ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

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

B. Tech. Scheme of Examination & Syllabus 2023-24

ELECTRICAL ENGINEERING

SEMESTER VII

Sr.No	Course Category	Course Code	Course Title	Hours per Week			Credits	Maximum Marks				Minimum passing marks	No of Hours for ESE
				L	T	P		Mid Sem Exam	Continual Assessment	End Sem Exam	Total		
1	PCC	**23EE701T**	Switchgear and Protection	**4**	**-**	**-**	**4**	**15**	**15**	**70**	**100**	**45**	**3**
2	PCC	**23EE701P**	Switchgear and Protection Lab	**-**	**-**	**2**	**1**	**-**	**25**	**25**	**50**	**25**	**-**
3	PCC	**23EE702P**	Power System Simulation Lab	**-**	**-**	**2**	**1**	**-**	**25**	**25**	**50**	**25**	**-**
4	PEC	**23EE703T**	Program Elective – III (Refer PE basket)	**4**	**-**	**-**	**4**	**15**	**15**	**70**	**100**	**45**	**3**
5	PEC	**23EE704T**	Program Elective – IV (Refer PE basket)	**4**	**-**	**-**	**4**	**15**	**15**	**70**	**100**	**45**	**3**
6	ELC	**23EE705P**	Project - II	**-**	**-**	**4**	**2**	**-**	**50**	**50**	**100**	**50**	**-**
7	ELC	**23EE706P**	Summer / Winter Internship*	**-**	**-**	**-**	**2**	**-**	**50**	**-**	**50**	**25**	**-**
8	MDM	**23EE731M**	Multidisciplinary Minor – V (Refer MDM basket)	**3**	**-**	**-**	**3**	**15**	**15**	**70**	**100**	**45**	**3**
			Total	**15**	**-**	**8**	**21**	**60**	**210**	**380**	**650**	**-**	**-**

*** Summer / Winter Internship (Evaluation of Four weeks Internship Completion till 6th Semester)**

Course Code	Program Elective - III
23EE703T(i)	Battery Management Systems
23EE703T(ii)	Electrical Installation and Design

Course Code	Program Elective - IV
23EE704T(i)	Power Semiconductor Based Drives
23EE704T(ii)	Electric Distribution System

Course Code	Multidisciplinary Minor - V
23EE731M	Control System Engineering

		July 2026	**NEP 1.0**	**Applicable for 2026-27**
Chairman - BoS	**Dean – Academics**	**Date of Release**	**Version**	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23EE701T	Switchgear and Protection	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended to 1. realize the importance of power system protection. 2. understand different types of Relays and Protective Schemes used in power system protection. 3. introduce construction, working and applications of Circuit Breakers.	**Students will be able to** 1. explain basic terminology of Protective Relaying. 2. analyse over-current protection schemes for transmission lines. 3. evaluate various distance protection schemes for transmission lines. 4. justify different protections used for Generator, Transformer and Motor. 5. explain working of circuit breakers.

Unit I **[12Hrs]**

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 Electromechanical, Static and Numerical relays.

Unit II **[12Hrs]**

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 **[12Hrs]**

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 **[12Hrs]**

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 **[12Hrs]**

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
23EE701P	Switchgear and Protection Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended to 1. realize the importance of power system protection. 2. understand different types of Relays and Protective Schemes used in power system protection. 3. introduce construction, working and applications of Circuit Breakers.	**Students will be able to** 1. Explain various types of relays and obtain the characteristics of Miniature Circuit Breaker (MCB) 2. plot the magnetic characteristics of current transformer. 3. Obtain the characteristics of different types of static relays 4. Use Gas Actuated Buchholz Relay to protect transformer 5. 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

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23EE702P	Power System Simulation Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended 1. 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 2. To apply programming and simulation knowledge to solve and design programs for applications related to electrical engineering	**Students will be able to** 1. To analyse MATLAB, PSIM and LABVIEW Software toolboxes 2. To develop and design programs in MATLAB Simulink 3. 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 Ferranti Effect
10	Substation Automation Virtual Lab IIT Bombay Monitoring of Feeder / Bus Parameters

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

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B. Tech. Scheme of Examination & Syllabus 2023-24

ELECTRICAL ENGINEERING

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23EE703T(i)	PE – III Battery Management Systems	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
The course aims to identify suitable energy storage system for Electric Vehicles, compare different energy storage system and explain use of Energy management systems for Energy Storage system.	**Students will be able to** 1. Identify suitable energy storage system for Electric Vehicles. 2. Compare different energy storage system. 3. 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 andpower, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, 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, Communication Interface, 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 Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing	
Unit IV: State of Health Estimation and Cell Balancing	**[9Hrs]**
Model-based state estimation,Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, 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 withmulti-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
2	Super capacitors- materials, Systems. And Applications.	Beguin and E. Frackowiak	2013.	Wiley-VCH Verlag GmbH & Company

Chairman - BoS	Dean – Academics	July 2026 Date of Release	NEP 2.1 Version	Applicable for 2026-27

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23EE703T(ii)	PE – III Electrical Installation and Design	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
1. Enable students to learn concepts about Consumer Loads, various cables, conductors and bus bar system in installation 2. Enable students to study switching and protection devices along with short circuit calculations 3. Enable students to study various Industrial AC motor starters and also Reactive power Management in industries 4. Enable students to learn designing industrial installations and testing of installations 5. Enable students to study substations used for industrial installations, Earthing systems and IE Rules	**Students will be able to** 1. Recognize concept of consumer load requirements, tariff structures, and various cables, conductors and busbar systems 2. Identify switches for smooth functioning of protective scheme utilized for short circuit calculations 3. Analyze Industrial AC Motor starters for industrial application and Reactive power Management in industries 4. Apply industrial installations system design and testing 5. 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 Bus-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): MOTOR CONTROL IN INDUSTRIES:
General Principle of Motor Control, Installation of Motors and Control Equipment, Functions of Motor Control, Various AC Motor Starters, Variable Frequency Control of Motors
(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
4	Industrial Motor Control	Stephen L. Herman	7th	Delmar Cengage Learning

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23EE704T(i)	PE- II Power Semiconductor Based Drives	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
This course is intended: - 1. To study the dynamics of Electric drives along with stability. 2. To learn the various converters control methods used for DC motor, Induction, Synchronous motor drives and advanced drives. 3. To study the traction drives using ac and dc motors with advanced control.	**Students will be able to** 1. Understand dynamics of electric drives used in industry with steady state stability. 2. Select various converters control methods used for DC drives. 3. Analyse control topologies used for induction motor applicable to various industrial Applications. 4. Select proper power electronic converter to control speed of Synchronous motor and select controlling parameter depending on the application of motor 5. Compare the electric and non-electric traction system with conventional methods of operation of traction system.

Unit I Dynamics of Electric Drives **[12 Hrs]**

Dynamics of electric drives and control of electric drives, Power Modulator, Block Diagram of Electrical Drives, Four Quadrant Speed Torque diagram, Hoist Drive, Components of Load torque, Control of Electric Drives, Modes of operation, Speed transition. Steady State Stability. Energy Conservation in Electric Drives.

Unit II DC Motor Drives **[12 Hrs]**

Introduction of D.C. Motor drives, controlled rectifier fed D.C. Drives, single phase and three phase rectifier control of D.C. separately excited motor. Dual converter control of D.C. separately excited motor. Power factor supply harmonics and ripple in motor current. Chopper controlled DC drives of separately excited DC motor chopper control of series motor, source current harmonics.

Unit III Induction Motor Drives **[12 Hrs]**

Introduction of Induction motor drives, stator voltage control, variable frequency control using voltage source inverter, current source inverter and cycloconverter. Modelling of 3-phase Induction Motor: a-b-c- to d-q-o transformation, Dynamic analysis in terms of stator d-q windings and rotor dq windings, Electromagnetic torque equation. Introduction to vector control of induction motor.

Unit IV Synchronous Motor Drives & Advanced Motor Drives **[12 Hrs]**

Introduction of Synchronous Motor Drives, starting, braking of synchronous motor, variable frequency control, self-controlled synchronous motor drive employing load commutated Thyristor inverter or cycloconverter, starting of large synchronous motors. Brushless DC Motor, Stepper Motor, Switched Reluctance Motor Drives and Solar and Battery powered drives.

Unit V Traction Drives **[12 Hrs]**

Conventional D.C. and A.C. Traction drives, semiconductors converter controlled Drives, 25KV AC Traction using semiconductor converter controlled DC Motor. DC Traction using semiconductor, chopper controlled DC motors

Text Books

S.N	Title	Authors	Edition	Publisher
1	Fundamentals of Electrical Drives	G. K. Dubey	2nd	Narosa
2	Modern Electric Traction	H. Partab	2nd	Dhanpat Rai
3	Electric Drives	Vedam Subhramanyam	2nd	McGraw-Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Electrical Drives Control	R Krishnan	2nd	PHI
2	Modern Power Electronics and AC Drives	B.K.Bose	2nd	PHI

		July 2026	NEP 1.0	Applicable for 2026-27
Chairman - BoS	Dean – Academics	Date of Release	Version	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23EE704T(ii)	PE – IV Electrical Distribution System	4	-	-	4	15	15	70	100

Course Objectives	Course Outcomes
1. To know about practical electrical distribution system and its necessity in the real world. 2. The conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e. voltage drops and power losses. 3. 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** 1. Explain the general aspects of electrical distribution system 2. Design and analyze distribution feeders and substations 3. Evaluate the voltage drop and power loss in the distribution system 4. Analyze the need for protection and distribution automation. 5. Determine the optimal location of a capacitor & analyse the power factor improvement methods in the distribution system.

Unit I	**[12 Hrs]**
INTRODUCTION & GENERAL CONCEPTS: Introduction to distribution systems, Load modeling and characteristics, Various factors, 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 11kV / 415V 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]**
DISTRIBUTION SYSTEM PROTECTION & DISTRIBUTION AUTOMATION : Objectives of distribution system protection, types of common faults. 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 Compensator, 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

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23EE705P	Project – II	-	-	4	2	50	50	100

Course Objectives	Course Outcomes
This course is intended To enable the Students to undertake short research projects and fabricate it.	**Students will be able to** Explain fabrication work of project set up / devices or developed software.

S.N.	Project
1	**Projects are based on :** Recent Trends in Electrical Power System, Power Electronics and Renewable Energy.

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23EE731M	MDM – V Control System Engineering	3	-	-	3	15	15	70	100

Course Objectives	Course Outcomes
This course is intended 1. To determine transfer function of linear time-invariant system 2. To understand the stability, time domain specifications and tools. 3. To study state variable analysis	**Students will be able to** 1. Determine transfer function by classical approach. 2. Understand time response specifications of second order system. 3. Analyse stability of the control system 4. Analyze the relative stability through root locus method. 5. Determine state model.

Unit I	**[09Hrs]**
Introduction to Control System:- Need of control system, Open loop and closed loop control system, Transfer function, Block diagram reduction. Signal flow graph.	
Unit II	**[09Hrs]**
Time Response Analysis:- Basic concept of steady state and transient response, Time response of first and second order system, Time response specifications of second order system.	
Unit III	**[09Hrs]**
Stability Analysis: - Stability of control systems, Stability by Routh Hurwitz criterion, special cases for determining relative stability.	
Unit IV	**[09 Hrs]**
Root Locus Techniques: Root location and its effect on time response, Construction of root locus.	
Unit V	**[09Hrs]**
Frequency Response Analysis: Frequency response method of analyzing linear system, Polar and Bode plot, stability and accuracy analysis from frequency response.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Feedback Control System	R A Barapatre	11	Tech-Max
2	Modern Control Engineering	D Roy Choudhary		PHI
3	Control System Engineeering	U A Bakshi		Technical Publications

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Control System Engineering	S. K. Bhattacharya		Pearson
2	Control Systems, Principles & Design	M. Gopal		TMH (Tata McGraw Hill)
3	Control Systems Engineering	Samarajit Ghosh		Pearson