VII SEMESTER

Sr No	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		CA	ESE	Total
1	22EE701T	Switchgear & Protection	4	-	-	4	30	70	100
2	22EE701P	Switchgear & Protection Lab	-	-	2	1	25	25	50
3	22EE702P	Power System Simulation Lab	-	-	2	1	25	25	50
4	22EE703T	Professional Elective - III	4	-	-	4	30	70	100
5	22EE704T	Professional Elective - IV	4	-	-	4	30	70	100
6	22EE761O	Open Elective - III	3	-	-	3	30	70	100
7	22EE705P	Project - II	-	-	6	3	50	50	100
8	22EE706P	Summer / Winter Internship *	-	-	-	2	50	-	50
9	22EE707P	Capstone Course - II **	-	-	2	1	50	-	50
			15	**0**	**12**	**23**	**320**	**380**	**700**

* Summer / Winter Internship (Evaluation of 4-6 weeks Internship Completion till 6th Semester
** Capstone Course – II (Comprehensive knowledge gained in Electrical Engineering)

	Professional Elective - III		Professional Elective - IV
22EE703T(i)	PE -III Power Station Practice	22EE704T(i)	PE -IV Power Semiconductor based Drives
22EE703T(ii)	PE -III Electrical Installation and Design	22EE704T(ii)	PE -IV Flexible AC Transmission Systems
22EE703T(iii)	PE -III Power Quality	22EE704T(iii)	PE -IV Advanced Control System
22EE703T(iv)	PE -III Battery Management Systems	22EE704T(iv)	PE -IV Energy Management and Audit
22EE703T(v)	PE -III Electrical Instrumentation	22EE704T(v)	PE -IV Electrical Distribution System
22EE703(vi)	PE -III Solar PV Systems	22EE704T(vi)	PE -IV HVDC Transmission system

	Open Elective - III
22EE761O(i)	OE-III Power Plant Engineering
22EE761O(ii)	OE-III Power Electronics

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EE701T	Switchgear and Protection	4	-	-	4	30	70	100

Course Objectives	Course Outcomes
This course is intended to • realize the importance of power system protection. • understand different types of Relays and Protective Schemes used in power system protection. • introduce construction, working and applications of Circuit Breakers.	**Students will be able to** • explain basic terminology of Protective Relaying. • describe over-current protection schemes for transmission lines. • explain various distance protection schemes for transmission lines. • explain different protections used for Generator, Transformer and Motor. • describe working of circuit breakers.

Unit I	**[10Hrs]**
General Philosophy of Protection: - Necessity of protection, Nature and causes of faults, Types and effects of faults, Fault Statistics, Protective zones, Primary and Back-up protection, Essential qualities of Protection, Basic trip circuit. Classification of relays. Introduction of Electro-mechanical, Static and Numerical relays.	
Unit II	**[9Hrs]**
Over-current Protection: - Time-Current characteristics, Current setting, Time setting, Relay coordination, Over current protection schemes for transmission Lines, directional-over current relay, Protection of parallel feeders and ring mains.	
Unit III	**[10Hrs]**
Distance Protection: - Working principle and characteristic of Impedance Relay, Mho Relay, Reactance Relay, Three step distance protection scheme for transmission Lines, Effect of arc resistance on the operation of distance relays. Carrier current protection.	
Unit IV	**[10Hrs]**
Equipment Protection: - Principle of differential relaying, causes and remedies for mal operation of differential protection, protection of generator and transformer by differential relaying and other relays. Protection of Induction Motors against overloading and short circuits.	
Unit V	**[9Hrs]**
Switchgears: - Arc interruption theory, Recovery and Restriking voltage, RRRV, different medium of arc interruption, Construction and operation of SF_6 and vacuum circuit breakers, rating of circuit breaker.	

Text Books:

S.N	Title	Authors	Edition	Publisher
1	Switchgear and Protection	Sunil S. Rao	Latest	Khanna publication
2	Power system protection and Switchgear	B Ram, D Vishwakarma	Latest	Tata McGraw Hill
3	Fundamental of power system protection	Y. Paithankar, S. Bhide	Latest	Prentice hall

Reference Books:

S.N	Title	Authors	Edition	Publisher
1	The art and science of protective relaying	C. Russell Mason	Latest	Willey
2	Protective Relaying Vol. I & II	Warrington	Latest	Springer
3	Switchgear Handbook	R. T. Lythall	Latest	Butterworth, London

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EE701P	Switchgear and Protection Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended to • realize the importance of power system protection. • understand different types of Relays and Protective Schemes used in power system protection. • introduce construction, working and applications of Circuit Breakers.	**Students will be able to** • Explain various types of relays and obtain the characteristics of Miniature Circuit Breaker (MCB) • plot the magnetic characteristics of current transformer. • Obtain the characteristics of different types of static relays • Use Gas Actuated Buchholz Relay to protect transformer • Obtain the characteristics of different types of numerical relays

Minimum 08 experiments to be conducted based on the syllabus. List of experiments may get modified.

Sr. No.	Title of the experiment
1	To plot the characteristic of MCB.
2	To plot the magnetization characteristic of current transformer.
3	To study the behaviour of static over voltage relay.
4	To plot the characteristic of static IDMT over current relay.
5	To plot the characteristic of numerical over current relay.
6	To study the operation of Buchholz relay.
7	To study the behaviour of numerical reverse power relay.
8	Study of various types of relays.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Switchgear and Protection	Sunil S. Rao	Latest	Khanna publication
2	Power system protection and Switchgear	B Ram, D Vishwakarma	Latest	Tata McGraw Hill
3	Fundamental of power system protection	Y Paithankar, S Bhide	Latest	Prentice hall

Reference Books

S.N	Title	Authors	Edition	Publisher
1	The art and science of protective relaying	C. Russell Mason	Latest	Willey
2	Protective Relaying Vol. I & II	Warrington	Latest	Springer
3	Switchgear Handbook	R. T. Lythall	Latest	Butterworth, London

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EE702P	Power System Simulation Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended ● To learn the concept of MATLAB, LABVIEW and PSIM Software's and apply it in the field of engineering and technology especially electrical power system simulation ● To apply programming and simulation knowledge to solve and design programs for applications related to electrical engineering	**Students will be able to** ● To analyze MATLAB , PSIM and LABVIEW Software toolboxes ● To develop and design programs in MATLAB Simulink ● To evaluate power system models in MATLAB, PSIM and LABVIEW Software

Expt. No. (Any 08)	Title of the experiment (Any 08)
1	To Determine Efficiency and Regulation of a medium transmission line by forming symmetric T network using MATLAB Software
2	Formation of Z Bus (without mutual coupling) using Z-Bus Building Algorithm using MATLAB Software
3	To Simulate and Design Suspension Insulator in MATLAB Software
4	To write a program in MATLAB for Bus Incidence Matrix
5	To Simulate Power System Protection using LABVIEW Software
6	To Simulate and Design rectifier circuit in PSIM Software
7	To simulate Inverter Circuit in PSIM Software
8	To study fault scenario in Power System using Virtual Lab IIT Bombay
9	To write a program in MATLAB for Ferrantii Effect

Text Books

S.N	Title	Authors	Edition	Publisher
1	Getting started with MATLAB	Rudra Pratap	2	Oxford
2	MATLAB and Simulink	Agam Tyagi	1	Oxford

Reference Books

S.N	Title	Authors	Edition	Publisher
1	MATLAB for Engineers	William J Palm	1	Tata Mcgraw Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EE703T(i)	PE-III Power Station Practice	4	-	-	4	30	70	100

Course Objectives	Course Outcomes
This course is intended 1) To Understand overview of different Power Plants and the associated energy conversion issues 2) To Understand fixation of tariff and voltage control of AC generator.	**Students will be able to** • Define Various sources of energy generation, conventional & Non – Conventional, Their scope and related factors with generation. They will also recognize the importance of interconnected grid systems • Recognize arrangement and operation of Thermal Power Station along with operation & importance of Various equipment's in Thermal Power plant. They will analyze and perform work in Thermal Power Plant • Recognize the arrangement and operation of Hydro Power Station along with operation & importance of Various equipment's & types of Hydro Power plant. They will analyze and perform work in Hydro Power Plant • Recognize Arrangement and operation of Nuclear Power Station along with operation & importance of Various equipment's like Nuclear Reactor in Nuclear Power plant. They will analyze and perform work in Nuclear Power Plant • Define about Co-generation & Captive Power Plant, their types. They will analyze and perform work with Co - Generation & Captive Power Generation units and also can lead the project for their sustainable development.

Unit I	**[12Hrs]**
Sources of Electrical Energy Generation: - Coal, oil, & natural gas, their scope and potentialities for energy conversion, Factors connected with generating stations, connected load, Maximum demand, demand factor, Load factor, diversity factor, Plant capacity and utilization factor, Load curve, load duration curve, Load survey, base load and peak load stations, Interconnection of Generating Stations - Advantages	
Unit II	**[12Hrs]**
Thermal Power Stations: - Choice of site. Size and no. of units, Rankine Cycle and its modification, General layout, Major equipment's, Essential and non-essential auxiliaries, Electric supply to auxiliaries, Cost of generation, Effect of different factors on costs	
Unit III	**[12Hrs]**
Hydro Power Stations: - Hydrology, Stream flow, Flow duration curve, power duration curve, Power duration curve, mass curve, Reservoir capacity, Types of hydro plants, Their field of use, problems, Pumped storage plants & their utilities, Surge tank, Governing characteristics of turbine & hydro generators	
Unit IV	**[12Hrs]**
Nuclear Power Stations: - Basics of Nuclear Energy Conversion, Layout and subsystems of Nuclear Power Plant, Boiler Water Reactor (BWR), Pressurized Water Reactor (PWR), Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactor (FBR), Gas Cooled and Liquid Meta Cooled reactors, Safety measures for nuclear power Plants	
Unit V	**[12Hrs]**
Cogeneration, Captive Power Generation & Sustainable Development: - Introduction, Definition & Scope, cogeneration technologies, industries suitable for cogeneration, Captive generation advantages and constraints, captive generation options, Type of captive power plants, financing of captive power plants, Energy problems, prospects of changes in energy supply, Agenda for sustainable development, General Discussions	

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Elements of Power Station design	M.V. Deshpande		PHI
2	Generation, Distribution and Utilization of Electrical Energy	C. L. Wadhwa		New Age International

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Electrical Power Stations	T. H. Carr	2nd	Chapman and Hall Ltd.
2	Electrical Power Station Control	H. P. Young		Chapman and Hall Ltd.
3	Non – Conventional Energy Sources	G. D. Rai	6th	Khanna Publishers

		June 2025	1.0	Applicable for 2025-26
Chairman - BoS	Dean – Academics	Date of Release	Version	

ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

B. Tech. Scheme of Examination & Syllabus 2022-23

ELECTRICAL ENGINEERING

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EE703T(ii)	PE-III Electrical Installation and Design	4	-	-	4	30	70	100

Course Objectives	Course Outcomes
• Enable students to learn concepts about Consumer Loads, various cables, conductors and bus bar system in installation • Enable students to study switching and protection devices along with short circuit calculations • Enable students to study Power and control circuit of starters for industrial application and also Reactive power Management in industries • Enable students to learn designing industrial installations and testing of installations • Enable students to study substations used for industrial installations, Earthing systems and IE Rules	**Students will be able to** • Recognize concept of consumer load requirements, tariff structures, and various cables, conductors and busbar systems • Identify switches for smooth functioning of protective scheme utilized for short circuit calculations • Analyze Power and control circuit of starters for industrial application and Reactive power Management in industries • Apply industrial installations system design and testing • Inferring the design of Electrical substations for industrial installations with IE Rules

Unit I **[12 Hrs]**

(A): CONSUMER LOAD REQUIREMENTS:

Consumer Factors, Least Cost of Supply, Revenue and Return, Electricity Tariff Trends in India, Energy Audit

(B): CABLES, CONDUCTORS & BUS- BARS:

Construction, selection, installation, rating of cables; Overhead line conductors - AAC, AAAC and ACSR; Various Bu-Bar Arrangements

Unit II **[12 Hrs]**

(A): SWITCHING & PROTECTION DEVICES:

Types, specifications; selections of isolators, switches, switch fuse units, MCB, ELCB, MCCB, ACB, VCB, SF6 breakers

(B): SYMMETRICAL SHORT CIRCUIT CALCULATIONS:

Determining symmetrical short circuit currents at various locations for selecting proper circuit breaker rating & determining value of series reactors for limiting short circuit current.

Unit III **[12 Hrs]**

(A): ELECTRIC SUPPLY TO INDUCTION MOTORS IN INDUSTRIES:

Types of motors, Various Devices for Starting and control of Electric Motors in Industries, Starters / Contactors / Relays

(B): REACTIVE POWER MANAGEMENT IN INDUSTRIES:

Reactive power compensation in industries using static capacitors, use of Power Triangle, Calculating payback period for capacitor investment due to reduced system currents.

Unit IV **[12 Hrs]**

DESIGN OF INDUSTRIAL ELECTRICAL INSTALLATION:

Preparing load list, assessing various factors associated with loads, selection of transformer, busbars, cables, switchgear, protective devices, Selection of Electric Drives in industries, testing of installation.

Unit V **[12 Hrs]**

SUBSTATIONS:

- Indoor/ outdoor substations, plan/elevations, Substation Equipments, Earthing System, Solar Roof Top Installation Design
- IE Rules applicable to residential, commercial & industrial installations

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Electric Power Distribution	Amarjit Singh Pabla	6th	TMH Edu. Pvt. Ltd.
2	A Text Book of Design of Electrical Installations	V. K. Jain, Amitabh Bajaj		Laxmi Publications
3	Principles of Power Systems	V. K. Mehta		S. Chand Publication
4	Utilization of Electric Power & Electric Traction	J. B. Gupta		Kataria Publications

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Indian Electricity Rules 1956		Latest	
2	IS 3043, Code of Practice for Earthing		Latest	
3	Residential, Commercial and Industrial Electrical Systems, Volume 1, 2, 3	Hemant Joshi		TMGH Publications

		June 2025	1.0	Applicable for 2025-26
Chairman - BoS	Dean – Academics	Date of Release	Version	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EE704T(v)	PE – IV Electrical Distribution System	4	-	-	4	30	70	100

Course Objectives	Course Outcomes
• To know about practical electrical distribution system and its necessity in the real world. • The conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e voltage drops and power losses. • How to improve the voltage profiles and power factor of the system to better value using various voltage control and compensation techniques.	**Students will be able to** • Explain the general aspects of electrical distribution system • Design and analysis of distribution feeders and substations • Calculate the voltage drop and power loss in the distribution system • Analyze the need for protection and distribution automation. • Evaluate the PF, Voltage and Power and design the equipment used to control it.

Unit I **[12 Hrs]**

INTRODUCTION & GENERAL CONCEPTS:

Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor. Classification of loads: Residential, commercial, Agricultural and Industrial loads and their characteristics.

Unit II **[12 Hrs]**

DISTRIBUTION FEEDERS & SUBSTATIONS:

Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system. SUBSTATIONS: Rating of distribution substation, service area within primary feeders, Benefits derived through optimal location of substations, Layout of the Substation

Unit III **[12 Hrs]**

DISTRIBUTION SYSTEM ANALYSIS:

Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

Unit IV **[12 Hrs]**

PROTECTIVE DEVICES&AUTOMATION :

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures and line sectionalizes, and circuit breakers. Automation:-Introduction to distribution automation, Data Acquisition System and decentralized control, data acquisition and protection considerations of control panel.

Unit V **[12 Hrs]**

VOLTAGE CONTROL & POWER FACTOR IMPROVEMENT:

Equipment for voltage control, effect of series capacitors, line drop Compensation, effect of AVB/AVR, Power factor control using different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and Switched), capacitor allocation-Economic Justification- Procedure to determine the best capacitor location.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Electrical Power Distribution Systems	V. Kamaraju		Tata Mc Graw-Hill Publishing Company
2	Electrical Power Distribution Systems	A. S. Pabla		Tata Mc Graw-Hill Publishing Company
3	Electric Power Distribution Automation	M. K. Khedkar& G. M. Dhole		University Science Press

		June 2025	1.0	Applicable for 2025-26
Chairman - BoS	Dean – Academics	Date of Release	Version	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EE761O(ii)	OE – III Power Electronics	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
This course is intended to ● introduce students, the basic theory of power semiconductor devices and their practical application in power electronics ● familiarize the operation principle of AC-DC, AC-AC, DC- DC, DC-AC conversion circuits and their applications ● provide the basis for further study of power electronics circuits and systems.	A student who successfully fulfil the course requirements will be able to ● understand basic operation of SCR and basic principle of switching circuits ● understand basic operation of various power semiconductor devices, along with their applications in electrical circuits. ● understand basic operation and characteristics of various power semiconductor devices ● understand the concepts of AC to DC and AC to AC circuit ● understand the concepts of DC to AC and DC to DC circuit

Unit I	**[09 Hrs]**
SCR: V-I, turn on & turn off characteristics, ratings, gate characteristics, over voltage and over current protection, Snubber circuit. Introduction and Classification Commutation techniques of SCR.	
Unit II	**[09 Hrs]**
Static controllable switches I: Characteristics & working of TRIAC, DIAC, UJT, AC regulator and working principle of UJT as relaxation oscillator.	
Unit III	**[09 Hrs]**
Static controllable switches II: Characteristics & working of MOSFET, Gate turn off thyristor and Insulated gate bipolar transistor. Introduction to advanced Power Devices.	
Unit IV	**[09 Hrs]**
Phase controlled Rectifiers (AC-DC Converters): Single phase half Wave controlled, full wave controlled rectifiers with R and RL load, Bridge Configurations with R and RL load, Effect of Freewheeling diode. **AC-AC Converters** • Basic Principle, Operation, Single phase AC voltage controller for R and RL loads. Introduction to Cycloconverters	
Unit V	**[09 Hrs]**
DC-DC converters (Chopper) Working principle of chopper, Types of choppers, Step-Up & Step-Down chopper for RL Load, Class-A, Class-B, Class-C, Class-D and Class-E chopper, Control Strategies. **DC-AC Converters (Inverter)** Classification of inverter, Working Principle of single phase Half Bridge and Single Phase Full Bridge inverter for R and RL load.	

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Power Electronics Circuits Devices and Applications	M. H. Rashid	Third	Pearson
2	Power Electronics	M. D. Singh & K. B. Khanchandani	Second	Tata McGraw Hill
3	Power Electronics	P. C. Sen.	Second	Tata McGraw Hill

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Power Electronics : Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Third	John Wiley & Sons

		June 2025	1.0	Applicable for 2025-26
Chairman - BoS	Dean – Academics	Date of Release	Version	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
22EEM701T	Battery Management Systems	4	-	-	4	30	70	100

Course Objectives	Course Outcomes
• Identify suitable energy storage system for Electric Vehicles, • Compare different energy storage system • Explain use of Energy management systems for Energy Storage system.	**Students will be able to** • Identify suitable energy storage system for Electric Vehicles. • Compare different energy storage system. • Explain use of Energy management systems for Energy Storage system.

Unit I : Introduction **[10Hrs]**

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Electrochemical and lithium-ion cells, Rechargeablecell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

Unit II: Battery Management System Requirement **[10Hrs]**

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Range estimation, State-of charge estimation, Cell total energy and cell total power.

Unit III: Battery State of Charge **[10Hrs]**

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Lithium-ion aging: Negative electrode, Lithium- i o n aging: Positive electrode,

Unit IV: State of Health Estimation and Cell Balancing **[9Hrs]**

Model-based state estimation, Battery Health Estimation, Cell Balancing, Causes of imbalance, Circuits for balancing

Unit V: Design of battery BMS **[9Hrs]**

Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system

Text Books

S.N	Title	Authors	Edition	Publisher
1	Battery management systems, Volume I	Plett, Gregory L	2015	Artech House
2	Battery management systems, Volume II	Plett, Gregory L	2015	Artech House
3	Battery Management Systems - Design by Modelling	Bergveld, H.J., Kruijt, W.S., Notten	2002	Philips Research Book Series

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Battery Management Systems for Large Lithium-ion Battery Packs	Davide Andrea	2010	Artech House