P D A College of Engineering

B.E. in Electrical and Electronics Engineering

Scheme of Teaching and Examinations 2022

Outcome Based Education(OBE) and Choice Based Credit System(CBCS)

VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl.No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lectur	Tutorial	Practical /Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22EE71	**Power System Protection**	EEE	3	0	2		03	50	50	100	4
2	IPCC	22EE72	**Electrical Estimation and Costing**	EEE	3	0	2		03	50	50	100	4
3	PCC	22EE73	**Electrical Machine Design**	EEE	4	0	0		03	50	50	100	4
4	PEC	22EE74X	Professional Elective-III	EEE	3	0	0		03	50	50	100	3
5	OEC	22EEOE75X	Open Elective-II	EEE	3	0	0		03	50	50	100	3
6	PROJ	22EEP76	**Major Project Phase-II**	EEE	0	0	12		03	50	50	100	6
										300	**300**	**600**	**24**

Professional Elective Course-III

22EE741	Power System Operation and Control	22EE743	Energy Audit and DSM
22EE742	Smart Grid Technology	22EE744	High Voltage Engineering

Open Elective Course-II

22EEOE751	Electric Vehicles	22EEOE753	Embedded Systems
22EEOE752	EMC in Electrical Systems	22EEOE754	Industrial Applications of Electrical Power

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:**Lecture,**T**:

Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program swapping facility

Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/industry internships after the VI semester

P D A College of Engineering

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Scheme of Teaching and Examinations 2022

Outcome Based Education(OBE) and Choice Based Credit System(CBCS)

VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl.No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board(PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical /Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	22EE81X	**Professional Elective-IV (Online Courses) –NPTEL**	EEE	3	0	0		03	50	50	100	3
2	OEC	22EEOE82X	**Open Elective-III (Online Courses)**	EEE	3	0	0		03	50	50	100	3
3	INT	22EEINT83	**Internship(Industry/Research)(14-20weeks)**	EEE	0	0	12		03	100		100	10
										200	**100**	**300**	**16**

Professional Elective Courses (Online courses)

22EE811	Probability Foundations For Electrical Engineers	22EE814	Charging Infrastructure
22EE812	Introduction To Semiconductor Devices	22EE815	A Basic Course On Electric And Magnetic Circuits
22EE813	Design Of Photovoltaic Systems	22EE816	Design And Simulation Of Power Conversion Using Open Source Tools

Open Elective Courses(Online Courses)

22EEOE821	Design For Internet Of Things	22EEOE824	Microsensors And Nanosensors
22EEOE822	Digital Circuits	22EEOE825	Public Speaking
22EEOE823	Soft Skills	22EEOE826	Literature, Culture And Media

L:Lecture, **T**:Tutorial, **P**:Practical **S=SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.**TD**-Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship/Research Internship/Rural Internship **Professional Elective/Open Elective Course:** These are the ONLINE courses suggested by the respective Board of Studies

Online Professional Course: The students need to register (anywhere between VI to VIII Semesters) NPTEL Course of 12 weeks duration (3 Credits course) and should pass the examination. The NPTEL Courses relevant to the program and need to be identified by the department and same is to be informed to the students.

Online Open Elective Course: The students need to register (anywhere between VI to VIII Semesters) NPTEL Course of 12 weeks duration (3 Credits course) and should pass the examination. The NPTEL Courses that enables skill enhancements and job opportunities need to be suggested by the department and same is to be informed to the students.

Course Title: **Power System Protection (IPCC)**		
Course Code	**22EE71**	CIE: 50
Number of Lecture Hours/Week	**3hrs.(Theory)+2hrs.(Practical)**	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03

Prerequisite:

- Power System Analysis
- Electrical Machines (AC & DC)
- Electrical Measurements
- Basic Control Systems
- Digital Electronics and Microprocessors

Course Objectives:

- To introduce the principles and need for protective systems in power networks.
- To study the functioning of electromechanical and microprocessor-based relays.
- To understand the protection schemes for electrical machines, feeders, and transformers.
- To learn about different types of protective relays for fault detection and isolation.

Modules	**Teaching Hours**
Module I **Fuses:** Introduction to fuse, fuse law, cut -off characteristics, Time current characteristics, fuse material, HRC fuse, liquid fuse, Applications of fuse. **Circuit Breakers:** Operating principles: Introduction, requirement of a circuit breakers, basic principle of operation of a circuit breaker, properties of arc initiation and maintenance, arc interruption theories -slepian's theory and energy balance theory, Restriking voltage, recovery voltage, Rate of rise of Restriking voltage, AC circuit breaking, current chopping, capacitance switching, resistance switching, Rating of Circuit breakers.	09 Hours
Module II **Circuits Breakers:** Types & Construction: SF 6 breaker, Puffer and non Puffer type of SF 6 breakers. Vacuum circuit breakers - principle of operation and constructional details. Advantages and disadvantages of different types of Circuit breakers. **Protective Relaying** Operating principles: Requirement of Protective Relaying, Zones of protection, primary and backup protection, Essential qualities of Protective Relaying, Classification of Protective Relays, A brief introduction to electromechanical relays, static relays and microprocessor based relays.	09 Hours
Module III **Protection philosophies:** Understanding of protection philosophies as applicable to the unit protection - such as non-pilot over-current protection of transmission lines, transformer protection, non-pilot distance protection of transmission lines, rotating machinery protection. **Induction Type Relay:** Non-directional and directional, over current relays, IDMT and Directional characteristics, Differential relay- Principle of operation, percentage differential relay, bias characteristics, distance relay – Three stepped distance protection, Impedance relay, Reactance relay , Mho relay, Buchholz relay, Microprocessor based over current relay – block diagram approach.	08 Hours
Module IV **Protection Schemes:** Principles and need for protective schemes, Zones of Protection. **Generator protection schemes**: differential, restricted earth fault, inter-turn faults **Motor protection:** overload, short circuit, phase failure, unbalance, locked rotor, Thermistor-based protection for large motors, Stall protection and protection during startup	08 Hours
Module V **Transformer Protection:** Differential protection, differential relay with harmonic restraint, Inter turn faults. **Bus bars and Transmission Line Protection:** Introduction, bus bar protection, frame leakage protection, differential protection, distance protection, three zones protection	08 Hours

Feeder Protection and Fault Relays: Radial and ring feeder protection

Laboratory Component

Sr. No	Experiment Title
1	Study of electromechanical overcurrent relay and its time-current characteristics
2	Testing and characteristics of Earth Fault Relay
3	Testing of overvoltage and undervoltage relays
4	Protection of a 3-phase induction motor against overload and phase failure
5	Study and testing of Buchholz relay (demonstration)
6	Study of generator protection using relay trainer kit or simulation
7	Feeder protection using IDMT relay coordination
8	Relay coordination and fault current calculation for a radial feeder

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Text books / Reference Books:

- **Power System Protection and Switchgear** – B. Ravindranath & M. Chander, New Age
- **Protection and Switchgear** – B. Ram & D. N. Vishwakarma, McGraw Hill
- **Digital Protection: Protective Relaying from Electromechanical to Microprocessor** – Lakshminarayana

Reference Books:

- **The Art and Science of Protective Relaying** – C. R. Mason
- **Power System Relaying** – Horowitz and Phadke
- **Switchgear and Protection** – J.B. Gupta
- **Power System Analysis and Design** – J. Duncan Glover, Thomas Overbye

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
22EE71	CO1	Understand the fundamental principles and classification of protective relays.
	CO2	Design and analyze protection systems for transformers, generators, and motors.
	CO3	Explain and apply feeder protection and line protection techniques.
	CO4	Differentiate and implement electromechanical and microprocessor-based relays.
	CO5	Understand and apply specific relays like over/under voltage, overcurrent, and earth fault relays.

Course Articulation Matrix for the Academic Year 2025-26

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Title: **ELECTRICAL ESTIMATION AND COSTING**			
CourseCode	22EE72	Credits:03	CIE: 50
NumberofLecture Hours/Week	3hrs (Theory) 2hrs(Practical)		SEE:50
TotalNumberofLectureHours	42		SEEHours:03

Prerequisite:
Knowledge about Elements of Electrical Engineering , Engineering Drawing, Electrical Wiring and Professional Ethics.

CourseObjectives:

1. Emphasize the estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost Availability.
2. Exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design.
3. These techniques should help the students to successfully estimate costing of the products/projects that are part of our everyday usage.
4. A basic knowledge on methods and types of estimation and its merits and demerits
5. To prepare the schedule of materials with specifications and estimates for different types of electrical installations.

Modules	**Teaching Hours**
Module I **DESIGN CONSIDERATIONS OF ELECTRICAL INSTALLATIONS:** Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of Electrical Installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections, Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution Board, guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electrical installations. **1. Load Calculation and Voltage Drop Analysis using MATLAB** • **Objective:** Calculate total load, current, and voltage drop for a given domestic wiring layout. • **Description:** Simulate different circuit combinations (lighting, power) and evaluate voltage drop using standard equations. • **Outcome:** Understand load balancing, permissible voltage drop, and cable selection. **2. Residential Wiring Schematic using AutoCAD Electrical** • **Objective:** Draw a residential single-line wiring diagram including DB, MCBs, switches, and outlets. • **Description:** Use symbol libraries to create a layout for a 2BHK flat with correct annotations and material list. • **Outcome:** Visualization and understanding of layout and component placement.	**09hrs**
Module II **ELECTRICAL INSTALLATION OF BUILDINGS AND SMALL INDUSTRIES:** Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries. **Estimation and Costing of Electrical Installation using MATLAB** • **Objective:** Prepare a cost sheet for residential/commercial installation based on user-defined load inputs. • **Description:** Design a script to calculate quantities and costs of cables, switches,	**08hrs**

conduits, DBs, etc. • **Outcome:** Exposure to automation of estimation and basic programming logic in MATLAB. **2. Wiring Layout for Small Industry using AutoCAD Electrical** • **Objective:** Create a wiring plan for a small industry (e.g., motor control panel, lighting, power circuits). • **Description:** Include power sockets, distribution boxes, 3-phase loads, and control switches. • **Outcome:** Understanding electrical layout complexity in small-scale industries.	
Module III **OVERHEAD AND UNDERGROUND TRANSMISSION AND DISTRIBUTION LINES:** Introduction, Supports for Transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables. **1. Mechanical Design of Overhead Lines using MATLAB** • **Objective:** Calculate sag and tension in conductors for various spans and weather conditions. • **Description:** Implement formulas for sag-tension under normal and extreme conditions. • **Outcome:** Understand mechanical constraints in transmission line design. **2. Underground Cable Routing Plan using AutoCAD Electrical** • **Objective:** Create a schematic for underground cable routing between two substations. • **Description:** Show cable trench layout, manholes, bends, and termination points with cable IDs. • **Outcome:** Learn layout planning for underground systems.	**08hrs**
Module IV **SUBSTATIONS** Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substation, Floor mounted type. **1. Load Flow and Fault Analysis for a Substation Feeder using MATLAB** • **Objective:** Perform load flow analysis and short circuit current calculation on a substation feeder. • **Description:** Model a simple substation with transformer and 2–3 feeders. • **Outcome:** Basic exposure to substation performance simulation. **2. Single-Line Diagram of a 11kV/415V Substation using AutoCAD Electrical** • **Objective:** Draft a detailed SLD of an indoor or outdoor substation. • **Description:** Include transformer, breakers, isolators, busbars, meters, and relay panels. • **Outcome:** Learn standard symbol usage and layout practices.	**09hrs**
Module V **DESIGN OF ILLUMINATION SCHEMES:** Introduction, Terminology in Illumination, laws of illumination, various types of light sources, Practical lighting schemes. **1. Illumination Level Calculation using MATLAB** • **Objective:** Calculate lux levels for different rooms using point-by-point method. • **Description:** Input room size, luminaire type, mounting height, and reflectance to compute illumination levels. • **Outcome:** Apply laws of illumination to practical room lighting design. **2. Lighting Layout Plan using AutoCAD Electrical** • **Objective:** Design the lighting layout for an office or classroom. • **Description:** Draw plan view with location of light fixtures, switches, and cable routing. • **Outcome:** Spatial understanding of lighting system design.	**08hrs**

Question paper pattern:
Total ten questions will be asked. Two from each module. The student has to answer five questions, Selecting at least one from each module.

Textbooks/Reference Books:

1. Electrical Design Estimating and Costing, K.B. Raina, S.K. Bhattacharya, New Age International Publisher.
2. Design of Electrical Installations, Dr. V.K. Jain, Dr. Amitabh Bajaj, University Science Press.
3. Electricity pricing Engineering Principles and Methodologies, Lawrence J. Vogt, P.E., CRCPress.
4. Guide for Electrical Layout in residential buildings, Indian Standard Institution, IS:4648-1968
5. Electrical Installation buildings Indian Standard Institution, IS:2032.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO	Course Outcome(CO)	
22EE72	CO1	**The estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost viability.**	
	CO2	**Exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design.**	
	CO3	**To design illumination systems.**	
	CO4	**Understand types of substations and their ratings.**	
	CO5	**These techniques should help the students to successfully estimate costing of the products/projects that are part of our everyday usage and apply the above concepts to real- world electrical and electronics problems and applications.**	

S.No.	PO CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1		1			1					2				2	
2	CO2		1								2				2	
3	CO3		1								2				2	
4	CO4		1								2				2	
5	CO5		1								2				2	
			1			1					2				2	

Course Title: **ELECTRICALMACHINEDESIGN**			
Course Code	22EE73	Credits:4	CIE:50
Number of Lecture Hours/Week	4hrs(Theory)		SEE:50
Total Number of Lecture Hours	42		SEE Hours:03

Prerequisite: Study of Electrical machines–I and Electrical machines–II. Study of Electrical Circuit Analysis.

Course Objectives:

1. To Study the Principles and design of DC machines.
2. To understand the design concept and design of AC machines.
3. To design of Induction motors and synchronous Machines.

Modules	Teaching Hours
Module-I **Introduction:** Needs of design of electrical machines and limitations. **Design of Armature of DC Machine:** Output equation, choice of specific loadings and choice of number of poles, main dimensions of the armature, design of armature winding, design of armature core, performance of the designed armature.	**07hrs**
Module-II **Design of Magnetic circuit of DC Machine:** Design of Field system, dimensions of pole, dimensions of the yoke, length of air gap, design of the field winding, performance of the field system. Design of the Commutator and brushes, performance of the Commutator. Design of inter poles: Flux density in the air gap under the inter pole, dimensions of the inter pole, design of inter pole winding.	**08hrs**
Module-III **Design of Single phase and Three phase Transformers**: Output equation for single phase and three phase transformer, expression for volts/turn, choice of specific loadings ,determination of main dimensions of the core, design of windings Andestimationofnumberofturnsandconductorcrosssectionalareaofprimaryand secondary windings, design of tank and cooling tubes.	**09hrs**
Module-IV **Design of Three Phase Induction Motors:** Output equation, choice of specific loadings, main dimensions of three phase induction motor, Stator winding design, choice of length of the air gap, estimation of number of slots for the squirrel cage rotor, design of rotor bars and end rings, design of slip ring induction motor.	**09hrs**
Module-V **Design of Synchronous Machine:** Output equation, choice of specific loadings, short circuit ratio, design of main dimensions, armature slots and windings, slot details for the stator of salient and non-salient pole synchronous machines, magnetic circuit, dimension of the pole body, design of the field winding, and design of rotor of non-salient pole machine.	**09hrs**

Question paper pattern: Total ten questions will be asked. Two from each module. The student Has to answer five questions, selecting at least one from each module.

Textbooks/Reference Books:

1. A.K.Sawhney, DhanpatRai&Co.,"AcourseinElectricalMachineDesign".6th Edition, 2006.
2. V.N.Mittle, ArvindMittal"DesignofElectricalMachine".5hedition-2009.
3. M.G.Say,"PerformanceAndDesignofACmachines",CBSpublishersanddistributors Pvt. Ltd. Edition 1983.
4. A.Shanmugsundarm,G.Gangadharan,R.Palani,"DesignDataHandbook",Wiley Eastern Ltd.
5. H.M.Rai(DhanpatRai)"Principles of Electrical Machines Design",Satyaprakasham, 1992.

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO	Course Outcome(CO)
22EE73	CO1	Design of a dc machine armature core and armature winding and provide the information required for the fabrication of the same along with an estimate of various performance indices
	CO2	Design of a dc machine field system, Commutator and inter pole and provide the information required for the fabrication of the same along with an estimate of various performance indices.
	CO3	Design of a transformer and provide the information required for the fabrication of the same along with an estimate of various performance indices.
	CO4	Design of a Induction motors and provide the information required for the Fabrication of the same along with an estimate of various performance indices.
	CO5	Design of a Synchronous Machines and provide the information required for the fabrication of the same along with an estimate of various Performance indices.

CourseArticulationMatrixfortheAcademicYear2025-26

S.No.	PO/ CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	2	3	2									3		1
2	CO2	3	2											3		2
3	CO3	3	2	3	2									3	2	2
4	CO4	3	1											3		1
5	CO5	3	3	2	2									3		2
		3	2	2.67	2									3	2	1.6

Course Title: **POWERSYSTEM OPERATION ANDCONTROL**			
Course Code	22EE741	Credits:3	CIE:50
Number of Lecture Hours/Week	**3hrs(Theory)**		SEE:50
Total Number of Lecture Hours	42		SEEHours:03

Prerequisite: Electrical Power Generation, Transmission and Distribution System.
Power System Stability and Analysis and control systems.

Course Objectives:

1. To understand optimal dispatch of generation with and without losses
2. To study the optimal scheduling of hydro thermal systems.
3. To study the optimal unit commitment problem.
4. To study the load frequency control for single area system
5. To understand the reactive power control and compensation of transmission lines.

Modules	**Teaching Hours**
Module I **Control Center Operation Of Power Systems:** Power system control and operating states, Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model.	08hrs
Module II **Optimal System Operation and Unit Commitment:** Introduction, Optimal operation of generators on a bus bar, Statement of the Unit Commitment problem, need for and importance of unit commitment, Constraint in Unit Commitment,UnitCommitmentsolutionmethods-Prioritylistsmethod,Forward Dynamic Programming method (excluding problem),Spinning reserve Examples.	08hrs
Module III **Power System Security:** Introduction, factors affecting power system security, Security analysis, Contingency Selection, Techniques for contingency evaluation-D.C. load flow AC load flow and fast Decoupled load flow (with flow charts excluding problems) detection of network problems, network sensitivity methods.	10hrs
Module IV **Automatic Generation Control:** Automatic voltage regulator, Automatic Load Frequency Control loops of generators, performance of Voltage Regulator, ALFC of single area system, concept control area, multi area system, POOL operation – two area system, tie-line bias control.	08hrs
Module V **Control of Voltage and Reactive Power:** Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse. **Power System Reliability:** Introduction, Modes of failures of a system, Reliability index.	08hrs

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting atleast one from each module.	
Textbooks/Reference Books: 1. GLKusic, "Computer aided power system analysis", PHI-2010. 2. I.J.NagarathandD.P.Kothri,"//modernpowersystemAnalysis",3rdEdition-2003 3. Allen.J.Wood&Woolenburg"PowerGeneration,Operation&control",JohnWiley&Sons -2nd Edition - 2009. 4. Power system operation and control Uma RaoK1stedition-2016 5. O.I.Elgerd, "ElectricalEnergySystemsTheory",TMH-2008.	
Ebooks and online course materials:	

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO#	Course Outcome(CO)
22EE741	**CO1**	Illustrate the operation power system with SCADA
	CO2	Determine the optimal operation of power system by unit commitment
	CO3	Examine the power system security with different methods
	CO4	Analyze automatic generation control in power system with different control Loops
	CO5	Examine voltage and reactive power control in power system
	C06	Recognizethemodesoffailuresinpowersystemforreliabilityassessments

CourseArticulationMatrixfortheAcademicYear2025-26

S.No.	PO CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3												3	2	
2	CO2	3	2											3	2	
3	CO3	3				2								3	2	
4	CO4	3	2			2								3	2	
5	CO5	3												3	2	
6	CO6	3												3	2	
		3	**2**			**2**								**3**	2	

Course Title: Smart Grid Technology			
Course Code	22EE742	Credits:3	CIE:50
Number of Lecture Hours/Week	**3Hrs (Theory)**		SEE:50
Total Number of Lecture Hours	42		SEEHours:03

Pre-requisites: Electrical Distribution Systems, Power System.

Course Objectives:

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

Modules	Teaching Hours
Module-I Introduction to Smart Grids: Definition, justification for smart grids, smart grid conceptual model, smartgridarchitectures,Interoperability,communicationtechnologies, role of smart grids standards, Intelli grid initiative, national smart grid mission (NSGM)by Govt. of India.	**08Hrs**
Module-II Smart Transmission Technologies: Substation automation, Supervisory control and data acquisition (SCADA),energy management system(EMS),phasor measurement units (PMU), Wide area measurement systems (WAMS).	**08Hrs**
Module-III Smart Distribution Technologies: Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure(AMI), fault location isolation and service restoration (FLISR), Outage Management Systems(OMS),Energy Storage ,Renewable Integration.	**09Hrs**
Module-IV Distributed Generation and Smart Consumption: Distributed energy resources(DERs),smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy managementsystem(HEMS),NetMetering,BuildingtoGridB2G,VehicletoGridV2G, Solar to Grid, Micro grid.	**08Hrs**

Module-V	
Regulations and Market Models for Smart Grid: Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of sma rtgrid projects.	**09Hrs**

Questionpaperpattern: Totaltenquestionswillbeasked.Twofromeachmodule.Thestudent hastoanswerfivequestions,selectingatleastonefromeach module.

TextBooks:

1. ClarkWGellings,"TheSmart Grid,EnablingEnergyEfficiencyandDemandSide Response"-CRC Press, 2009.
2. JeanClaudeSabonnadière,NouredineHadjsaïd,"SmartGrids",Wiley-ISTE,IEEEPress, May 2012.

References:

1. JanakaEkanayake,KithsiriLiyanage,Jianzhong.Wu,AkihikoYokoyama,NickJenkins, "Smart Grid: Technology and Applications"-Wiley, 2012.
2. JamesMomoh,"Smart Grid:FundamentalsofDesignand Analysis" -Wiley,IEEE Press,2012.
3. IndiaSmart GridKnowledgePortal

Course outcomes:
Oncompletion ofthecourse,thestudent willhavetheability to:

CourseCode	CO	CourseOutcome(CO)	BloomsLevel
22EE742	CO1	Understandtechnologiesforsmart grid	1
	CO2	Understand the different smart grid technologies in Transmission system.	1
	CO3	Understand the different smart grid technologies in distribution system.	1
	CO4	Realizethedistributiongenerationandsmart Consumption	3
	CO5	Knowtheregulationsandmarketmodelsforsmart grid.	2

CourseArticulationMatrixfortheAcademicYear2022-23

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

Course Title: Energy Audit and Demand Side Management			
Course Code	**22EE743**	Credits:3	CIE: 50
Number of Lecture Hours/Week	**3Hrs (Theory)**		SEE: 50
Total Number of Lecture Hours	42		SEE Hours: 03

Pre-requisites:

- Basics of Electrical Machines and Power Systems
- Electrical Measurements and Instrumentation
- Fundamentals of Energy Conversion
- Basic Thermodynamics
- Understanding of Electricity Tariff and Billing

Course Objectives:

- To introduce the principles and practices of energy auditing.
- To develop analytical skills for evaluating energy efficiency.
- To understand demand side management strategies and load optimization.
- To identify opportunities for energy conservation in different sectors

Modules	Teaching Hours
Module- I **Energy Scenarios:** Energy Conservation, Energy Audit, Energy Scenarios, Energy Consumption, Energy Security, Energy Strategy, Clean Development Mechanism. **Types of Energy Audits and Energy-Audit Methodology:** Definition of Energy Audit, Place of Audit, Energy – Audit Methodology, Financial Analysis, Sensitivity Analysis, Project Financing Options, Energy Monitoring and Training. **Survey Instrumentation:** Electrical Measurement, Thermal Measurement, Light Measurement, Speed Measurement, Data Logger and Data – Acquisition System, Thermal Basis.	**07 Hrs**
Module-II **Energy Audit of Boilers:** Classification of Boilers, Parts of Boiler, Efficiency of a Boiler, Role of excess Air in Boiler Efficiency, Energy Saving Methods. **Energy Audit of Furnaces:** Parts of a Furnace, classification of Furnaces, Energy saving Measures in Furnaces, Furnace Efficiency.	**09 Hrs**
Module- III **Energy Audit of HVAC Systems:** Introduction to HVAC, Components of Air – Conditioning System, Types of Air – Conditioning Systems, Human Comfort Zone and Psychrometry, Vapour – Compression Refrigeration Cycle, Energy Use Indices, Impact of Refrigerants on Environment and Global Warming, Energy – Saving Measures in HVAC, Star Rating and Labelling by BEE. **Electrical-Load Management:** Electrical Basics, Electrical Load Management, Variable- Frequency Drives, Harmonics and its Effects, Electricity Tariff, Power Factor, Transmission and Distribution Losses..	**09 Hrs**
Module- IV **Energy Audit of Motors:** Classification of Motors, Parameters related to Motors, Efficiency of a Motor, Energy Conservation in Motors, BEE Star Rating and Labelling. **Energy Audit of Lighting Systems:**Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures (Luminaries), Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting System Audit, Energy Saving Opportunities.	**08 Hrs**

Module-V	09 Hrs
Energy Audit Applied to Buildings: Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings. **Demand side Management:** Scope of DSM, Evolution of DSM concept, DSM planning and Implementation, Load management as a DSM strategy, Applications of Load Control, End use energy conservation, Tariff options for DSM, customer acceptance, implementation issues, Implementation strategies, DSM and Environment. **Energy Conservation:** Motivation of energy conservation, Principles of Energy conservation, Energy conservation planning, Energy conservation in industries, EC in SSI, EC in electrical generation, transmission and distribution, EC in household and commercial sectors, EC in transport, EC in agriculture, EC legislation.	

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Text Books:

1. Kennedy, William J., Turner, Wayne C., &Capehart, Barney L., Guide to Energy Management, The Fairmount Press
2. Callaghan, P.W., Design and Management for Energy Conservation", Pergamon Press, Oxford

Reference Books:

1. Dryden, I.G.C., The Efficient Use of Energy, Butterworths, London
2. Turner, W.C., Energy Management Handbook, Wiley, New York (1982)
3. Energy Manager Training Manual (www.energymanagertraining.com)

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO	Course Outcome (CO)
22EE743	CO1	Understand and explain the principles and objectives of energy auditing and energy management.
	CO2	Perform basic and detailed energy audits in electrical and thermal systems.
	CO3	Evaluate and improve efficiency in electrical installations and industrial equipment.
	CO4	Understand and implement DSM strategies in residential, commercial, and industrial settings.
	CO5	Analyze energy performance in buildings and industrial case studies using real-world standards and tools.

Course Articulation Matrix for the Academic Year 2024-25

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1					3					2
CO2	3	3										2
CO3	3	3										2
CO4	3	3										2
CO5	3	3			1							2

Course Title: **High Voltage Engineering**

Course Code	**22EE744**	CIE: 50
Number of Lecture Hours/Week	**3hrs.(Theory)**	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03

Prerequisite: Study of Electrical Power Transmission and Distribution, Power Electronics

Course Objectives:

1- To understand the principles of theory of high voltage generation and measurements.
2- To study the operation of high voltage power supplies for ac, dc and impulse voltages
3- To get familiar with various applications where high voltage field is used.
4- To understand breakdown 0f HV insulation (solid, Liquid and Gas).
5- To know lightning phenomena and HV Insulation Environmental pollution.

Modules	**Teaching Hours**
Module I **Breakdown Phenomenon:** **Gaseous Dielectrics :** Ionization, primary and secondary ionization process, Townsend's criterion for gaseous insulation breakdown, time lag in breakdown, Streamer theory, breakdown in Non-Uniform fields, Paschen's law and its significance, breakdown in Electronegative gases. **Breakdown in Liquid Dielectrics:** Suspended Particle theory, Cavitations and Bubble mechanism, thermal mechanism, stressed oil volume theory.	09 Hours
Module II **Breakdown in Solid Dielectrics:** Intrinsic breakdown, Avalanche breakdown, Thermal breakdown and Electromechanical breakdown. **Generation of High Voltages :** **HVAC:** Need for high AC voltage generation, Cascade connection of transformer, series resonant circuit-Tesla coil, High frequency AC voltages. HVDC : Rectifier circuits, Voltage doubler circuit, Cockroft-walton voltage multiplier circuit, Electrostatic generator.	09 Hours
Module III **Impulse Voltage :** Introduction to lightning and switching impulse voltage, Concept of standard impulse wave, front and tail times, derivation of output voltage of impulse generator(Single stage) in terms of input voltage and circuit components, Marx circuit, modified Marx circuit, components of multistage impulse generator, tripping of impulse generator by three electrode gap , trigatron gap, Generation of switching impulse voltages, generation of impulse current.	08 Hours
Module IV **Measurement of High Voltages :** **HVDC:** Series Resistance micro ammeter method, resistance potential divider method, Generating voltmeter method. **HVAC:** Series capacitance method, Electrostatic voltmeter method, peak reading AC voltmeters, Chubb and Fortescue method. **Impulse Voltage:** Potential divider method (Resistive, capacitive and Mixed), factors affecting the spark over voltage. Surge Current Measurement: Klydonograph and magnetic links.	08 Hours
Module V **Over Voltage Phenomenon:** Concept of Lightning, Mechanism of Lightning stroke, Travelling wave, behavior of travelling wave (Unit step function) at transition points.	

Non-destructive Insulation Testing Techniques: Dielectric loss and loss measurement by using Schering bridge, Transformer ratio Arm bridge, Need for Partial Discharge detection and detection methods(Straight and Balance)	08 Hours

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Text books / Reference Books:

1. E. Kuffel and W.S. Zaengil, "High Voltage Engineering Fundamentals", 2nd Edition, Elsvier Press-2005.
2. M.S. Naidu and V. Kamaraju," High Voltage Engineering, 5th Edition, McGraw Hill Education (India) Publication,2014
3. C.L.Wadhwa, "High Voltage Engineering, "New Age International Publishers.2008
4. Abdul Salam, H. Anis, Roshdy Radwan, "High Voltage Engineering theory and Practice", 2nd edition, Special Indian Edition by BSP books Publishers.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
22EE744	**CO1**	Analyze breakdown phenomenon in solids, liquids, and gaseous dielectrics for practical applications.
	CO2	Identify different methods of generating HVAC,HVDC,
	CO3	Outline Impulse Voltage and Current Generators.
	CO4	Analyze travelling wave at different transition points.
	CO5	Illustrate different Non destructive insulation testing techniques for various electrical applications.

Course Articulation Matrix for the Academic Year 2025-26

S.No.	PO CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	3										1	3	2	1
2	CO2	3											1	3	2	1
3	CO3	3											1	3	2	1
4	CO4	3	3										1	3	2	1
5	CO5	3											1	3	2	1
		3	**3**										**1**	**3**	**2**	**1**

Course Title: ELECTRIC VEHICLES			
Course Code	**22EEOE751**	Credits:3	CIE: 50
Number of Lecture Hours/Week	**3Hrs (Theory)**		SEE: 50
Total Number of Lecture Hours	42		SEE Hours: 03

Pre-requisites:

Course Objectives:

- To develop basic schemes of electric vehicles and hybrid electric vehicles.
- To understand requirement of electric vehicle motors & their control
- To Choose a suitable drive scheme for developing an electric vehicle depending on resources
- To Choose proper energy storage and charging systems for vehicle applications

Modules	Teaching Hours
Module I **Introduction to Electrical Vehicle (EV):** Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. **Hybrid Electric Vehicle (HEV):** Configuration of HEV (Series, Parallel, Series-parallel &Complex), Examples of HEV system performance, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine.	**09 Hrs**
Module II **Electric Drive-trains:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.	**08 Hrs**
Module III **EV Motors:** Requirement of EV motors, Comparison of EV motors, Types of EV motors: **DC Motor (**Basics of DC Motor, Torque speed characteristics), **Induction Motor (**Rotating Magnetic Field, Basics of Induction motor, Speed-Torque Curve) and construction & working of **Switched reluctance Motors**(SRM).	**08 Hrs**
Module IV **EV Storages:** **Battery parameters:** Cell and battery voltages, Charge capacity, Energy stored, Energy density, Specific power, charge efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature, heating and cooling needs, Battery life and number of deep cycles. **EV Batteries:** Lead Acid, Nickel-based, Sodium-based, Lithium and Metal Air Batteries, Ultra-Capacitors.	**09 Hrs**
Module V **EV Charging:** **Battery Chargers**: Charge equalization, Conductive (Basic charger circuits, Arrangement of an off-board conductive charger, Standard power levels of conductive chargers), Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods. **Charging Infrastructure**: Domestic and Public Charging Infrastructures, Normal, Occasional and Fast Charging Stations, Battery Swapping Station, Move-and-charge zone.	**08 Hrs**

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Reference Books:

Text books / Reference Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
5.K Wang Hee Nam: AC Motor Control & Electrical Vehicle Application, CR Press, Taylor & Francis Group, 2019

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO	Course Outcome (CO)
22EEOE751	CO1	Analyze suitable drive scheme for Electric Vehicles depending on resources.
	CO2	Relate the electric drive trains for EV
	CO3	Identify appropriate motor and converter for EV applications
	CO4	Distinguish battery, battery indication system for EV applications
	CO5	Appraise battery charger for an EV

Course Articulation Matrix for the Academic Year 2025-26

S.No.	PO CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	2	1			3	2					2	3	2	
2	CO2	3	2	1			3	2					2	3	2	
3	CO3	3	2	1			3	2					2	3	2	
4	CO4	3	2	1			3	2					2	3	2	
5	CO5	3	2	1			3	2					2	3	2	

EMC IN ELECTRICAL SYSTEMS			
Course Code	22EEOE752	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Credits	03	Exam Hours	03

Module-1

Electromagnetic Disturbances: Introduction, Classification of disturbances by frequency content, by character and transmission mode.

Conducted EMI Measurement: Introduction, EMI measuring instruments, Basic terms and conducted EMI references, Measuring the interference voltage and current, Spectrum analysers, EMI measurements for consumerapplications, Measuring impulse like EMI.

EMI in Power Electronic Equipment: EMI from power semiconductors, controlled rectifier circuits, EMI calculation for semiconductor equipment. **(09 HRS)**

Module-2

EMI Filter Elements: Measuring High Frequency Characteristics OF EMI Filter Elements, Capacitors, Choke Coils, Resistors. **(08 HRS)**

Module-3

Noise Suppression: Noise Suppression in Relay Systems, Application of AC Switching Relays, Application of RC – Snubbers to Power Semiconductors, Shielded Transformers, Capacitor Filters, EMI Generation and Reduction at its Source, Influence of Layout and Control of Parasitics.

EMI Filter Circuit selection and measurement: Definition of EMI Filter Parameters, ENI Filter Circuits, Insertion Loss Test Methods. **(09 HRS)**

Module-4

EMI Filter Design: EMI Filter Design for Insertion Loss, Calculation of Worst – case Insertion Loss, Design Method for Mismatched Impedance Condition, Design Method for EMI Filters with Common – Mode Choke Coils,Damped EMI Filters and Lossy Filter Elements, HF Characteristics of Noise Filter Circuit Elements, EMI Filter Layout. **(08 HRS)**

Module-5

Testing for Susceptibility to Power Line Disturbances: Surge Voltages in AC Power Mains, EMC Tests as per IEC Specifications, Other EMS Test Methods.

Reduction Techniques for internal EMI: Conductive Noise Coupling, Electromagnetic Coupling, Electromagnetic Coupling Reduction Methods, Wiring Layout Methods to Reduce EMI Coupling, PCB Design Considerations. **(08 HRS)**

Course outcomes:

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

- Describe Electromagnetic interference and its classification and measurement of conducted highfrequency disturbance.
- Survey electromagnetic interference specific to power electronic equipment.
- Explain the characteristics of circuit elements used for noise suppression.
- Explain EMI suppression methods used in semiconductor and electromechanical devices.
- Explain design of EMI filter circuits and filtering methods.
- Explain susceptibility and noise withstand capability test.
- Explain EMS reduction techniques for power electronic equipment.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook

1. Electromagnetic Compatibility in Power Electronics, Laszlo Tihanyi, Newnes, 1st Edition, 1995.

Course Title: Embedded Systems			
Course Code	22EEOE753	Credits:3	CIE: 50
NumberofLectureHours/Week	**3Hrs (Theory)**		SEE:50
TotalNumberofLectureHours	42		SEEHours:03

Pre-requisites:
Programming languages C, C++, OOPs Java, Microcontroller, Microprocessor, ARM processor,sensorsandnetworking.

CourseObjectives:

To impart knowledge on the following Topics

- Building Blocks of Embeded System
- Various Embeded Development Strategies
- Bus Communication in processors, Input/output interfacing.
- Basics of Real time operating system and example

Modules	TeachingHours
Module–I **Introduction to Embedded Systems:** Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in a System, Embedded Software, Complex System Design. Design process in Embedded Systems. Formalization of System Design. Classification of Embedded Systems.	**08 Hrs**
Module–II **8051 Microcontroller:** Architecture, Input/Output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts, Real World Interfacing, Processor and Memory organization. **Devices and Communication Buses for Devices Network:** Serial and Parallel Devices and Ports, Wireless Devices, Timer and counting devices, Watchdog Timer, Real Time Clock, Networked Embedded Systems, Internet Enabled Systems, Wireless and Mobile System protocols.	**09 Hrs**
Module–III **Device Drivers and Interrupts service Mechanism:** Programming – I/O, Busy Wait Approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt service Handling, Multiple Interrupts, Direct Memory Access. **Real Time Operating Systems:** OS services, Process and Memory Management, Real – Time Operating Systems, Basic Design Using an RTOS, Task Scheduling Models, Interrupt Latency.	**09 Hrs**
Module–IV **Embedded Programming Concepts**: Software Programming in Assembly language and High level Language, Data types, Structures, Modifiers, Loops and Pointers, Macros and functions.	**08 Hrs**
Module–V **Embedded Software Development Process and Tools:** Introduction to Embedded Software Development Process and Tools, Host and Target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware-Software Design and Co-Design. **Testing, Simulating and Debugging Techniques and Tools:** Testing on Host Machine, Simulators, Laboratory Tools.	**08 Hrs**

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Reference Books:

TextBooks:

Embedded Systems, Raj Kamal, Second Edition TMI.

ReferenceBooks:

1. Embedded/Real – Time Systems, Dr.K.V.K.K.Prasad, DreamTech press.
2. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Pearson
3. An Embedded Software Primer, David E Simon, Pearson Education.
4. Microcontrollers, Raj Kamal, Pearson Education.
5. Introduction to Embedded Systems, Shibu K.V.TMH.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO	Course Outcome (CO)	Blooms Level
	CO1	Explain and analyze Embedded systems.	**L2**
	CO2	Describe various processors architecture and suggest an embedded system for a given application.	**L4**
	CO3	Operate various Embedded Development Strategies	**L4**
	CO4	Study about the bus Communication in processors and programming concepts in Embedded systems	**L2**
	CO5	Explain the basics of Real time operating system and software development process and testing tools in embedded systems.	**L4**

S.No.	PO CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3	1											1		
2	CO2	3	1											1		
3	CO3	3	1											1	1	
4	CO4	3	1		1									1	1	
5	CO5	3	1											1		
		3	**1**		**1**									**1**	**1**	

Course Title: **INDUSTRIAL APPLICATIONS OF ELECTRICAL POWER**			
Course Code	22EEOE754	Credit:3	CIE: 50
Number of Lecture Hours/Week	**2hrs.(Theory) +2hrs (Tutorial)**		SEE: 50
Total Number of Lecture Hours	42		SEE Hours: 03

Prerequisite:

1.Applications of Basic Electrical Engineering.

Course Objectives:

1**.** To study Heating and Welding
2. To understand Welding and Illumination.
3.To know Lighting Applications.
4.To understand basic concept of Electric Drive.
5.To get an Exposure about Electric traction .

Modules	**Teaching Hours**
Module I **Electrical Energy Needs:** Introduction to electrical energy, application of heating, lighting and plating. **Heating Applications:** Different methods of Electric heating and their advantages, Resistance heating, Dielectric heating, Resistance ovens, Induction heating, Arc furnace. Electroplating, factors effecting electro deposition process.	**09 hrs**
Module II **Welding:** Introduction, Types – Gas welding, Shielded metal arc welding (SMAW), Gas metal arc welding (GMAW) and Gas tungsten arc welding (GTAW), Safety practices and Testing. **Illumination:** Introduction, Radiant Energy, Definitions, Laws of lllumination,Polar curves, Photometry, Measurement of Mean Spherical Candle power by Integrating sphere, illumination photometer, Energy radiation and luminous efficiency, illumination for different purposes.	**08 hrs**
Module III **Lighting Applications**: Introduction, requirements of good lighting, lighting calculations, Factory lighting, Flood lighting, Street lighting, Lighting technologies, Lighting Design principle. **Lamps:** Construction and working of Mercury vapor lamp, sodium vapor lamp, electric lamp, cold cathode lamp, lighting fittings and High-Intensity discharge lamps(HID),Lamp performance parameters.	**08 hrs**
Module IV **Drive Application:** Concept, classification and advantages of electric drives, Block diagram of typical electric drives. Components of electric drive, Choice of electric drives. Comparison of DC electric drives with AC electric drives. **Dynamics of Electric drives**: Fundamental Torque equation, speed torque conventions and multiquadrant operation, equivalent vales of drive parameters, components of torques, nature and classification of load torques.	**09 hrs**

Module V	
Electric Traction: Introduction to traction system, requirement of an ideal traction system, supply system for electrical traction, Motors for Electric traction, Speed- Time curves for train movement. **Electrical Braking:** Introduction, and types of braking, Regenerative braking with three phase induction motors, Braking with single phase series motors, Magnetic track brake, and Electro-Mechanical Drum brakes.	**08 hrs**

Question paper pattern: Total ten questions will be asked. Two from each module. The student has to answer five questions, selecting at least one from each module.

Reference Books:

1. Soni Gupta and Bhatnagar, "A Course in Electrical Power", Dhanpatrai and Sons Edition 2002
2. G.C Garg, "Utilization of Electrical Power and Electric Traction", Khanna Publishers 6th Edition 1999.
3. Open Shaw Taylor, "Utilization of Electrical Energy", 12th Impression Universities Press-2009
4. Dr. S.L.Uppal, "Electrical Power", Khanna Publishers Eighth Reprint -1999.
5. Mehrbad Ehsani, Yimin Gao, Sabastian E. Gay Ali Emadi, "Modern Electric Hybrid Electric and Fuel cell vehicles", CRC Press, 2010.
6. Utilization of Electrical Power, 2nd Edition, R.K.Rajput, Laxmi publications, New Delhi
7. Fundamentals of Electrical Drives by " G.K.Dubey ".

Course outcomes: On completion of the course, the student will have the ability to:

Course Code	CO	Course Outcome (CO)
22EEOE754	CO1	Describe the specified heating & welding methods and electrolysis process
	CO2	Define the laws of illumination and compute the illumination for specified applications,
	CO3	Discuss about Lighting applications and lamps
	CO4	Concept of Electric Drives.
	CO5	Discuss about electric traction.

Course Articulation Matrix for the Academic Year 2025-26

S.No.	PO CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	CO1	3		1									1	3	2	1
2	CO2	3	3										1	3	2	1
3	CO3	3	2										1	3	1	1
4	CO4	3											1	3	1	1
5	CO5	3											1	3	1	1
		3	2.5	1									1	3	1	1

LIST OF NPTEL/SWAYAM (ON-LINE) COURSES FOR 8TH SEM-2025-26

PROFESSIONAL ELECTIVES-22EE81X

22EE811 - PROBABILITY FOUNDATIONS FOR ELECTRICAL ENGINEERS
22EE812 - INTRODUCTION TO SEMICONDUCTOR DEVICES
22EE813 - DESIGN OF PHOTOVOLTAIC SYSTEMS
22EE814 - CHARGING INFRASTRUCTURE
22EE815 - A BASIC COURSE ON ELECTRIC AND MAGNETIC CIRCUITS
22EE816 - DESIGN AND SIMULATION OF POWER CONVERSION USING OPEN SOURCE TOOLS

OPEN ELECTIVES-22EE82X

22EEOE821 - DESIGN FOR INTERNET OF THINGS
22EEOE822 - DIGITAL CIRCUITS
22EEOE823 - SOFT SKILLS 22EEOE824 - MICROSENSORS AND NANOSENSORS
22EEOE825 - PUBLIC SPEAKING
22EEOE826 - LITERATURE, CULTURE AND MEDIA