converters, Resonant Pulse Inverters and multilevel inverters.
- Explain the operation and frequency characteristics of resonant inverters and the techniques for zero- voltage and zero-current switching.
- Discuss the types and circuit topologies of power supplies and explain the operation and analysis of power supplies.
- Study the applications of power electronic devices.

Module-1 DC–DC Converters	**8 hours**
Switching-mode regulators, comparison of regulators, multi-output boost converter, diode rectifier-fed boost converter, averaging models of converters, state–space analysis of regulators, design considerations for input filter and converters, drive IC for converters.	
Module-2 Resonant Pulse Inverters	**8 hours**
Introduction. Series resonant inverters, frequency response of series inverters, parallel resonant inverters, voltage controlled resonant inverters, class e resonant inverter, class e resonant rectifier, zero – current switching (ZCS) resonant converters, zero voltage switching resonant converters (ZVS), comparison between ZCS and ZVS resonant converters, two quadrant ZVS resonant converters, resonant DC – link inverters.	
Module-3 Multilevel Inverters	**8 hours**
Introduction, multilevel concept, types of multilevel inverters, diode – clamped multilevel inverter, flying - capacitors multilevel inverter. Cascaded multilevel inverter, applications, features of multilevel inverters, comparison of multilevel converters.	
Module-4 Power Supplies	**8 hours**
Introduction, DC power supplies, AC power supplies, multistage conversions, control circuits, magnetic design considerations.	
Module-5 Electrical Utility Applications	**8 hours**
Introduction, high voltage DC transmission, static VAR compensators, interconnection of renewable energy sources and energy storage systems to the utility grid, active filters.	

Course Outcomes: At the end of the course the student will be able to:	
21EEE7035.1	Discuss and describe the design technique of different type of switching regulators and converters
21EEE7035.2	Evaluate the performance parameters of resonant converters.
21EEE7035.3	Discuss ZVS and ZCS of resonant converters.
21EEE7035.4	Describe the control strategies of multilevel inverters.
21EEE7035.5	Discuss the types, topologies and operation of power supplies.
21EEE7035.6	Discuss the electrical utility applications of power electronic devices.

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 Converters, Applications and Design (For Module 5: Chapters 16 and 17)	Ned Mohan et al	Wiley	3rd Edition, 2014

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/107/108107128/ (Advanced Power Electronics and Control)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7035.1	3	0	0	0	0	0	0	0	0	0	0	2	1	0
21EEE7035.2	0	0	0	0	3	0	0	0	0	0	0	2	1	0
21EEE7035.3	3	0	0	0	2	0	0	0	0	0	0	0	1	0
21EEE7035.4	0	0	0	0	1	0	0	0	0	0	0	3	2	0
21EEE7035.5	0	0	0	0	3	0	0	0	0	0	0	0	2	0
21EEE7035.6	0	0	0	0	0	0	0	0	0	0	0	3	2	0

1: Low 2: Medium 3: High

Industrial Drives and Applications			
Course Code	**21EEE7041**	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

- Define electric drive, its parts, and advantages, explain choice of electric drive.
- Explain dynamics and modes of operation of electric drives.
- Explain selection of motor power ratings and control of dc motor using rectifiers.
- Analyze the performance and control of induction motor, synchronous motor and stepper motor drives.
- Discuss typical applications electrical drives in the industry.

Module-1 Dynamics and Control of Electrical Drives **8 hours**

Electrical Drives: electrical drives, advantages of electrical drives, parts of electrical drives, choice of electrical drives, status of DC and AC drives.

Dynamics of Electrical Drives: fundamental torque equations, speed torque conventions and multiquadrant operation, equivalent values of drive parameters, components of load torque, nature and classification of load torques, calculation of time and energy loss in transient operations, steady state stability, load equalization.

Control of Electrical Drives: modes of operation, speed control and drive classifications, closed loop control of drives.

Module-2 Control of DC Motor Drives **8 hours**

Direct Current Motor Drives: controlled rectifier fed DC drives, single phase fully controlled rectifier control of DC separately excited motor, single phase half controlled rectifier control of DC separately excited motor, three phase fully controlled rectifier control of DC separately excited motor, three phase half controlled rectifier control of DC separately excited motor, multiquadrant operation of DC separately excited motor fed form fully controlled rectifier, chopper control of separately excited DC motor.(no mathematical derivations)

Module-3 Performance of Induction Motor Drives **8 hours**

Induction Motor Drives: analysis and performance of three phase induction motors, operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting, braking, transient analysis.

Module-4 Speed Control of Induction Motor Drives and Performance of synchronous Motor Drives **8 hours**

Speed Control Techniques: brief introduction to scalar and vector control, stator voltage control, variable voltage frequency control from voltage sources, voltage source inverter (VSI) control, closed loop speed control of induction motor drives, variable frequency control from a current source, current source inverter (CSI) control, current regulated voltage source inverter control, speed control of single phase induction motors.

Synchronous Motor Drives: operation from fixed frequency supply- starting of synchronous motor.

Module-5 Control of Synchronous Motor, PMAC, BLDC, Stepper Motor and Industrial Drives **8 hours**

Thyristor inverter, starting of large synchronous machines, permanent magnet ac (PMAC) motor drives, sinusoidal PMAC motor drives, brushless DC motor drives.

Stepper Motor Drives: variable reluctance, permanent magnet, important features of stepper motors, and torque versus stepping rate characteristics, drive circuits for stepper motor.

Industrial Drives: textile mills, steel rolling mills, cranes and hoists, machine tools.

Course Outcomes: At the end of the course the student will be able to:	
21EEE7041.1	Explain the advantages and choice of electric drive.
21EEE7041.2	Explain dynamics and different modes of operation of electric drives.
21EEE7041.3	Suggest the motor power rating to suit industry requirements, analyze the performance and control of dc motor using controlled rectifiers and choppers.
21EEE7041.4	Analyze the performance and speed control of induction motor drives under different operating conditions.
21EEE7041.5	Analyze the performance and control of synchronous motors, PMAC, BLDC and stepper motor drives.
21EEE7041.6	Suggest a suitable electrical drive for specific application in the industry.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Fundamentals of Electrical Drives	Gopal K Dubey	Narosa Publishers	2nd Edition, 2001
2	Electrical Drives: Concepts and applications	Vedam Subramanyam	McGraw Hill	2nd Edition, 2011
Reference Books				
1	Electric Drives	N K De, P K Sen	PHI Learning	1st Edition, 2009

Web links and Video Lectures (e-Resources):

- https://www.digimat.in/nptel/courses/video/108108077/L01.html
- https://www.youtube.com/watch?v=ChJ_wPVRJeQ
- https://www.youtube.com/watch?v=GVCUrgLafcg
- https://www.youtube.com/watch?v=abHlibN9sTo
- https://www.youtube.com/watch?v=Ub-csHc4VhA
- https://www.youtube.com/watch?v=hLxeZVGrYgQ

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE7041.1	3	0	0	0	0	2	0	0	0	0	0	2	0	0
21EEE7041.2	0	3	0	0	0	2	0	0	0	0	0	2	0	0
21EEE7041.3	3	0	0	0	0	2	0	0	0	0	0	2	0	2
21EEE7041.4	0	2	0	0	0	2	0	0	0	0	0	2	0	2
21EEE7041.5	0	3	0	0	0	2	0	0	0	0	0	2	0	1
21EEE7041.6	0	2	0	0	0	2	0	0	0	0	0	2	0	1

1: Low 2: Medium 3: High

Electrical Safety Practices			
Course Code	**21EEE7042**	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

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

Module-1 Fundamentals and Safety Measures in Electrical Systems **8 hours**

Introduction, terms and definitions, objectives of safety and security measures, hazards associated with electric current and voltage, who is exposed, principles of electrical safety, approaches to prevent accidents, scope of subject electrical safety.
Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ spark overs, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, and residential buildings.

Module-2 Emergency Response and First Aid Techniques for Electrical Incidents **8 hours**

Introduction, removal of contact with live conductor, first principles of actions after electric shock, artificial respiration, Schafer's prone pressure method, Sylvester's method, Nielson's arm-lift back pressure method, mouth to mouth method, use of artificial resuscitator, external cardiac massage, cardiac pulmonary resuscitation, chocking, poisoning, open wounds, burns and scalds.

Module-3 Safety in Wiring, Appliances and Installations **8 hours**

Wiring and fittings, domestic appliances, case studies on shocks due to water tap, wet wall and ceiling fan. Multi-storeyed buildings, temporary installations, agricultural pump installation, do's and don'ts for safety in the use of domestic electrical appliances.

Module-4 Overview of Hazardous Zones and Equipment Classification **8 hours**

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

Module-5 Safety Management and Industrial Electrical Regulations **8 hours**

Principles of safety management, management's safety policy, safety organization, safety auditing, motivation to managers, supervisors and employees.
Review of IE rules and acts and their significance, objectives and scope of IE act and IE rules, ground clearance and section clearance, rules regarding first aid and firefighting facility, electrical safety general requirements.

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

21EEE7042.1	Explain the objectives and precautions of electrical safety, effects of shocks and their prevention.
21EEE7042.2	Outline the electrical safety procedures in hazardous zones.
21EEE7042.3	Illustrate the electrical safety in residential, commercial and agricultural installations using case studies.
21EEE7042.4	Describe the various techniques of first aid and life support.
21EEE7042.5	Analyze the policies and rules governing electrical safety management.
21EEE7042.6	Apply the principles of safety management in electrical installations and process plants.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Electrical Safety, Fire Safety Engineering and Safety Management	S. Rao, R.K.Jain, Prof. H.L Saluja	Khanna Publishers	2nd Edition 2012
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://nptel.ac.in/courses/103106071 (Safety Practices in Chemical and Nuclear Industries)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7042.1	3	2	0	0	2	2	0	2	0	0	0	0	2	2
21EEE7042.2	1	2	0	0	1	2	0	0	0	0	0	0	0	0
21EEE7042.3	3	2	0	0	2	1	0	0	0	0	0	0	2	1
21EEE7042.4	2	1	0	0	2	2	0	0	0	0	0	0	2	0
21EEE7042.5	2	2	0	0	3	1	0	0	0	0	0	0	0	2
21EEE7042.6	3	1	0	0	3	1	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

HVDC and FACTS			
Course Code	**21EEE7043**	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

- Explain the importance of HVDC transmission
- Analyze HVDC converters
- Identify the faults and protections required in HVDC system
- Design Filters to reduce harmonics in HVDC transmission
- Summarize FACTS devices and their application

Module-1 FACTS Concepts	**8 hours**
Transmission interconnections, flow of power in an ac system, what limits the loading capability? Power flow and dynamic stability considerations of a transmission interconnection, relative importance of controllable parameters, basic types of FACTS controllers, brief description and definitions of FACTS controllers, checklist of possible benefits from FACTS technology, in perspective: HVDC or FACTS.	
Module-2 Static Shunt Compensators	**8 hours**
Objectives of shunt compensation - midpoint voltage regulation for line segmentation, end of line voltage support to prevent voltage instability, improvement of transient stability. Methods of controllable var generation –thyristor controlled reactor (TCR) and thyristor switched reactor (TSR), thyristor switched capacitor (TSC). Operation of single phase TSC – TSR. Switching converter type var generators, basic operating principles, basic control approaches. Static var compensators: SVC and STATCOM, the regulation slope. Comparison between STATCOM and SVC, V –I and V –Q characteristics, transient stability, response time.	
Module-3 Static Series Compensators	**8 hours**
Objectives of series compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability. GTO thyristor-controlled series capacitor, thyristor-switched series capacitor, thyristor-controlled series capacitor, the static synchronous series compensator, transmitted power versus transmission angle characteristics.	
Module-4 Development of HVDC Technology	**8 hours**
Introduction, advantages of HVDC systems, HVDC system costs, overview and organization of HVDC systems, HVDC characteristics and economic aspects.	
Module-5 Control of HVDC Converter	**8 hours**
Converter control for an HVDC system, commutation failure, HVDC control and design, HVDC control functions, reactive power and voltage stability.	

Course Outcomes: At the end of the course the student will be able to:	
21EEE7043.1	List the advantages of HVDC transmission system.
21EEE7043.2	Analyze the need of static shunt and series static compensators in the HVDC system for lifelong learning.
21EEE7043.3	Examine the effects of power converters.
21EEE7043.4	Explain the development of HVDC technology.
21EEE7043.5	Categorize FACTS devices and identify their importance.
21EEE7043.6	Analyze control of HVDC converter and system.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems	Narain G Hingorani, Laszlo Gyugyi	Wiley	1st Edition, 2000.
2	HVDC Transmission: Power Conversion Applications in Power Systems	Chan-Ki Kim et al	Wiley	1st Edition, 2009
Reference Books				
1	Thyristor Based FACTS Controllers for Electrical Transmission Systems	R. Mohan Mathur, Rajiv K. Varma	Wiley	1st Edition, 2002

Web links and Video Lectures (e-Resources):

- https://www.pdfdrive.com/hvdc-and-facts-controllers-applications-of-static-converters-in-power-systems-e56221012.html
- https://www.pdfdrive.com/hvdc-transmission-power-conversion-applications-in-power-systems-e165548454.html

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7043.1	0	3	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7043.2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
21EEE7043.3	0	0	0	2	0	0	0	0	0	0	0	0	0	0
21EEE7043.4	0	0	2	0	0	0	0	0	0	0	0	0	0	0
21EEE7043.5	0	2	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7043.6	0	0	0	0	0	0	0	0	0	0	0	2	0	2

1: Low 2: Medium 3: High

Computer Aided Electrical Drawing			
Course Code	**21EEE7044**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Professional Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Discuss the terminology of DC and AC armature windings.
- Discuss design and procedure to draw armature winding diagrams for DC and AC machines.
- Discuss the substation equipment, their location in a substation and development of a layout for substation.
- Discuss different sectional views of transformers, DC machine, its parts and alternator and its parts.
- Explain the development of sectional views of Transformers, DC machine and alternators using the design data, sketches.

Suitable CAD software can be used for drawing

Module-1 DC and AC Machine Winding diagrams	**8 hours**
(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, bus bar 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**
Transformers - sectional views of single and three phase core and shell type transformers.	
Module-4 D.C. Generator/Motor Assembly	**8 hours**
Sectional views of yoke with poles, armature and commutator dealt separately.	
Module-5 Alternator Assembly	**8 hours**
Sectional views of stator and rotor dealt separately.	

Course Outcomes: At the end of the course the student will be able to:	
21EEE7044.1	Discuss the terminology and types of DC and AC armature windings
21EEE7044.2	Develop armature winding diagram for DC and AC machines
21EEE7044.3	Develop a layout for substation using the standard symbols for substation equipment.
21EEE7044.4	Draw sectional views of core and shell types transformers using the design data
21EEE7044.5	Draw sectional views of assembled DC machine or its parts using the design data or the sketches.
21EEE7044.6	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 Engineering Drawing	K. L. Narang	Satya Prakashan	2nd Edition 2014
2	Electrical Drafting	S F Devalapur	EBP	2009
3	A course in Electrical Machine design	A. K. Sawhney	DhanpatRai	6th Edition, 2013
4	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
21EEE7044.1	2	0	0	0	2	0	0	0	0	0	0	0	3	0
21EEE7044.2	3	2	0	0	2	0	0	0	0	0	0	0	3	0
21EEE7044.3	0	2	0	0	2	2	0	0	0	0	0	0	3	0
21EEE7044.4	2	0	0	0	2	0	2	0	0	0	0	0	3	0
21EEE7044.5	2	0	0	0	2	0	0	0	0	0	0	0	3	0
21EEE7044.6	0	3	0	0	2	0	0	0	0	0	0	0	3	0

1: Low 2: Medium 3: High

CMOS VLSI Design			
Course Code	**21EEE7045**	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 the MOS transistor theory and CMOS fabrication technologies.
- Understand the design rules and layout.
- Know the circuit design and CMOS logic structures
- Understand the basic circuit concepts and scaling.
- Apply the knowledge to design CMOS subsystems and know the working of semiconductor memory circuits.

Module-1 MOS Technology	**8 hours**
Brief history, enhancement and depletion mode MOS transistors, NMOS fabrication, CMOS fabrication. Thermal aspects of processing, BiCMOS technology, production of E-beam masks.	
Module-2 MOS Transistor Theory	**8 hours**
Introduction, MOS device design, the complementary CMOS Inverter – DC Characteristics, MOS inverters, the differential inverter, the transmission gate, tristate inverter.	
Module-3 Circuit Design Processes	**8 hours**
MOS layers, stick diagrams, design rules and layout, lambda-based design and other rules, layout diagrams, symbolic diagram, different aspects of testing and verification. CMOS logic structures, CMOS complementary logic, BiCMOS logic, pseudo-NMOS logic, dynamic CMOS logic, clocked CMOS logic, pass transistor logic.	
Module-4 Scaling of MOS Circuits	**8 hours**
Basic circuit concepts, sheet resistance, area capacitances, capacitance calculations. The delay unit, inverter delays, driving capacitive loads, propagation delays. Scaling of MOS circuits, scaling models and factors, limits on scaling, limits due to current density and noise.	
Module-5 CMOS Subsystem Design	**8 hours**
Architectural issues, switch logic, gate logic, design examples – combinational logic, clocked circuits. Semiconductor memories, introduction, dynamic random-access memory (DRAM) and static random access memory (SRAM)	

Course Outcomes: At the end of the course the student will be able to:	
21EEE7045.1	Understand the basics of MOS transistor and different fabrication technologies.
21EEE7045.2	Analyze the inverter circuits and DC characteristics of CMOS inverter.
21EEE7045.3	Apply the rules to design layout diagrams, stick diagrams for the logic gates with testing and verification of the design.
21EEE7045.4	Construct CMOS logic circuits and understand the concept of pass transistor.
21EEE7045.5	Apply the knowledge of physical design aspects for logic gates and estimate the delay.
21EEE7045.6	Design CMOS subsystems and explain the structure of SRAM & DRAM

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	CMOS VLSI Design- A Circuits and Systems Perspective	Neil H. E. Weste and David Money Harris	Pearson Education India	4th Edition, 2011

2	CMOS Digital Integrated Circuits: Analysis and Design	Sung Mo Kang, Yosuf Leblebici	Tata McGraw-Hill	3rd Edition,2002
3	Basic VLSI Design	Douglas A Pucknell & Kamran Eshragian	PHI	3rd Edition ,2005
Reference Books				
1	Principles of CMOS VLSI Design	Neil H. E. Weste and Kamaran Eshraghian	Addison- Wesley	2nd Edition, 2004

Web links and Video Lectures (e-Resources):

- https://youtu.be/ZwD1kNvzO_g
- https://youtu.be/UQqliHhtHcM
- https://youtu.be/oL8SKNxEaHs

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE7045.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7045.2	3	0	1	0	0	0	0	0	0	0	0	0	0	0
21EEE7045.3	3	0	0	0	1	0	0	0	0	0	0	0	0	0
21EEE7045.4	3	0	1	0	1	0	0	0	0	0	0	0	0	0
21EEE7045.5	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7045.6	3	0	1	0	2	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Fundamentals of Electric Vehicles			
Course Code	**21EEE7051**	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 the fundamental laws and vehicle mechanics.
- Understand working of Electric Vehicles and hybrid electric vehicles.
- Discuss the energy storage concepts for electric vehicles.
- Discuss the energy management strategies for electric and hybrid electric vehicles.

Module-1 Vehicle Mechanics	**8 hours**
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, super capacitors.	
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:

21EEE7051.1	Explain the working of electric vehicles and recent trends.
21EEE7051.2	Explain the architecture of hybrid electric vehicles and recent trends.
21EEE7051.3	Analyze different energy storage used for electric vehicle.
21EEE7051.4	Analyze the energy management system in a better way.
21EEE7051.5	Design the battery parameters for electric vehicles.
21EEE7051.6	Analyze the fundamentals of a vehicle.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press	2nd Edition 2010
2	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

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 AndApplications With Practical Perspectives	Chris Mi, M. AbulMasrur, David Wenzhong Gao	Wiley Publication	1st Edition 2011

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108106170 (Fundamentals of Electric Vehicles)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7051.1	2	2	0	0	0	0	0	0	0	1	1	0	0	0
21EEE7051.2	2	2	0	0	0	1	1	0	2	0	0	0	2	0
21EEE7051.3	0	0	2	0	2	0	0	0	0	0	0	2	0	0
21EEE7051.4	0	0	2	0	0	0	0	0	0	0	0	0	3	0
21EEE7051.5	0	0	2	0	0	0	2	0	0	1	0	0	0	0
21EEE7051.6	2	0	0	0	0	0	0	0	0	0	0	0	2	0

1: Low 2: Medium 3: High

Energy Storage Devices			
Course Code	**21EEE7052**	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

- To discuss the current status of various rechargeable batteries and fuel cells for various applications.
- To discuss the performance capabilities and limitations of batteries and fuel cells.
- Analyze the performance capabilities of batteries for aerospace and communication satellite.
- To identify the design aspects and performance characteristics of Micro and Nano batteries best suited for detection, sensing, and monitoring devices.
- Understand the application of low power rechargeable batteries for space and medical needs.

Module-1 Rechargeable Batteries and Fuel Cells **8 hours**

Fundamental aspects of rechargeable battery-critical performance characteristics, recycling of batteries, characteristics and performance.
Applications – commercial and military applications, low and moderate power applications and fuel cells

Module-2 Batteries for Aerospace and Communication Satellite Applications **8 hours**

On-board electrical power system, battery power requirements and associated critical components, ideal batteries for aerospace and communications satellites, performance capabilities. Military satellites for communications, surveillance, reconnaissance, and target tracking, batteries best suited to power satellite communications satellites.

Module-3 Fuel Cell Technology **8 hours**

Introduction, classification, performance capabilities based on electrolytes, low-temperature. Fuel cells using various electrolytes, fuel cells using a combination of fuels, fuel cell designs for multiple applications, ion-exchange membrane fuel cells. Potential applications of fuel cells – fuel cells for aircraft, commercial, military and space applications.

Module-4 Batteries for Electric and Hybrid Vehicles **8 hours**

Introduction, performance parameters, development history of the latest electric and hybrid electric vehicle – types, performance capabilities and limitations, performance requirements of various rechargeable batteries, materials for rechargeable batteries.

Module-5 Low Power Rechargeable Batteries **8 hours**

Introduction, low power battery configurations, characteristics, batteries for miniaturized electronic system applications, aerospace and medical applications, selection criteria for primary and secondary (rechargeable) batteries for specific applications.

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

21EEE7052.1	Understand the current status, the performance capabilities and performance requirement of rechargeable batteries and fuel cells.
21EEE7052.2	Identify the high-power batteries currently used by EVs and HEVs.
21EEE7052.3	Understand low-power battery configurations for various applications.
21EEE7052.4	Analyze the design aspects and performance characteristics of micro and nano-batteries.
21EEE7052.5	Analyze performance requirements of various Rechargeable Batteries.
21EEE7052.6	Understand the application of batteries for aerospace and communication satellites.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Next-Generation Batteries and Fuel Cells for Commercial, Military, and Space Applications.	A.R. JHA	CRC Press	1st Edition, 2012
Reference Books				
1	Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors.	Vladimir S. Bagotsky	John Wiley	1st Edition, 2015
2	Modelling and Control of Fuel Cells: Distributed Generation Applications.	M.Hashem Nehrir Caisheng Wang	Wiley	1st Edition, 2009

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=-xwVboWt4cs
- https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr
- https://www.youtube.com/watch?v=A3fHQsIkYeU

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7052.1	1	2	3	0	0	0	0	0	0	0	0	3	0	0
21EEE7052.2	1	2	0	0	0	0	3	0	0	0	0	0	0	0
21EEE7052.3	1	0	0	0	0	0	0	0	0	0	0	3	0	0
21EEE7052.4	1	2	0	0	0	0	3	0	0	0	0	3	0	0
21EEE7052.5	1	0	0	0	0	0	2	0	0	0	0	0	0	0
21EEE7052.6	1	0	0	0	0	0	0	0	0	0	0	3	0	0

1: Low 2: Medium 3: High

Nuclear Reactors and Safety			
Course Code	**21EEE7053**	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 the current nuclear energy scenario and importance of Nuclear Power.
- Explain the different radiation sources & the protection schemes.
- Understand the different safety approaches from site selection to operation of Nuclear reactors.
- Discuss on the regulatory approaches adopted, which assures safety.

Module-1 Overview of Nuclear Science & Technology **8 hours**

Energy sources, nuclear power production, medical and societal applications of radiation, nuclear fuel cycle, atomic structure, isotopes, radioactivity, half-life basics of fission reaction, moderation, criticality, decay heat, reactivity and feedback, breeding.

Module-2 Nuclear Reactor Types **8 hours**

Components of nuclear reactor, present reactor types generation IV concepts, radiation and its units, natural background and man-made radiation biological effects, exposure limits and protection, sources of radiation, shielding.

Module-3 Safety Principles **8 hours**

Safety objectives, defence in depth philosophy, multiple barriers, rad-waste management levels of defence, redundancy, diversity principles, event analysis, core inventory, emergency response. Deterministic approach- design basis events & beyond design basis events, acceptance criteria probabilistic approach- fault tree, event tree, failure rates.

Module-4 Nuclear Safety System **8 hours**

Quality assurance plan, materials, design, fabrication, maintenance surveillance, in service inspection, training & qualification, quality audit**,** shutdown systems in PWR,BWR,PHWR, reactivity worth of shutdown system, trip signals, safety logic operating environment, grouping of safety systems, heat removal systems, emergency core cooling, containment and subsystems.

Module-5 Assessment of Radiological Consequences **8 hours**

Basis of containment, quantity of radioactive materials, neutron activation of structures, transfer and deposition in buildings, containment leak rate, environmental transport and deposition, source term, safety regulation in India, atomic energy regulatory board, functions, safety documents, safety review of site, design, regulatory inspections, safety review for PFBR, Koodankulam.
Passive safety: definition, categorization, passive reactor shutdown systems for PHWR, FBR, passive decay heat removal systems for PWR,PHWR.

Course Outcomes: At the end of the course the student will be able to:	
21EEE7053.1	Apply basics of physics to analyze nuclear power production & societal application of radiations.
21EEE7053.2	Demonstrate knowledge on nuclear reactor & its radiation sources along with its protection for the sustainable development.
21EEE7053.3	Select appropriate modern techniques to ensure reliable safety principles & approaches from site selection to operation of nuclear reactors.
21EEE7053.4	Demonstrate knowledge on engineering concepts of quality assurance & safety systems to work in a team by following ethical principles.
21EEE7053.5	Select appropriate assessment of radiological consequences to ensure electrical safety when working as an individual or a team.
21EEE7053.6	Show an understanding of different safety regulations & related passive safety norms.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Nuclear Reactor Engineering (Principles and Concepts)	Vaidyanathan. G.	S.Chand & Company, New Delhi	1st Edition, 2013
2	Elements Of Nuclear Safety	Jacques LIBMANN	Les Editions de Physique	1st Edition 1996
3	Nuclear Power Reactor Safety	E.E. Lewis	John Wiley and Sons, Inc., New York	1st Edition 1977
Reference Books				
1	Nuclear Safety	Gianni Petrangeli,	Butterworth Heinemann,	2nd Edition 2019

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/115106087 (Nuclear Reactors and safety)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7053.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7053.2	3	0	0	0	0	0	2	0	0	0	0	0	0	0
21EEE7053.3	3	0	0	0	2	0	0	0	0	0	0	0	0	0
21EEE7053.4	2	0	0	0	0	0	0	2	2	0	0	0	0	0
21EEE7053.5	3	0	0	0	0	0	0	2	0	0	0	0	0	0
21EEE7053.6	3	2	0	0	0	0	0	0	0	0	0	0	0	0

1: Low 2: Medium 3: High

Sensors and Transducers			
Course Code	**21EEE7054**	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

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

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

Introduction, classification of transducers, advantages and disadvantages of electrical transducers, transducers actuating mechanisms, resistance transducers, variable inductance transducers, capacitive transducers, piezoelectric transducers, hall effect transducers, thermoelectric transducers, photoelectric transducers.

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

Strain gauges, load cells, proximity sensors, pneumatic sensors, light sensors, tactile sensors, fiber optic transducers, digital transducers, recent trends smart pressure transmitters, selection of sensors, rotary variable differential transformer, synchros and resolvers, induction potentiometers, micro electromechanical systems.

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

Introduction to signal condition, functions of signal conditioning equipment, amplification, types of amplifiers, mechanical amplifiers fluid amplifiers, optical amplifiers, electrical and electronic amplifiers.

Data acquisition systems and conversion: Introduction, objectives and configuration of data acquisition system, data acquisition systems, data conversion.

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

Data/signal transmission, telemetry, general telemetering system, types of telemetering systems, voltage telemetering system, current telemetering system, position telemetering system, radio frequency telemetering system, modulation and demodulation, digital modulation techniques.

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

Introduction of pressure measurement, temperature measurement, flow measurement, 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.

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

21EEE7054.1	Explain the need for and working of various transducers and sensors.
21EEE7054.2	Outline the recent trends in sensor technology and their selection.
21EEE7054.3	Analyze the signal conditioning and signal conditioning equipment.
21EEE7054.4	Illustrate different configuration of data acquisition system and data conversion.
21EEE7054.5	Display the knowledge of data transmission and telemetry.
21EEE7054.6	Explain measurement of non-electrical quantities -temperature, flow, speed, force, torque, power and viscosity.

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

Web links and Video Lectures (e-Resources):

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

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EEE7054.1	3	0	0	0	0	0	0	0	0	0	0	1	2	0
21EEE7054.2	0	3	0	0	0	0	0	0	0	0	0	2	3	0
21EEE7054.3	3	0	0	0	0	0	0	0	0	0	0	0	2	0
21EEE7054.4	0	2	0	0	3	0	0	0	0	0	0	0	1	0
21EEE7054.5	1	0	0	0	0	0	0	0	0	0	0	3	2	0
21EEE7054.6	0	2	0	0	3	0	0	0	0	0	0	0	1	0

1: Low 2: Medium 3: High

Industrial Servo Control Systems			
Course Code	**21EEE7055**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory (Open Elective)	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE Hours	03
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Articulate the importance of servos, with descriptions of servo drive actuators, amplifiers, feedback transducers, performance, and troubleshooting techniques.
- Determination of analogous quantities and transfer functions of differential equations.
- Develop mathematical modelling of electric servo motors, both DC and brushless DC servo motors.
- Apply the frequency response techniques for servo compensation.
- Estimate performance indices and criteria for servo systems and discuss the mechanical considerations of servo systems.

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

Introduction, benefits of servo systems, types of servos - evolution of servo drives, classification of drives, components of servos - hydraulic/electric circuit equations, actuators- electric, actuators-hydraulic,amplifiers-electric,amplifiers-hydraulic,transducers (feedback).

Module-2 Machine Servo Drives **8 hours**

Machine servo drives: Types of drives, feed drive performance.
Troubleshooting techniques: Techniques by drive, problems: their causes and cures.
Machine feed drives: Advances in technology, parameters for making application choices.
Application of industrial servo drives: Introduction, physical system analogus quantities and vectors, differential equations for physical systems, electric servo motor transfer functions and time constants, transport lag transfer function, hydraulic servo motor characteristics, general transfer characteristics.

Module-3 Generalized Control Theory **8 hours**

Servo block diagrams, frequency-response characteristics and construction of approximate (bode) frequency charts, Nichols charts, servo analysis techniques, and servo compensation.
Indexes of performance: definition of indexes of performance for servo drives, indexes of performance for electric and hydraulic drives.

Module-4 Performance Criteria **8 hours**

Performance criteria - Percent regulation, servo system responses.
Servo plant compensation techniques: Dead-zone nonlinearity, change-in-gain nonlinearity, structural resonances, frequency selective feedback, feed forward control.
Machine considerations: Machine feed drive considerations, ball screw mechanical resonances and reflected inertias for machine drives.

Module-5 Machine Considerations **8 hours**

Drive stiffness, drive resolution, drive acceleration, drive speed considerations, drive ratio considerations, drive thrust/torque and friction considerations, drive duty cycles.

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

21EEE7055.1	Identify variety of servo drives for various applications and analyze Hydraulic/Electric Circuit Equations.
21EEE7055.2	Apply the first principles to highlight the advances in technology that have led to the development of high-performance feed drives and resolve common problems that can occur in servo drives.
21EEE7055.3	Employ mathematical modelling techniques with simulation tools to analyze Frequency-Response Characteristics and different compensation techniques used to modify the control system to achieve desired performance.

21EEE7055.4	Apply simulation techniques to study servo plant compensation techniques and determine servo system responses
21EEE7055.5	Recognize the need for lifelong learning in the selection and design of servo systems for machine feed drives for professional engineering practice.
21EEE7055.6	Identify the need for independent learning regarding drive duty cycles for professional engineering practice.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Industrial Servo Control Systems Fundamentals and Applications	George W. Younkin	Marcel Dekker	1st Edition, 2003
Reference Books				
1	Servo Motors and Industrial Control	Riazollah Firoozian	Springer	2nd Edition, 2014
2	DC SERVOS Application and Design with MATLAB	Stephen M. Tobin	CRC	1st Edition, 2011

Web links and Video Lectures (e-Resources):

- https://vlab.amrita.edu/?sub=3&brch=257&sim=1480&cnt=1
- http://vlabs.iitkgp.ernet.in/vlabs/vlab4/exp.html
- https://englab.dawsoncollege.qc.ca/workshop/Exercise%201.html#move-a-robot
- https://www.coursera.org/learn/motors-circuits-design

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21EEE7055.1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7055.2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
21EEE7055.3	0	0	0	0	2	0	0	0	0	0	0	0	3	0
21EEE7055.4	0	0	0	0	2	0	0	0	0	0	0	0	0	0
21EEE7055.5	0	0	0	0	0	0	0	0	0	0	0	2	0	0
21EEE7055.6	0	0	0	0	0	0	0	0	0	0	0	3	0	0

1: Low 2: Medium 3: High

Technical Seminar			
Course Code	**21EES706**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE	-
Total Hours	20 hours	Credits	01

Course Learning Objectives:

1. To equip students with the ability to conduct in-depth research, analyze technical literature, and explore contemporary advancements in their field of study.
2. To effectively organize, design, and deliver technical presentations that convey complex information clearly to a diverse audience.
3. To encourage students to critically analyse and evaluate emerging trends, technologies, or methodologies relevant to their chosen seminar topic.
4. To enable students to improve their written and oral communication by preparing well-structured seminar reports and articulating ideas confidently during presentations.
5. To stimulate independent learning and problem-solving abilities by allowing students to explore specific topics of interest, enhancing self-directed research and learning.
6. To prepare students to effectively discuss and defend their technical knowledge in a professional setting, such as viva-voce, aligning with future industry or academic pursuits.

1. Selection of Technical Seminar Topic

- Students should select a technical topic related to their field of study, preferably focusing on recent advancements or emerging technologies. Inter-disciplinary/Multi-disciplinary topics are appreciated.
- Topics must be approved by the seminar coordinator within the first few weeks of the semester.

2 Research and Preparation

- Extensive research should be carried out using credible sources such as research papers, technical journals, books, and online databases.
- A minimum of 10-20 references is recommended, ensuring a mix of primary and secondary sources.

3. Seminar Report

- A detailed report (approximately 20-30 pages) must be prepared, summarizing the research findings and organized in a structured manner.
- The report should include sections like introduction, literature review, methodology, results, discussion, conclusion, and references.
- The report should follow a standard format as prescribed by the Department (font, spacing, citation style, etc.).

4. Oral Presentation

- Students must deliver an oral presentation lasting 15-20 minutes, followed by a question-and-answer session.
- Presentations should be well-structured, with appropriate use of visuals (slides, graphs, diagrams) to clearly convey technical content.
- All presentations must be conducted on scheduled dates, and attendance is mandatory for both presenters and all other students.

5. Question and Answer Session

- After the presentation, students will face a viva-voce where they are required to answer questions posed by the Departmental Seminar Evaluation Committee regarding their seminar topic.
- The viva will test the student's depth of understanding, research analysis, and ability to think critically about the subject matter.

6. Evaluation Criteria
• **Seminar Report**: Clarity, technical depth, comprehensiveness, quality of research, organization, and adherence to format (50 marks). • **Oral Presentation**: Communication skills, visual aids, clarity of content, timing, etc. (25 marks). • **Viva-Voce**: Ability to answer questions effectively, depth of understanding, and analytical skills (25 marks).
7. Submission Deadlines
• The report should be submitted at least one week prior to the scheduled presentation date. • Late submissions will be penalized as per department rules.
8. Plagiarism Check
• All seminar reports must be subjected to plagiarism checking, and the similarity index should be within acceptable limits specified by the Department. • Instances of plagiarism will result in penalties, which could include rejection of the report or a reduction in marks.
9. Mentorship and Feedback
• Students are required to consult with their faculty mentors regularly throughout the preparation phase to seek guidance and feedback. • At least three mentorship meetings should be recorded before the final presentation.
10. Attendance
• Students must attend all seminar sessions conducted by their peers, as it promotes collaborative learning and constructive feedback. • Attendance could be considered for internal evaluation.

Course Outcomes: At the end of the course the student will be able to :	
21EES706.1	Demonstrate a thorough understanding of a specialized topic by conducting extensive research and presenting technical content effectively.
21EES706.2	Exhibit proficiency in delivering well-organized and visually supported oral presentations, clearly articulating complex technical ideas to an audience.
21EES706.3	Apply critical thinking and research methodologies to explore, analyze, and synthesize information from various sources, leading to sound conclusions.
21EES706.4	Prepare a detailed and well-structured seminar report that adheres to technical writing standards, showcasing the ability to document research findings comprehensively.
21EES706.5	Respond confidently and competently to questions during the viva-voce, defending the technical work and demonstrating an in-depth understanding of the topic.
21EES706.6	Engage actively in peer seminars, providing constructive feedback, and reflecting on insights gained from discussions with fellow students and faculty.

Useful Links:
• https://homes.cs.washington.edu/~mernst/advice/giving-talk.html (How to give a technical presentation) • https://learnerbits.com/essential-tips-for-engineering-presentations • https://onlinecourses.nptel.ac.in/noc24_hs175/preview (Technical English for Engineers)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21EES706.1	-	1	-	3	-	-	-	-	-	2	-	-	-	-
21EES706.2	-	-	-	-	2	-	-	-	-	3	-	1	-	-
21EES706.3	-	2	-	3	-	-	-	-	-	-	-	-	-	-
21EES706.4	-	-	-	-	-	1	-	2	-	3	-	-	-	-
21EES706.5	-	-	-	-	-	-	-	-	-	3	-	-	-	-
21EES706.6	-	-	-	-	-	1	-	-	-	3	-	2	-	-

1: Low 2: Medium 3: High

Major Project Work			
Course Code	**21EEP707**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:6)	SEE	3 Hrs
Total Hours	60 hours	Credits	05

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. Final Submission

- **Report**: The final project report should include an abstract, introduction, literature review, methodology, implementation, 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 final 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.

10. Post Submission

- **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field.
- **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Project Synopsis Evaluation (Phase I)	Beginning of the 7th Semester	10 marks
2. Project Progress Evaluation	Middle of the 7th Semester	20 marks
3. Project Report Evaluation (Phase II)	End of the 7th Semester	20 marks
Semester End Examinations (SEE)		
4. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		
• When all the Project Objectives are met and the Project Work is successfully completed and final Project Report is submitted as reported by the Department Project Evaluation Committee (DPEC), the CIE and SEE performance of the 7th semester will be carried forward to the 8th semester. There will not be any separate CIE and SEE for such project batches in the 8th semester.		

- In case of any Project Objectives not met, Project Work not completed or final Project Report not submitted, as reported by the DPEC, the CIE and SEE will be conducted in the 7th semester for the completed portion of the Project Work. In such cases, the submission of the Draft Copy of the Project Report is mandatory for evaluation. The remaining part of the project shall be completed during the 8th semester and there will be a CIE and SEE for the Project Work in the 8th semester.

Students are advised to complete the Project Work during the 7th semester and devote the 8th semester for Industry Internship/Research Internship.

Course Outcomes: At the end of the course the student will be able to :	
21EEP707.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21EEP707.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21EEP707.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21EEP707.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21EEP707.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21EEP707.6	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**
21EEP707.1	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21EEP707.2	**-**	**-**	**3**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21EEP707.3	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21EEP707.4	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**2**	**2**	**-**	**-**	**-**
21EEP707.5	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
21EEP707.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**

1: Low 2: Medium 3: High

VIII Semester

Massive Open Online Course (MOOC)			
Course Code	**21AEC801**	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 Hrs
Total Hours	20 hours	Credits	02

Course Learning Objectives:

1. Enable students to acquire a strong foundation in core engineering subjects through high-quality, accessible online resources.
2. Facilitate skill development in specific engineering domains using practical exercises, simulations, and projects offered through the MOOC platform.
3. Encourage students to develop autonomy in learning by navigating and managing their course content, assignments, and assessments independently.
4. Expose students to interdisciplinary concepts and applications, fostering an understanding of how engineering principles integrate with other fields.
5. Provide exposure to global best practices and trends in engineering, allowing students to learn from international faculty and peer collaboration.
6. Develop essential soft skills by participating in discussion forums, group projects, and peer assessments, enhancing communication and teamwork skills.

1. Selection of MOOCs

1.1 Accredited Platforms: Students shall select MOOCs from accredited platforms such as Coursera, edX, SWAYAM/NPTEL, Udacity, or any online learning platform recognized by the respective Engineering Department / Board of Studies (BoS). Engineering Departments with the approval of BoS shall publish a list of MOOCs courses in the beginning of every semester.

1.2 Prerequisites: Students shall ensure that he/she has completed any foundational courses or prerequisites required for the chosen MOOCs.

1.3 Relevant Courses: Students shall choose courses that are relevant to the Student's Engineering discipline and career goals. Students shall NOT opt for the course which is part of their curriculum (I to VIII semester B.E program) and Honors Degree/Minor Degree courses. In case of any overlapping in the contents of the MOOC Course with that in the curriculum or other courses, the maximum permitted overlapping in the course contents (syllabus) is 20-25%.

1.4 Credit Value: Students shall ensure that the selected MOOCs collectively account for 2 credits. Typically, a 2-credit MOOC will require around 20-25 hours of study and a 1-credit MOOC will require 10-12 hours of study.

1.5 Duration of Course: A 4-weeks MOOCs is eligible for 1-credit. Students are advised to enrol for one 8-weeks MOOCs course to earn 2 credits. However, Students can also take two 4-weeks MOOCs instead of one course. In each case, the number of hours of study mentioned shall be satisfied.

2. Approval Process

2.1 Pre-Approval: Students must seek pre-approval from the Department MOOCs Coordinator before enrolling in MOOCs.

2.2 Submission of Proposal: Students can submit a detailed proposal to Department MOOCs Coordinator including the name of the MOOCs, the platforms, course duration, credit value, and relevance to their field of study.

If a Student has already completed any MOOCs course/s from the beginning of the III semester B.E, that satisfies the criteria mentioned in the clause 1. Selection of MOOCs, such course/s can be considered by the Department for credit transfer, provided the student has NOT already claimed the benefit of completing the MOOCs under any assessment in any of the subject.

2.3 Evaluation: The Department will evaluate the proposal for relevance, academic rigor, and credit equivalence and will communicate the decision to the Students.

3. Registration and Enrollment
3.1 Official Enrollment: Students shall register for the approved MOOCs on the respective platforms. **3.2 Documentation:** Students shall keep documentation of registration and course details for future reference and provide the same when asked by the Department.
4. Course Completion
4.1 Active Participation: Students shall engage actively in all course activities including lectures, assignments, quizzes, and discussion forums. **4.2 Completion Certificate:** Students shall obtain a verified certificate of completion for MOOC Course. Free versions without certificates are NOT eligible for credit.
5. Assessment and Evaluation
5.1 Performance Tracking: Students shall maintain records of performance in all assessments throughout the course. **5.2 Final Assessment:** The Department may conduct a final assessment (proctored exam) to ensure that the knowledge gained aligns with the academic standards. This summative assessment (proctored exam) by the Engineering Department is mandatory in the absence of such assessment in the MOOC course/s by the online platform.
6. Credit Transfer
6.1 Submission of Certificates: Students shall submit the completion certificate/s and performance records to the Department MOOCs Coordinator. **6.2 Credit Evaluation:** The Department will evaluate the certificates and performance records to approve the credit transfer. **6.3 Grade Conversion:** College will take care to convert the grades from the MOOCs into the grading system as per established Academic Rules and Regulations.
7. Integration into Academic Record
7.1 Transcript Update: Upon approval, the credits and grades will be integrated into the student's academic transcript. **7.2 Grade Point Average (GPA) Calculation:** The MOOC grades are included in the calculation of the student's GPA.
8. Support and Resources
8.1 Academic Advising: The Department MOOCs Coordinator shall provide guidance and support to the students throughout the process. **8. 2 Technical Support:** The Department MOOCs Coordinator shall ensure that students have access to the necessary technical resources to complete MOOCs courses.
9. Feedback and Improvement
9.1 Student Feedback: Department MOOCs Coordinator shall collect feedback from students on their MOOC experiences to improve future implementations. **9.2 Continuous Improvement:** MOOCs guidelines and processes will be updated based on student feedback, Department feedback and evolving educational standards.

Course Outcomes: At the end of the course the student will be able to :	
21AEC801.1	Students will demonstrate a strong grasp of essential engineering concepts and methodologies relevant to their chosen field.
21AEC801.2	Students will apply engineering knowledge to solve real-world problems through projects and case studies presented in the course.
21AEC801.3	Students will proficiently use online tools and resources, including simulations, interactive modules, and digital libraries, to enhance their learning experience.
21AEC801.4	Students will gain insights into new technologies and innovations within engineering, preparing them to adapt to technological advancements.
21AEC801.5	Students will exhibit improved teamwork and communication skills by engaging in online discussions, group projects, and peer assessments.

21AEC801.6	Students will develop a broader understanding of how engineering intersects with other disciplines and cultural contexts, informed by national/global perspectives gained through the MOOC.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21AEC801.1	3	2	-	-	1	-	-	-	-	-	-	-	-	-
21AEC801.2	3	-	2	-	-	-	-	-	-	-	-	2	-	-
21AEC801.3	-	-	-	-	3	-	-	-	-	-	-	2	-	-
21AEC801.4	3	-	-	-	2	-	-	-	-	-	-	1	-	-
21AEC801.5	-	-	-	-	-	-	-	-	2	3	-	1	-	-
21AEC801.6	-	2	-	-	-	2	-	-	-	-	-	1	-	-

1: Low 2: Medium 3: High

Major Project Work			
Course Code	**21EEP802**	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	3 Hrs
Total Hours	20 hours	Credits	05

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 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.

2. Progress 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.

3. Final Submission

- **Report**: The final project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

4. 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.

5. 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 final report, presentation, and the ability to answer questions.

6. 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%).
7. 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.
8. Post Submission
• **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field. • **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Progress Review	During the 8th semester	25 marks
2. Project Report Evaluation	End of the 8th Semester	25 marks
Semester End Examinations (SEE)		
3. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		

Course Outcomes: At the end of the course the student will be able to :	
21EEP802.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21EEP802.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21EEP802.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21EEP802.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21EEP802.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21EEP802.6	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
21EEP802.1	2	3	-	-	1	-	-	-	-	-	-	-	-	-
21EEP802.2	-	-	3	-	-	2	1	-	-	-	-	-	-	-
21EEP802.3	1	2	-	3	-	-	-	-	-	-	-	-	-	-
21EEP802.4	-	-	-	-	-	1	-	-	3	2	2	-	-	-
21EEP802.5	-	-	1	-	-	-	2	3	-	-	-	-	-	-
21EEP802.6	-	-	-	-	-	-	-	-	-	3	2	1	-	-

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Research Internship

Course Learning Objectives:

1. To equip students with the knowledge of fundamental research principles, methodologies, and techniques applicable to their engineering discipline.
2. To enable students to formulate research questions, design experiments or studies, and use appropriate data collection and analysis tools.
3. To foster the ability to think critically and innovatively while solving complex engineering problems during the research process.
4. To guide students in developing the skills necessary for writing clear and well-structured research reports, papers, and presentations.
5. To instill an understanding of ethical practices in research, including integrity, responsible data handling, and respect for intellectual property.
6. To prepare students to work effectively in research teams, communicate their ideas clearly, and present their findings to both technical and non-technical audiences.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) and the Research Supervisor to understand the research goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, research agreements and confidentiality agreements, if applicable.
3. **Research Proposal:** Develop a research proposal in consultation with the Research Supervisor and academic mentor outlining the objectives, methodology, and expected outcomes.

During the Internship

1. **Work Plan:** Follow a structured research plan provided by the supervising researcher or mentor.
2. **Literature Review:** Conduct a comprehensive literature review to understand the current state of research in the chosen area.
3. **Regular Meetings:** Participate in regular meetings with academic and research mentors to discuss progress, challenges, and next steps.
4. **Lab Work/Field Work:** Engage in experimental work, simulations, or field studies as required by the research project.
5. **Data Collection and Analysis:** Collect, analyze, and interpret data using appropriate tools and techniques.
6. **Documentation:** Maintain detailed records of research activities, experiments, and findings.

Deliverables

1. **Weekly Reports:** Submit weekly progress reports to academic and research mentors.
2. **Monthly Reports:** Submit monthly progress reports to academic and research mentors.
3. **Mid-Term Review:** Participate in a mid-term review meeting to assess progress and realign research goals if necessary.
4. **Report and Research Paper:** Prepare a draft report and a research paper detailing the research problem, methodology, results and discussions, and conclusions.
5. **Presentation:** Deliver a presentation summarizing the research work to faculty, peers, and other stakeholders upon completion of the internship.

Assessment Criteria
1. **Research Quality:** Evaluate the quality and rigor of the research conducted. 2. **Report Quality:** Assess the clarity, organization, and thoroughness of the report and the research paper. 3. **Presentation:** Evaluate the effectiveness and clarity of the final presentation. 4. **Innovation and Creativity:** Consider the originality and innovative aspects of the research. 5. **Self-Reflection:** Review the student's ability to critically reflect on their research experience and identify areas for future growth.
Post-Internship
1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the research experience and areas of improvement. 2. **Publication:** Explore opportunities to publish the research findings in academic journals or conferences. 3. **Networking:** Maintain professional relationships established during the internship for future research collaborations.
Additional Tips
• **Curiosity:** Cultivate a curious mindset and a willingness to explore new ideas. • **Collaboration:** Work collaboratively with other researchers and team members. • **Adaptability:** Be open to modifying research approaches based on findings and feedback. • **Communication:** Develop strong written and oral communication skills to effectively present research findings. • **Time Management:** Prioritize tasks and manage time efficiently to meet research deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (Only OFFLINE)	Will be conducted during the 7th semester BE. Students shall submit the Research Internship Proposal and make a presentation and answer questions raised by the Departmental Internship Evaluation Committee (DIEC). Marks split-up: Research Internship Proposal – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): II (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on progress done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): III (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final internship report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
CIE Marks (Max 100)	Average of the CIE:I , CIE-II and CIE:III marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply appropriate research methodologies and tools to design and conduct experiments, analyze data, and draw conclusions.
21INT803.2	Demonstrate the ability to identify and solve complex engineering problems through innovative and systematic research approaches.
21INT803.3	Acquire proficiency in using advanced technologies, tools, and techniques relevant to their field of research.
21INT803.4	Develop skills in writing comprehensive research reports, documentation, and effectively presenting research findings.
21INT803.5	Understand and apply ethical standards in research, including plagiarism avoidance, proper citations, and data integrity.
21INT803.6	Gain experience in working collaboratively within a research team and contributing effectively to the shared goals of the project.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

3. VTU Mandatory Internship Guidelines 2021.
Available at https://vtu.ac.in/pdf/regulations2021/anex4.pdf

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21INT803.1	**1**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.3	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**1**	**-**	**-**
21INT803.5	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**	**-**

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Industry Internship

Course Learning Objectives:

1. To develop practical engineering skills through hands-on experience in a real-world industrial environment.
2. To enhance the ability to identify, analyze, and solve complex engineering problems encountered during the internship.
3. To gain an understanding of the functioning of the industry, including exposure to its standards, practices, and emerging technologies.
4. To improve communication, collaboration, and teamwork skills by working with professionals in a multidisciplinary team setting.
5. To foster adaptability by learning to work in dynamic and fast-paced industrial environments while embracing lifelong learning.
6. To instill a sense of professional ethics, responsibility, and accountability in engineering practice by adhering to industry-specific codes of conduct.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) to understand the internship goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, internship agreements if applicable etc.
3. **Goal Setting:** Define specific, measurable, achievable, relevant, and time-bound (SMART) goals in consultation with academic and industry mentors.

During the Internship

1. **Work Plan:** Follow a structured work plan provided by the host organization.
2. **Mentorship:** Regularly meet with assigned industry and academic mentors to review progress and seek guidance.
3. **Work Diary/Daily Report/Learning Diary:** Maintain a diary/logbook documenting daily activities, learnings, challenges, and reflections.
4. **Professional Conduct:** Adhere to the professional and ethical standards of the host organization, including dress code, punctuality, and communication protocols.
5. **Skill Application:** Actively participate in projects and tasks assigned, applying theoretical knowledge to practical situations.

Deliverables

1. **Weekly Reports:** Submit the weekly progress reports to academic and industry mentors.
2. **Monthly Reports:** Submit the monthly progress reports to academic and industry mentors.
3. **Mid-Term Review/Evaluation:** Participate in a mid-term review meeting/evaluation to assess progress and realign goals if necessary.
4. **Final Report:** Prepare a comprehensive final report in the specified format detailing the projects undertaken, skills acquired, challenges faced, and overall learning experience.
5. **Presentation:** Deliver a presentation summarizing the internship experience to faculty evaluators and peers upon completion of the internship.

Assessment Criteria
1. **Performance Evaluation:** Receive feedback from the industry mentor based on work performance, technical skills, and professional behaviour. 2. **Report Quality:** Evaluate the quality, clarity, and comprehensiveness of the final report. 3. **Presentation:** Assess the effectiveness and clarity of the final presentation. 4. **Self-Reflection:** Review the student's ability to critically reflect on their learning experience and identify areas for future growth.
Post-Internship
1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the internship experience and areas of improvement. 2. **Certification:** Obtain an internship completion certificate from the host organization. 3. **Networking:** Maintain professional relationships established during the internship for future opportunities.
Additional Tips
• **Professionalism:** Demonstrate a professional attitude and work ethic at all times. • **Adaptability:** Be open to learning and adapting to new environments and technologies. • **Communication:** Develop strong communication skills to effectively collaborate with colleagues and mentors. • **Time Management:** Prioritize tasks and manage time efficiently to meet deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on work done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
Continuous Internal Evaluation (CIE): II (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
CIE Marks (Max 100)	Average of the CIE:I and CIE:II marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply engineering concepts and theoretical knowledge to solve real-world industry problems.
21INT803.2	Enhance their problem-solving abilities by identifying, analyzing, and providing innovative solutions to engineering challenges in the industry.
21INT803.3	Develop key professional skills such as teamwork, communication, and time management in a corporate or industrial environment.
21INT803.4	Gain exposure to industry-standard tools, technologies, methodologies, and regulatory standards relevant to their field of study.

21INT803.5	Demonstrate understanding and adherence to professional ethics, safety regulations, and responsibilities in an industrial setting.
21INT803.6	Build a network of industry professionals and gain insights into career opportunities, preparing them for future employment in the engineering sector.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf

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21INT803.1	3	2	-	-	-	1	-	-	-	-	1	-	-	-
21INT803.2	-	3	2	1	-	-	-	-	-	-	1	-	-	-
21INT803.3	-	-	-	-	-	-	-	-	3	2	-	-	-	-
21INT803.4	-	-	-	-	3	2	-	-	-	-	-	1	-	-
21INT803.5	-	-	-	-	-	2	-	3	-	-	-	-	-	-
21INT803.6	-	-	-	-	-	-	-	-	2	3	-	1	-	-

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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