



**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA
(JHAJJAR)**

An Autonomous Institute

‘A’ GRADE ACCREDITED BY NAAC

Scheme of Studies and Examinations

(Under NEP-2020)

B-SCHEME

Common for Bachelor of Technology Electrical Engineering

And

Bachelor of Technology Electrical Engineering-Working Professionals

Effective from

Academic Session 2026-27 (From 2nd Year onwards)



**APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MDU,
ROHTAK**

5. DEFINITION OF CREDIT

1	1 Lecture (L) per week	1 Credit
2	1 Tutorial (T) per week	1 Credit
3	1 Practical (P) per week	0.5 Credit
4	2 Practical (Lab) per week	1 Credit

6. RANGE OF CREDIT

A range of credits from 160 to 170 for a student to be eligible to get Under Graduate degree in Electrical Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 18-20 credits. These could be acquired through MOOCs.

7. STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM (B.TECH)

Sr. No.	Category	Breakup of Credits
1	Basic Science Courses	21
2	Engineering Science Courses	22
3	Professional Core Courses	71
4	Professional Elective Courses (Relevant to chosen specialization/branch)	12
5	Open Electives Courses	9
6	Humanities and Social Sciences including Management courses	12
7	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	20
8	Value Added Courses	03
9	Mandatory Non Credit Courses – Audit Course	(Non-Credit)
	Total Credits	170

8. COURSE CODE AND DEFINITIONS

Sr. No.	Category	Course Code
1	Basic Science Courses	BSC
2	Engineering Science Courses	ESC
3	Professional Core Courses	PCC
4	Professional Elective Courses (Relevant to chosen specialization/branch)	PEC
5	Indian Knowledge System	IKS
6	Multidisciplinary Open Electives Courses	OEC
7	Humanities and Social Sciences including Management courses	HSMC
8	Laboratory Courses	LC
9	Mandatory Non-Credit Courses (Audit Course)	MC
10	Project	PR
11	Internship/ Practical Training/ Seminar	INT

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA,
JHAJJAR (HR.)**

**Scheme of Studies and Examinations
Common for B.Tech (Electrical Engineering) – 3rd Semester
and**

**B.Tech (Electrical Engineering-Working Professionals) – 3rd Semester
w.e.f. 2026-27**

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Humanities and Social Sciences including Management courses	HSMC-02B	Economics for Engineers	3	0	0	3	3	30	45		75	3
2	Professional Core Courses	PCC-EE-201B	Analog Electronics	3	0	0	3	3	30	45		75	3
3	Professional Core Courses	PCC-EE-203B	Electric Circuit Analysis	3	1	0	4	4	40	60		100	3
4	Professional Core Courses	PCC-EE-205B	Measurement and Instrumentation	3	0	0	3	3	30	45		75	3
5	Professional Core Courses	PCC-EE-207B	Electrical Machines-I	3	0	0	3	3	30	45		75	3
6	Professional Core Courses	PCC-EE-209B	Electrical Engineering Materials	3	0	0	3	3	30	45		75	3
7	Professional Core Courses	LC-EE-211B	Analog Electronics Lab	0	0	2	2	1	10		15	25	3
8	Professional Core Courses	LC-EE-213B	Electric Circuit Analysis Lab	0	0	2	2	1	10		15	25	3
9	Engineering Science Courses	LC-EE-215B	Measurement and Instrumentation Lab	0	0	2	2	1	10		15	25	3
10	Professional Core Courses	LC-EE-217B	Electrical Machines-I Lab	0	0	2	2	1	10		15	25	3
Total Credits								23				575	

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA,
JHAJJAR (HR.)**

**Scheme of Studies and Examinations
Common for B.Tech (Electrical Engineering) – 4th Semester
and**

**B.Tech (Electrical Engineering-Working Professionals) – 4th Semester
w.e.f. 2026-27**

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Basic Science Course	BSC-MEE-202B	Engineering Mathematics-III	3	1	0	4	4	40	60		100	3
2	Professional Core Course	PCC-EE-204B	Electrical Machines-II	3	0	0	3	3	30	45		75	3
3	Professional Core Course	PCC-EE-206B	Digital Electronics	3	0	0	3	3	30	45		75	3
4	Professional Core Course	PCC-EE-208B	Power Systems-I	3	0	0	3	3	30	45		75	3
5	Engineering Science Course	PCC-CSE-207B	Python Programming (Common with CSE 3 rd Sem)	3	0	0	3	3	30	45		75	3
6	Professional Elective Course	Refer Table-I	Professional Elective-I	3	0	0	3	3	30	45		75	3
7	Professional Core Course	LC-EE-210B	Electrical Machines-II Lab	0	0	2	2	1	10		15	25	3
8	Professional Core Course	LC-EE-212B	Digital Electronics Lab	0	0	2	2	1	10		15	25	3
9	Professional Core Course	LC-EE-214B	Power Systems-I Lab	0	0	2	2	1	10		15	25	3
10	Engineering Science Course	LC-CSE-213B	Python Programming Lab	0	0	2	2	1	10		15	25	3
11	Mandatory Courses	MC-201B	Environmental Science	2	0	0	2	0	20		30	50*	3
Total Credits								23				575	

Notes:

- I. Note-1: MC-201B is a mandatory non-credit course in which students will be required to obtain passing marks in theory. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these marks will be shown in detailed marks certificate of student.
- II. At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester. For students who didn't attend practical training: If you didn't attend practical training, discuss with your Coordinator/Head of Department to explore options and create a plan to complete the requirement. Students who miss practical training due to personal or technical reasons can pursue it during session timings after classroom hours with the Head of Department's permission. The student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training centre/Project/Seminar report, etc.
- III. The students under working professionals must obtain training certificate preferably from the company in which currently working.
- IV. Students should take Massive Open Online Courses (MOOCs) approved by the concerned Chairperson Board of Studies (BoS)
- V. Choose any one from Professional Elective-I

Table 1 Professional Elective – I

Sr. No.	Code	Subject
1	PEC-EE-216B	Wind and Solar Energy Systems
2	PEC-EE-218B	Electromagnetic Field Theory
3	PEC-EE-220B	Special Electrical Machines
4	PEC-EE-222B	High Voltage Engineering

*A student can do only one course from MOOC in lieu of elective courses in a semester with a approval of Head of the Department.

Course Code	HSMC-02B				
Category	Humanities and Social Sciences including Management Courses				
Course Title	Economics for Engineers				
Scheme and Credits	L	T	P	Credits	Semester- III
	3	0	0	3	
Course Objectives	The objectives of this course are to • Introduce the basic concepts of economics and their relevance to science, engineering, and national development. • Develop a foundational understanding of microeconomic principles such as demand, supply, production, cost, and market structures. • Equip students with tools to apply economic reasoning to real-world pricing, output, and market decisions. • Familiarize students with macroeconomic elements like the Indian economy, banking system, privatization, and globalization.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe economic concepts, the connection between economics and engineering and technological development, along with economic laws relevant to resource-based decision making in society.	Level 1: Remember
CO2	Explain economic growth theories and illustrate the role of engineering and technology in supporting economic development.	Level 2: Understand
CO3	Apply theories of consumption and production to the design and development of engineering products.	Level 3: Apply
CO4	Analyze market conditions, evaluate cost structures and financial aspects to assess the feasibility of engineering projects.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Definition of Economics: Various Definitions, Types of Economics, Micro and Macro Economics, Nature of Economic Problem, Production Possibility Curve, Economic Laws and their Nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand: Meaning of Demand, Law of Demand, Elasticity of Demand, Meaning, Factors affecting the Elasticity of Demand, Practical Application and Importance.

Unit-II

Production: Meaning of Production and Factors of production, Law of Variable Proportions, Returns to Scale, Internal and External Economies and Diseconomies of Scale, Various concepts of Cost of Production- Fixed Cost, Variable Cost, Money Cost, Real Cost, Accounting Cost, Marginal Cost, Opportunity Cost, Shape of Average Cost, Marginal Cost, Total Cost etc. in short run and long run.

Unit-III

Market: Meaning of Market, Types of Market- Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly (main features).

Supply: Supply and Law of Supply, Role of Demand and Supply in Price Determination and Effect of Changes in Demand and Supply on Prices.

Unit-IV

Indian Economy: Nature and Characteristics of Indian Economy as underdeveloped, developing and mixed economy (brief and elementary introduction).

Privatization: Meaning, Merits and Demerits.

Globalization of the Indian Economy: Merits and Demerits

Banking: Concept of a Bank, Commercial Bank, Central Bank, Functions of a Bank, Difference between Commercial and Central Bank.

Suggested Readings:

- Modern Microeconomics: Theory and Applications by H.L. Ahuja, S. Chand & Company Pvt. Ltd.
- Indian Economy by S.K. Misra & V.K. Puri, Himalaya Publishing House.
- Indian Economy: Principles and Policies by Sri Rangam, Sri Ram, & Rohit Deo, Pearson Education.
- Managerial Economics by R. Cauvery, S. Chand & Company Pvt. Ltd.
- Microeconomic Theory by Andreu, Whinston, D. Michael, Green, R. Jerry, Oxford University Press.
- Principles of Economics by E. Karl, C. Ray, Oster, & E. Sharon, Pearson Education.

Useful Video Links:

Unit No.	Topics	Links
Unit-I	Fundamental concepts of microeconomics, including definitions, types, and the nature of economic problems.	https://www.youtube.com/watch?v=IFtOcNbej0o&list=PLFNFJbo2hfBGRTCMuroZGykNzacwmAH2L
Unit-II	Production and Cost of production	https://www.youtube.com/watch?v=VU1zySe-8NA
Unit-III	Theory of Markets	https://www.youtube.com/watch?v=HylqSa58lqQ
Unit-IV	Nature and characteristics of the Indian economy, highlighting aspects of underdevelopment and development.	https://www.youtube.com/watch?v=ME-0GOhhZcs&list=PLFW6lRTa1g83winAoIK92HL4xTytJaW7S

Course Code	PCC-EE-201B				
Category	Professional Core Courses				
Course Title	Analog Electronics				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives	The objectives of this course are • To understand response of BJT and MOSFET. • To develop the ability to design and implement OP-AMP-based applications. • To design oscillator and power amplifier circuits. • To impart knowledge of feedback principles and feedback topologies				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Remember the fundamentals and characteristics of semiconductor devices and analog electronic circuits.	Level 1: Remember
CO2	Understand the principles and operation of amplifiers, feedback circuits, and operational amplifiers.	Level 2: Understand
CO3	Apply the concepts of analog electronics to basic circuit analysis and electronic applications.	Level 3: Apply
CO4	Analyze the performance and behavior of analog electronic circuits and systems.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Semiconductor Devices: P-N Junction Diode: I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits, Special Purpose Diodes: LED, Photodiode, Varactor diode, Schottky diode.

Bipolar Junction Transistors (BJT): Structure and characteristics, Common base, common collector and common emitter configuration, BJT as Switch, BJT as an amplifier, RC Coupled amplifier: Frequency response curve, Bandwidth.

MOSFET: Structure and I-V characteristics, MOSFET as a switch, MOSFET as amplifier.

Unit-II

Feedback: Concept of Feedback, Negative Feedback and Positive feedback, properties of negative feedback, Advantages and Disadvantages of Negative Feedback, the four basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, and the shunt-shunt and shunt series feedback amplifier.

Power Amplifier: Definition, Application & Types of Power Amplifiers (Class A, B, C, & D), Push Pull Amplifiers, Distortion & Efficiency of Power Amplifier, Integrated Circuit Power Amplifier.

Unit-III

Operational Amplifier Fundamentals: Block Diagram Representation, Ideal OP-AMP, OP-AMP Equivalent Circuit, Characteristics of OP-AMP, Characteristics of Ideal OP-AMP, Ideal Voltage Transfer Curve, Input Offset Voltage, Input Bias Current, Input Offset Current, Output Offset Voltage, Thermal Drift, Effect of Variation in Power Supply Voltages on Offset Voltage, Common Mode Configuration and CMRR, Frequency Response of OP-AMP: Open Loop Response, Close Loop Response, Input and Output Impedances, Effect of Finite Gain Bandwidth Product, Slew Rate, OP-AMP as Integrator & Differentiator.

Unit-IV

Operational Amplifier Applications: Linear and non-linear applications- Instrumentation Amplifier, voltage regulator, Active Filters, ADC and DAC, Square wave and triangular wave generator, Multivibrators.

Oscillators: Introduction, Barkhausen Criterion, Conditions for Sustained Oscillations & Frequency of Oscillations, Oscillator with RC Feedback circuit (RC Phase Shift, Wien Bridge), Tuned Collector, LC Feedback circuits (Hartley, Colpitts), Crystal Oscillator.

Suggested Readings:

- Integrated Electronics by Millman Halkias, TMH.
- Electronics Device & Circuit by Robert Boylestad, & Louis Nashelsky, Pearson Education.
- Electronics Device & Circuit Theory by I.J. Nagraath, PHI Learning.
- Electronics Device & Integrated Circuit by A.K. Singh, PHI Learning.
- A Textbook of Electronic Devices and Circuits by J.B. Gupta, S.K. Kataria and Sons.
- Integrated Electronics: Analog and Digital Circuits and Systems by Millman, Jacob, TMH.
- Applications and Design with Analog Integrated Circuits by Jacob, Michael, Pearson Education.

Useful Video Links

Unit No.	Topics	Links
Unit-I	RC Coupled Amplifiers	https://youtu.be/BSR26SU3R2U
Unit-II	Power Amplifiers	https://youtu.be/huDZjQcEBMg
Unit-III	Voltage regulators	https://youtu.be/R_QnIAEk7Go
Unit-IV	Operational Amplifier	https://youtu.be/cITA0pONnMs

Course Code	PCC-EE-203B				
Category	Professional Core Courses				
Course Title	Electric Circuit Analysis				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Objectives	The objectives of this course are • To make the students familiar with the fundamental principles and analysis techniques of electrical circuits using network theorems and circuit laws. • To develop the understanding of students in the transient and steady-state behavior of electrical circuits under various excitation conditions. • To familiarize the students with AC circuit analysis, resonance phenomena, and transform-based methods for circuit evaluation. • To make the students learn about passive network synthesis and two-port network representations for electrical network analysis and design.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fundamental concepts, circuit laws, network theorems, transient and steady-state parameters, synthesis methods, and two-port network representations used in electrical circuit analysis	Level 1: Remember
CO2	Discuss the behavior of electrical circuits under transient and steady-state conditions, network synthesis techniques, and two-port network characteristics.	Level 2: Understand
CO3	Determine circuit parameters, network responses, resonance conditions, transform-based solutions, and two-port network characteristics for electrical circuits.	Level 3: Apply
CO4	Classify electrical networks, transient and steady-state responses, synthesized networks, and two-port network configurations based on their characteristics and performance.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each Unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Network Theorems in AC Circuit: Circuit elements, KCL, KVL, Nodal and mesh Analysis, Independent and dependent sources, Star-delta transformation, Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem.

Unit-II

Transient State Analysis: Forced and free response, Time constants, Transient behavior of circuit elements under switching conditions and their representations, Solution of first and second-order

circuits, Evaluations of initial and final states in series and parallel RL, RC and RLC circuits with AC and DC excitation.

Unit-III

Steady State Analysis: Sinusoidal response of series and parallel RL, RC and RLC circuits, Power in AC circuits, Three-phase circuits, Resonance, Laplace Transform and its application in circuit analysis.

Unit-IV

Synthesis of passive networks: Hurwitz polynomials, Positive real functions, Concept of Network Synthesis, RL, RC & LC network synthesis, Network graphs.

Two Port Network: Impedance parameter, Admittance parameter, Transmission parameter, Hybrid parameter, Inverse hybrid parameter, Inverse transmission parameter, Relationship between parameter sets, Interconnection of two-port networks.

Suggested Readings

- Fundamentals of electric circuits by Alexander, K. Charles, & Matthew Sadiku, McGraw Hill Education.
- Network Analysis by M E. Van-Valkenburg, Prentice Hall.
- Circuits and Networks by A Sudhakar, Tata McGraw-Hill.
- Engineering Circuit Analysis by W. Hayt, Tata McGraw-Hill.
- Electric Circuit by D.A. Bell, Oxford University press.
- Introduction to Modern Network Synthesis by M E. Van-Valkenburg, Wiley and Sons.
- Introduction to Modern Network Synthesis by Suresh Kumar, Dorling Kindsley.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Basic Circuit Elements	https://youtu.be/zkWvL1pPkMY
	Mesh and Nodal Analysis	https://youtu.be/TBmX3d8zuXU
	Network Theorems	https://youtu.be/LPttepJwgNE
Unit-II	Transient State Analysis	https://youtu.be/jT7R1Ez6Vg?list=PLbRMhDVUMngfNnABo5mre45ZbHqJE2sUn
	First and Second Order Circuits	https://youtu.be/alkm4B9JPWw
	Laplace transformation and its application	https://youtu.be/uJujJlkro6s
Unit-III	Sinusoidal steady state Analysis	https://youtu.be/c6U3Vnq6IL4
	Active and Reactive power in A.C circuit	https://youtu.be/4SnFYwxsr8M
Unit-IV	Graph Theory	https://youtu.be/0BQ2yyC6Lc8?list=PLbRMhDVUMngfNnABo5mre45ZbHqJE2sUn
	Two port networks	https://youtu.be/geM6Qz61MBA

Course Code	PCC-EE-205B				
Category	Professional Core Courses				
Course Title	Measurement and Instrumentation				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives	The objectives of this course are • To make the students familiar with the fundamental principles, characteristics, and standards of electrical measurements and measuring instruments. • To develop the understanding of students in measurement errors, instrument performance, and techniques for accurate electrical measurements. • To familiarize the students with analog and digital measuring instruments, transducers, and display devices used in electrical engineering applications. • To make the students learn about bridge methods and measurement techniques for determining electrical parameters and resistances with high accuracy.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fundamental concepts, characteristics, errors, measuring instruments, transducers, and bridge circuits used in electrical measurements.	Level 1: Remember
CO2	Explain the operating principles, performance characteristics, error sources, and measurement techniques of electrical measuring instruments and systems.	Level 2: Understand
CO3	Determine electrical quantities, instrument parameters, bridge balance conditions, and measurement results using appropriate measurement techniques.	Level 3: Apply
CO4	Classify measuring instruments, transducers, measurement errors, and bridge circuits based on their characteristics, accuracy, and application requirements.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Introduction: Introduction to measurement, Methods of measurement, Classification of instruments, Types of errors in measurement. Accuracy, tolerance, sensitivity, reproducibility, absolute and secondary measuring instruments, recording instruments. CRO.

Unit-II

Analog Instruments: Classifications of analog instruments, Introduction to operating, controlling and damping torque, Electrodynamometer type wattmeter, Electro-dynamometer type Power factor meter. Moving Coil

(PMMC) & Moving Iron (MI) instruments: construction, torque equation range extension, effect of temperature, classification, errors, advantages, and disadvantages.

Unit-III

AC-DC Bridges and Potentiometer: AC-DC Bridges: Measurement of resistance: Wheatstone, Kelvins Double, and Megger, earth resistance measurement by earth tester Measurement of inductance and capacitance: Maxwell's bridge, Schering bridge, Potentiometer, Numerical problem

Unit-IV

Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Instrument Transformer: Current Transformer (CT), Types of CT (measuring and protection), Potential Transformer (PT). Introduction to Transducers and their Application

Suggested Readings:

- A course in Electrical and Electronic Measurements and Instrumentation by A. K. Sawhney, & Puneet Sawhney, Dhanpat Rai & Company.
- LabVIEW graphical programming by Jennings, Richard, & Fabiola De La Cueva, McGraw-Hill Education.
- Electronic Instrumentation and Measurements by A. David Bell, Oxford University Press.
- Electrical Measurements and Measuring Instruments by E. W. Golding, F. C. Widdis, 6th Edition, Medtech.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Sources of Errors in measurements	https://www.jove.com/v/14506/types-of-errors-detection-and-minimization
	Loading effects of instruments	https://www.electricalengineering.xyz/loading-effect-of-electrical-measurement-instruments/
Unit-II	Single phase energy meter	https://emimnit.wordpress.com/2016/10/16/single-phase-energy-meter/?utm_source=chatgpt.com
	Introduction of virtual instruments	https://www.youtube.com/watch?v=iGYOlNp6vw
Unit-III	Comparison of analog & digital techniques	https://www.youtube.com/watch?v=rkOWP9oVaXk
	Oscilloscope & its application	https://www.tek.com/en/documents/primer/oscilloscope-basics?utm_source=chatgpt.com
Unit-IV	Limitation of Wheatstone bridge	https://www.shiksha.com/online-courses/articles/learning-wheatstone-bridge-principle/?utm_source=chatgpt.com
	General balance equation , CKT diagram, phasor diagram	https://www.electrical4u.com/wheatstone-bridge-circuit-theory-and-principle/

Course Code	PCC-EE-207B				
Category	Professional Core Courses				
Course Title	Electrical Machines-I				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives	The objectives of this course are • To make the students familiar with the principles of electromagnetic induction, magnetic circuits, and the constructional features of electrical machines. • To develop the understanding of students in the operation, characteristics, testing, and performance of DC machines. • To familiarize the students with the construction, operation, equivalent circuits, testing, and performance evaluation of transformers. • To make the students learn about three-phase transformers, special transformer connections, parallel operation, and transformer performance enhancement techniques.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fundamental concept of magnetic circuits, constructional features, operating principles, characteristics, and testing methods of DC machines and transformers.	Level 1: Remember
CO2	Discuss the general laws and rules of electromagnetic induction, operation, performance characteristics, losses, testing procedures, and transformer connections used in electrical machines.	Level 2: Understand
CO3	Calculate machine and transformer parameters, performance characteristics, efficiency, voltage regulation, and operating conditions using appropriate methods.	Level 3: Apply
CO4	Analyze DC machine characteristics, transformer configurations, operating performance, testing results, and connection schemes based on application requirements.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

General introduction to electrical machines: Magnetic circuits, Concepts of reluctance and permeance, Faraday's law of electromagnetic induction, Lenz's Law and Fleming's rules. Electromechanical energy conversion principle, Principle of operation of generators and motors. Magnetic curves and their relevance.

Unit-II

D.C Machines: Constructional features, armature windings - simple lap and wave winding; armature voltage and torque equations. D.C generators: Classifications, performance characteristics; Losses, efficiency and power flow diagram.

D.C. motors: Classifications, torque/speed characteristics of different types; Losses, efficiency and power flow diagram. Starting, speed control and braking. Testing and efficiency. BLDC motor

Unit-III

Transformers: Constructional features; Ideal transformer and practical transformer, name plate rating, phasor diagrams, equivalent circuit and determination of its parameters from O.C and S.C tests, sunneber test and other test; referred values of Input and output side; Regulation, efficiency and all-day efficiency expressions and calculations. Parallel operation.

Unit-IV

Autotransformer: Basic constructional features; Comparative study with two winding transformers. 3-phase Transformer: As a single unit with name plate rating and as a bank of three single phase transformers; Parallel operation conditions and load sharing.

Suggested Readings:

- Electric Machinery by A. E. Fitzgerald and C. Kingsley, McGraw Hill Education.
- Performance and design of DC machines by A. E. Clayton and N. N. Hancock, CBS Publishers.
- Performance and design of AC machines by M. G. Say, CBS Publishers.
- Electrical Machinery by P. S. Bimbhra, Khanna Publishers.
- Electric Machines by I. J. Nagrath and D. P. Kothari, McGraw Hill Education.
- Electric Machines by Ashfaq Husain and Haroon Ashfaq, Dhanpat Rai & Co.
- A Text Book of Electrical Technology by B.L. Theraja & A.K. Theraja, S.Chand.
- DC Machines and Transformers by Deshveer Narwal, M. Balasubbareddy, Atul Katiyar, & Nitish Kumar, SIPH.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Principle of Rotating Electrical Machines	https://youtu.be/Rd5q7a7IXvs
	Pitch factor and Winding Factor	https://youtu.be/cyl9uLt4swo
Unit-II	Introduction to DC Machine	https://youtu.be/PRdLNTQ2fRE
	Armature Winding	https://youtu.be/GdwG6Padf2M
Unit-III	Starting of DC Motor	https://youtu.be/DgQE286XwHw
	Speed Control of DC Shunt Motor	https://youtu.be/J3EUw7J16c8
Unit-IV	Short Circuit Test	https://youtu.be/puQ7lzZJ_3s
	Voltage Regulation	https://youtu.be/NnBbKE7VHRQ

Course code	PCC-EE-209B				
Category	Professional Core Courses				
Course title	Electrical Engineering Materials				
Scheme and Credits	L	T	P	Credits	Semester- III
	3	0	0	3	
Course Objectives:	The objectives of this course are • To develop a comprehensive understanding of the electrical and thermal conductivity properties of materials. • To explore magnetic and dielectric properties of materials and their applications. • To analyze magnetic materials and their practical utilization. • To develop an understanding of semiconductor physics for electrical and electronic applications.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skill demonstrated	RBT Level
CO1	Describe the fundamental concepts, properties, classifications, and phenomena associated with conducting, dielectric, magnetic, and semiconductor materials.	Level 1: Remember
CO2	Discuss the electrical, thermal, magnetic, and dielectric behavior of engineering materials and the factors influencing their characteristics.	Level 2: Understand
CO3	Calculate material parameters and electrical characteristics related to conduction, polarization, magnetization, and semiconductor behavior.	Level 3: Apply
CO4	Classify engineering materials based on their electrical, dielectric, magnetic, and semiconductor properties for suitable electrical applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, thermionic emission, photoelectric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

Unit-II

Dielectric Materials: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, dielectric losses, significance of the loss tangent, frequency and

temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, ferroelectricity, piezoelectricity.

Unit-III

Magnetic Materials: Introduction, Classification of magnetic materials, diamagnetism, Paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.

Unit-IV

Semiconductors: Energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

Suggested Readings

- An Introduction to Electrical Engineering by C. S. Indulkar and S. Thiruvengadam, S. Chand Publications.
- Engineering Materials by Kenneth G. Budinski, Prentice Hall of India, New Delhi.
- Electrical Engineering Materials by A. J. Dekker, Pearson Publications.
- A Text Book of Electrical and Electronics Engineering Materials by P. L. Kapoor, Khanna Publishers.
- A Textbook of Electrical Engineering Materials by R. K. Rajput, Laxmi Publications.

Useful Video Links:

Unit No.	Topic	Link
Unit-I	Expression for electrical conductivity in metals	https://www.youtube.com/watch?v=wzWJwjju9I
Unit-II	Insulating Materials	https://www.youtube.com/watch?v=-fAphSvtVKA
Unit-III	Magnetic Materials	https://www.youtube.com/watch?v=-fAphSvtVKA
Unit-IV	Semiconductor materials	https://www.youtube.com/watch?v=-5iR1H2nxvo

Course code	LC-EE-211B				
Category	Professional Core Courses				
Course title	Analog Electronics Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Course Objectives	The objectives of this course are to • Understand the characteristics and AC analysis of RC coupled amplifiers, oscillators, regulators and timers. • Developing Knowledge of Rectifiers, Regulators, and Power Supplies • Analyzing and Designing Amplifiers and Oscillators • Application of Operational Amplifiers and Timer Circuits in Signal Processing				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply theoretical knowledge to assemble, test, and troubleshoot electronic circuits	Level 3: Apply
CO2	Analyze and interpret the VI characteristics of Zener diodes, MOSFETs, and transistors	Level 4: Analyze
CO3	Evaluate the performance of rectifiers and filters by calculating theoretical and practical ripple factors	Level 5: Evaluate
CO4	Differentiate and compare various feedback topologies	Level 6: Create

List of Experiments

Sr. No.	Content
1	To plot VI characteristics of a Zener diode.
2	To study rectifier and the effect of filters on the output of rectifier. Also, calculate the theoretical and practical ripple factor.
3	To analyze and study different types of feedback topology.
4	To analyze and study RC phase shift oscillator.
5	To analyze and study Wein's bridge oscillator.
6	To plot the characteristics of MOSFET.
7	To plot input and output characteristics of transistor configurations.
8	To analyze and study inverting and non-inverting op-amp amplifiers.
9	To analyze and study the 555 timer as a square wave generator.
10	To analyze and study the frequency response of RC coupled amplifier.

11	To analyze and study the working of Push-Pull amplifiers.
12	To analyze and study op-amp amplifiers as a differentiator.
13	To analyze and study op-amp amplifiers as an integrator.

Virtual Lab Links

Experiment Name	Virtual Lab Link
To analyze and study op-amp amplifiers as an integrator.	https://ade2-iitr.vlabs.ac.in/exp/mathematical-operations/
To analyze and study op-amp amplifiers as a differentiator	https://ade2-iitr.vlabs.ac.in/exp/mathematical-operations/
555 timer as a square wave generator	https://aec-iitkgp.vlabs.ac.in/exp/monostable-multivibrator/
Inverting and non-inverting op-amp amplifiers	https://ade2-iitr.vlabs.ac.in/exp/characteristic-parameters/

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course code	LC-EE-213B				
Category	Professional Core Courses				
Course title	Electric Circuit Analysis Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Course Objectives	The objectives of this course are to • Enhance problem-solving abilities by verifying network theorems, Nodal and Mesh analysis techniques for systematic circuit analysis. • Analyse transient responses of RL and RC circuits and interpret their time-domain behaviour. • Learn to synthesise a network from a given network function and experimentally verify its response. • Evaluate and experimentally verify Z, Y, and T parameters of two-port networks.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply various circuit analysis techniques, Nodal Analysis, Mesh Analysis and fundamental theorems.	Level 3: Apply
CO2	Analyze the transient response of RL and RC circuits and examine resonance phenomena in series and parallel AC circuits.	Level 4: Analyze
CO3	Evaluate Z, Y, and T parameters of two-port networks and determine equivalent parameters for various interconnections.	Level 5: Evaluate
CO4	Design and verify network responses by synthesizing a given network function.	Level 6: Create

List of Experiments

Sr. No.	Content
1	To study Nodal Analysis.
2	To study Mesh Analysis.
3	To verify Thevenin's theorem in AC circuit.
4	To verify Norton's theorem in AC circuit.
5	To verify Superposition theorem in AC circuit.
6	To verify Maximum Power Transfer Theorem in AC circuit.
7	To Study transient state response of RL and RC circuit.
8	To plot current locus diagram of RL, RC and RLC series circuit.
9	To synthesize a network of give network function and verify its response.
10	To study resonance in series and parallel AC circuits.

11	To evaluate and verify Z, Y and T parameters of a two port network.
12	To determine equivalent parameters of various interconnections of a two port network.

Virtual Lab Links

Experiment Name	Virtual Lab Link
To study Nodal Analysis.	https://pltw.multisim.com/content/rhoaBoJsuRZbvGTWpdmz3E/lab-3-kirchhoffs-laws-and-mesh-and-nodal-analysis/
To study Mesh Analysis.	https://pltw.multisim.com/content/rhoaBoJsuRZbvGTWpdmz3E/lab-3-kirchhoffs-laws-and-mesh-and-nodal-analysis/
To Study transient state response.	https://asnm-iitkgp.vlabs.ac.in/exp/transient-state-response/
To plot current locus diagram of RL, RC and RLC series circuit.	https://asnm-iitkgp.vlabs.ac.in/exp/current-locus-diagrams/
To synthesize a network of give network function and verify its response.	https://asnm-iitkgp.vlabs.ac.in/exp/network-function-synthesis/
To study resonance in circuits.	https://asnm-iitkgp.vlabs.ac.in/exp/resonance-in-circuits/
To evaluate and verify Z, Y and T parameters of a two port network.	https://asnm-iitkgp.vlabs.ac.in/exp/two-port-network/
To determine equivalent parameters of various interconnections of a two port network.	https://asnm-iitkgp.vlabs.ac.in/exp/two-port-network/

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course code	LC-EE-215B				
Category	Professional Core Courses				
Course title	Measurement and Instrumentation Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Course Objectives	The objectives of this course are to • To understand the construction, working principles, and proper connections of various electrical and electronic measuring instruments. • To develop the ability to calibrate electrical measuring instruments for accurate measurement. • To acquire practical skills in measuring electrical quantities, power, power factor, and circuit parameters using conventional and advanced methods. • To understand the application of transducers for the measurement of physical parameters and their characteristics.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Understand the construction, working and connection of different types of meters, transducers, strain gauges and star delta starters.	Level 2: Understand
CO2	Apply electrical measuring instruments such as voltmeters, ammeters, wattmeter, and energy meters using appropriate calibration techniques to ensure accurate measurements.	Level 3: Apply
CO3	Analyze accuracy of Measuring instrument for electrical quantities such as resistance, inductance, capacitance, power, and power factor using bridges, CT/PT arrangements.	Level 4: Analyze
CO4	Evaluate the characteristics of transducers such as LVDTs and capacitive sensors, and apply them for displacement and liquid level measurements.	Level 4: Evaluate

List of Experiments

Sr. No.	Content
1	To study construction of different types of meters & study how to connect them in a circuit.
2	To calibrate a Voltmeter & an ammeter using a potentiometer.
3	Calibration of AC Wattmeter by Standard Voltmeter and Ammeter.
4	Calibration of single-phase energy meter.
5	To Measure Power & P.F by using 3 ammeter & 3 voltmeter methods.
6	To Measure Power & P.F by two wattmeter method.
7	To measure low resistance by Kelvin double bridge.
8	Measurement of Inductance using Maxwell Bridge.

9	To Measure capacitance by De Sauty bridge.
10	To Measure power with help of CT & PT.
11	Determine output characteristics of LVDT and Measure displacement using LVDT.
12	Measurement of liquid level; using capacitive transducer.
13	To Measure high resistance by loss of charge methods.
14	Determine the unknown Inductance & Q factor by Hay's bridge.
15	Study blocks wise construction of analog Oscilloscope & function generator.
16	To study LAB VIEW.

Virtual Lab Links

Experiment Name	Virtual Lab Link
To study LAB VIEW.	https://www.iitk.ac.in/oscillations/index.html
Study blocks wise construction of analog Oscilloscope & function generator.	https://aec-iitkgp.vlabs.ac.in/?utm_source=chatgpt.com
Determine output characteristics of LVDT and Measure displacement using LVDT.	https://virtual-labs.github.io/exp-lvdt-coep/index.html?utm_source=chatgpt.com
To Measure power with help of CT & PT.	https://vp-dei.vlabs.ac.in/vp-dei/Dreamweaver/?utm_source=chatgpt.com
To measure low resistance by Kelvin double bridge.	https://elms-iitr.vlabs.ac.in/exp/kelvin-sdouble-bridge/simulation/index.html
To measure high resistance by the loss of charge methods.	https://virtual-labs.github.io/exp-loss-of-charge-method

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course code	LC-EE-217B				
Category	Professional Core Courses				
Course title	Electrical Machines-I Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Course Objectives	The objectives of this course are • To understand the working of DC machines and transformers. • To perform key tests to analyze machine performance. • To develop practical skills in handling electrical equipment.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Understand the principles of DC machines and transformers.	Level 2: Understand
CO2	Apply testing methods to assess machine performance.	Level 3: Apply
CO3	Analyze machine behavior under different conditions.	Level 4: Analyze
CO4	Evaluate speed control and transformer operation methods.	Level 5: Evaluate

List of Experiments

Sr. No.	Content
1	To perform an open-circuit test of a single-phase transformer.
2	To perform short-circuit test of a single-phase transformer.
3	To perform a load test on the single-phase transformer
4	To study the conversion of 3 phase to six phase using 3 single phase transformers.
5	To study the parallel operation of two single-phase transformers.
6	To perform polarity test on the single-phase transformer.
7	To study the Load Characteristics of DC shunt generator.
8	To study the Load Characteristics of DC series motor.
9	To perform the speed control of a DC Motor by field resistance Control and Armature control method.
10	To perform speed control of a DC motor by using Ward-Leonard Method. Draw the graph between armature voltage and speed of motor.
11	To study Hopkinson's test of DC Shunt machine.
12	To study the magnetisation characteristics of DC Shunt Generator. Draw the graph between the armature voltage and field current.

Virtual Lab Links

Experiment Name	Virtual Lab Link
To study the Load Characteristics of DC shunt generator	https://ems-iitr.vlabs.ac.in/exp/load-characteristics-dc-shunt/
To study the speed control of DC Motor by field resistance Control.	https://ems-iitr.vlabs.ac.in/exp/dcmotor-field-resistance-control/simulation.html
To study the speed control of D.C. Shunt motor by armature control method.	https://ems-iitr.vlabs.ac.in/exp/dcshunt-motor-armature-control/
To perform speed control of DC motor by using Ward-Leonard Method. Draw the graph between armature voltage and speed of motor.	https://ems-iitr.vlabs.ac.in/exp/dcmotor-ward-leonard/simulation.html
To study the magnetisation characteristics of DC Shunt Generator. Draw the graph between the armature voltage and field current.	https://ems-iitr.vlabs.ac.in/exp/magnetization-characteristics-dcshunt/

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course Code	MC-201B				
Category	Mandatory Courses				
Course Title	Environmental Science				
Scheme and Credits	L	T	P	Credits	Semester-IV
	2	0	0	-	
Course Objectives	The objectives of this course are to • Create awareness of the multidisciplinary nature and importance of environmental studies, including the sustainable management and conservation of natural resources. • Develop an understanding of ecosystem dynamics, biodiversity, pollution types, and their impacts on environmental and human health. • Foster critical thinking on social, ethical, and legislative aspects of environmental protection, emphasizing the role of individuals and society. • Engage students in practical learning through fieldwork and case studies to apply environmental concepts for sustainable development and responsible citizenship.				
Practical/Field Visits	20 Marks				
End Semester Examination	30 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				
Remarks	The subject of Environmental Studies will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same otherwise the final result will not be declared and degree will not be awarded. The duration of the course will be 40 lectures. The examination will be conducted along with the semester examinations. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these marks will be shown in the detailed marks certificate of the students.				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	Level
CO1	Describe key concepts of environmental studies, types of natural resources, ecosystem structures, pollution types, major environmental laws, and human-environment interactions.	Level 1: Remember
CO2	Explain the interrelationships among ecosystems, biodiversity, pollution, social issues, environmental ethics, and related legislation for sustainable development.	Level 2: Understand
CO3	Apply principles of environmental management, pollution control, disaster preparedness, and sustainable practices in real-world and field-based environmental contexts.	Level 3: Apply
CO4	Analyze environmental problems, population growth impacts, climate change, welfare programs, and the role of information technology in promoting public health and environmental sustainability.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I.

Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems.

a) Forest resources: Use and over-exploitation: deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer pesticide problems, Water logging, salinity, case studies. **e) Energy resources:** Growing energy needs; renewable and non-renewable energy sources, use of alternate energy sources, case studies.

e) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, equitable use of resources for sustainable life styles

Unit-II

Ecosystems: Producers, Consumers and Decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, Food web and ecological pyramids, Introduction, types, characteristic features, structure and function of Forest ecosystem, Grass land ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Bio diversity and its conservation: Introduction, Definition, Genetic, Species and ecosystem diversity. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-spots of biodiversity. Threats to biodiversity, habitat loss, poaching of wild life, man-wild life conflicts, Endangered and endemic species of India, In-situ and ex-situ conservation of biodiversity.

Unit-III

Environmental Pollution: Definition, Causes, Effects and Control Measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards.

Solids Waste Management: Causes, Effects and Control Measures of Urban and Industrial Wastes, Role of an Individual in Prevention of Pollution, Pollution Case Studies.

Disaster Management: Floods, Earthquake, Cyclone and Landslides.

Social issues and the Environment: From unsustainable to sustainable development, Urban problems related to energy, Water conservation, Rain Water Harvesting, Watershed Management, Resettlement and Rehabilitation of People, its problems and concerns case studies.

Environmental Ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies, Waste land reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wild life Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Unit-IV

Human population and the Environment: Population growth, Variation among Nations, Population explosion-Family Welfare Programme, Environment and human health, Human Rights. Value Education, HIV/AIDS, Woman and Child Welfare Role of Information Technology in Environment and human health. Case Studies.

Field Work (Field work equal to 10 lecture hours)- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-urban/Rural/Industrial/ Agricultural, Study of

common plants, insects, birds, Study of simple ecosystems-pond, river, hills, slopes, etc.

Suggested Readings:

- Environmental Biology by K.C. Agarwal, Nidi Pub. Ltd., Bikaner.
- The Biodiversity of India by Bharucha, MA Pin Publishing Pvt. Ltd., Ahmedabad.
- Hazardous Waste Incineration by R.C. Brunner, McGraw Hill.
- Environmental Chemistry by A.K. De, Wiley Eastern Ltd.
- Global Biodiversity Assessment by V.H. Heywood & R.T. Watson, Cambridge University Press.
- Environmental Protection and Laws by H. Jadhav & V.M. Bhosale, Himalaya Pub. House.
- Matter Hazardous by A.K. Mhaskar, Techno-Science Publications.
- Waste Water Treatment by M.N. Rao & A.K. Datta, Oxford & IBH Publication.
- Environmental Chemistry by B.K. Sharma, Goel Publication. House, Meerut.
- Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II by R.K. Trivedi, Enviro Media.
- Introduction to Air Pollution by R.K. Trivedi & P.K. Goel, Techno-Science Publications.
- Environmental Management by K.D. Wagner, W.B. Saunders Co., Philadelphia, USA.
- A Textbook of Environmental Education by Dr. J.P. Yadav, G.V.S. Publishers.

Useful Video Links:

Unit No.	Topics	Links
Unit-I	Environment Science: Introduction	https://www.youtube.com/watch?v=5QxxaVfgQ3k
	Natural Resources	https://www.youtube.com/watch?v=CXCT2R1K6Ts
	Ecosystem	https://www.youtube.com/watch?v=ldBU6HB8G6s
Unit-II	Biodiversity and its conservation	https://archive.nptel.ac.in/courses/102/104/102104068/
Unit-III	Sustainable Water Management In Urban Areas	http://digimat.in/nptel/courses/video/127106004/L29.ht
	Environmental Pollution	https://archive.nptel.ac.in/courses/123/105/123105001/
Unit-IV	Population and population growth	https://archive.nptel.ac.in/courses/102/104/102104068/
	National Family Welfare Programme	https://www.youtube.com/watch?v=X5F99L8ZEtc

Course Code	BSC-MEE-202B				
Category	Basic Science Courses				
Course Title	Engineering Mathematics-III				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	1	0	4	
Course Objectives	The objectives of this course are to • Provide fundamental knowledge of partial differential equations, numerical methods, probability, and statistical concepts relevant to engineering problems. • Make the students familiar with analytical and numerical techniques for solving differential equations and problems involving probabilistic and statistical models. • Emphasize the application of appropriate mathematical and statistical methods in the modelling, analysis, and solution of engineering problems.				
Course Pre-requisite	Mathematics up to 12 th Standard and Engineering Mathematics-I& II				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall fundamental concepts, definitions, formulae, and standard methods related to partial differential equations, probability and statistics and numerical methods.	Level 1: Remember
CO2	Explain the fundamental concepts of partial differential equations, probability distributions, statistical measures and numerical methods.	Level 2: Understand
CO3	Apply appropriate analytical, numerical and statistical methods and techniques to solve engineering problems.	Level 3: Apply
CO4	Analyze engineering problems to select suitable methods for their solution and interpret the results.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each Unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Definition of Partial Differential Equations, First order linear partial differential equations, Partial Differential Equations of higher order: Second-order linear partial differential equations and their classification, Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method, Initial and boundary conditions, Separation of variables method to simple problems in Cartesian coordinates.

Unit-II

Numerical Methods: Solution of polynomial and transcendental equations – Bisection method, Regula-Falsi method and Newton-Raphson method, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae, Numerical integration, Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Unit-III

Measures of central tendency, Moments, Skewness and Kurtosis Basic concept of Probability, Conditional probability, Bayes' theorem, Discrete random variables, Binomial distribution, Poisson distribution, Expectation of discrete random variables, Variance of a sum, Correlation coefficient, Continuous random variables and their properties, Distribution functions, Normal Distribution.

Unit-IV

Testing of hypothesis, Test of significance, large sample test for single proportion, Difference of proportions, Tests for single mean, Difference of means and Difference of standard deviations, Test for ratio of variances, Chi-square test for goodness of fit and Independence of attributes.

Suggested Readings:

- Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers.
- Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publishing Company Limited.
- A text book of Engineering Mathematics by N. P. Bali and Manish Goyal, Laxmi Publications.
- Numerical Methods by P. Kandasamy, K. Thilagavathy, & K. Gunavathi, S. Chand and Company.
- Introductory Methods of Numerical Analysis by S. S. Sastry, PHI learning publication.
- Business Statistics by T.R. Jain, S.C. Aggarwal, VK Global Publications Pvt. Ltd.

Useful Video Links:

Unit No.	Topics	Links
Unit-I	Definition of Partial Differential Equations.	https://www.youtube.com/watch?v=KIZqe4UC1jk
	Solution to homogenous and non-homogenous linear partial differential equations	https://www.youtube.com/watch?v=5cZbgxmpK3Q&t=520s
	Initial and boundary conditions of partial differential equations of second order	https://www.youtube.com/watch?v=PVUfuiuWaZQ
Unit-II	Bisection method, Regula-Falsi method and Newton-Raphson method	https://www.youtube.com/watch?v=3j0c_FhOt5U&list=PLU6SqDYcYsflk1VhXxIYNPFU67ym6gae8
	Interpolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae	https://www.youtube.com/watch?v=Y-yMQvYpltU https://www.youtube.com/watch?v=zdyUwzOm1zw https://www.youtube.com/watch?v=2h0R0Uka1HI
	Numerical integration, Trapezoidal rule and Simpson's 1/3rd and 3/8 rules	https://www.youtube.com/watch?v=EA76ONWBgK4&list=PLhSp9OSVmeyJBkLSO51JFPSEIloeRiaJy
Unit-III	Basic concept of Probability, Conditional probability, Bays' theorem	https://youtu.be/60vHy2lA4o4 https://www.youtube.com/watch?v=ZFMcWe_SNyI https://www.youtube.com/watch?v=-ELHOnLwE9U
Unit-IV	Testing of Hypothesis & Levels of significance, Large Sample Test	https://auce.digimat.in/nptel/courses/video/111105090/L72.html
	Chi-Square Test	https://youtu.be/SICsNb-VXds?feature=shared
	Miscellaneous	https://onlinecourses.nptel.ac.in/noc22_ma81/preview

Course Code	PCC-EE-204B				
Category	Professional Core Courses				
Course Title	Electrical Machines-II				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are ● To understand the construction, working principles, and performance of induction machines. ● To learn the operation, characteristics, and control of synchronous machines. ● To gain basic knowledge of special machines and their industrial applications.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fundamental concepts, constructional features, operating principles, characteristics, testing methods, and applications of induction, synchronous, and special electrical machines.	Level 1: Remember
CO2	Discuss the operation, performance characteristics, control methods, testing procedures, and applications of induction, synchronous, and special machines.	Level 2: Understand
CO3	Calculate machine parameters, performance characteristics, speed control methods, voltage regulation, and operating conditions of electrical machines.	Level 3: Apply
CO4	Classify electrical machines based on their construction, operating characteristics, performance, control techniques, and application requirements.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Poly-Phase Induction Motor: Constructional features, Principal of operation, production of rotating magnetic field, speed and slip, frequency of rotor voltage and current, induction motor action, torque production, testing, development of equivalent circuit, performance characteristics, winding emfs, starting methods, double cage and deep bar motors. Methods of speed control - stator voltage control, stator resistance control, frequency control, rotor resistance control, slip power recovery control, efficiency, cogging or magnetic locking, limitations and applications of I.M.

Unit-II

Single-Phase Induction Motors: Introduction, Principle of operation, double revolving field theory, cross-field theory, starting methods, different types of single-phase induction motors, and equivalent circuit of a single-phase induction motor. Induction Generator: Principle of operation, types and applications.

Special Machines: Reluctance motors, Hysteresis motors, servomotors, linear induction motors, stepper motors, step angle and their applications.

Unit-III

Synchronous Generator: Principle, construction of cylindrical rotor and salient pole machines, winding, EMF equation, Armature reaction, testing, model of the machine, regulation – synchronous reactance method, Potier triangle method. Output power equation, power angle curve, Transient and sub-transient reactance, synchronization, parallel operation.

Unit-IV

Synchronous Motor: Principles of synchronous motor, power angle curve, V-curve, starting, hunting, cause and effect of hunting, damper winding, synchronous condenser, Applications: Industrial applications, speed control applications and power factor correction.

Suggested Readings:

- Principle of Electrical Machines by V K Mehta, Rohit Mehta, S Chand.
- Electric Machines by Ashfaq Hussain, Dhanpat Rai.
- Electric Machines by I.J. Nagrath, & D.P. Kothari, TMH, New Delhi.
- Generalized theory of Electrical Machines by P.S. Bhimbra, Khanna Publication.
- Electric Machinery by Fitzgerald and Kingsley, MGH.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Poly-phase Induction Motor	https://youtu.be/leXNHZM-CZE
	Speed and Slip	https://youtu.be/DANGZvHOgj0
Unit-II	Single Phase Induction motors	https://youtu.be/KPMY_L7oyOk
	Equivalent circuit of 1 phase I.M	https://youtu.be/h8386o98deY
Unit-III	Construction of synchronous machine	https://youtu.be/D-uPPjFBKDI
	Armature reaction and synchronous reactance	https://youtu.be/FCKx-1xR4To
Unit-IV	Synchronous motor operation, phasor diagram	https://youtu.be/edJFTap0zYw
	Phasor diagram of salient pole synchronous motor under various conditions	https://youtu.be/hx_QAyjgrNM

Course Code	PCC-EE-206B				
Category	Professional Core Courses				
Course Title	Digital Electronics				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To learn the fundamentals of logic simplification using logic gates, Boolean algebra, De Morgan’s theorem, and canonical forms (SOP & POS) • To understand mastering number systems, complements, and operations on complement numbers, along with techniques like Karnaugh Maps (up to 6 variables) and the Quine-McCluskey (QM) method for systematic logic reduction • To Design and Analyze Combinational Logic Circuits and Implement Sequential Logic Systems • To Explore Data Conversion Techniques and Programmable Logic Devices				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts, logic functions, combinational and sequential circuit elements, data converters, and programmable logic devices used in digital systems.	Level 1: Remember
CO2	Discuss the operation, design principles, and functional characteristics of digital logic circuits, data converters, and programmable logic devices.	Level 2: Understand
CO3	Apply logic simplification, combinational circuit design, sequential circuit design, and data conversion techniques for digital system applications.	Level 3: Apply
CO4	Analyze digital circuits, sequential systems, data converters, and programmable logic devices based on their characteristics, performance, and application requirements.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Digital Systems and Binary numbers: Digital signals, digital systems, advantages of digital systems, logic levels, signed binary numbers, complement binary arithmetic, binary codes, BCD arithmetic, error detecting and correcting codes.

Digital Logic Families: Types of logic families, voltage levels, noise margin, power dissipation, fan-in and fan-out, CMOS logic.

Unit-II

Gate Level Minimization: Canonical and standard forms, POS and SOP simplifications, K-Map method, Q-M method, don't care conditions, NAND and NOR implementations, integrated circuits

Unit-III

Combinational Logic: Design and analysis of combinational circuits – adders, carry look ahead adder, subtractors, multiplier, magnitude comparators, encoders, demultiplexers and multiplexers.

Unit-IV

Sequential Logic: Design and analysis of sequential circuits – latches, flip-flops, registers and counters.

A/D and D/A converter: Introduction to Digital to analog converters: weighted resistor/resistor divider converter, R-2R Ladder D/A converter, specifications for D/A converters, Introduction to analog to digital converters: sample and hold circuit, quantization and encoding, parallel comparator A/D converter, counter type A/D converter, successive approximation A/D converter, dual slope A/D converter.

Suggested Readings

- Modern Digital Electronics by R.P. Jain, Tata McGraw Hill, 4th edition.
- Switching Theory & Logic Design by A. Anand Kumar, PHI.
- Digital Electronics Circuit and System by V K Puri, TMH.
- Digital Circuits and Systems by D.V. Hall, Tata McGraw Hill.
- Principle of Digital Electronics by K Meena, PHI learning.
- Logic & Computer Fundamentals by Morris Mano, 4th Edition, Pearson Education.

Useful Video Links

Unit No.	Topics	Links
Unit-I	Boolean Algebra	https://www.youtube.com/shorts/xtAYbY_Pz7I
Unit-II	Multiplexer	Introduction to Multiplexer What are Multiplexers Digital Electronics
	Combinational Circuits	https://www.youtube.com/watch?v=fXrbYMDDevDU
Unit-III	Sequential Circuits	https://www.youtube.com/watch?v=S0mKCNLmCh4&list=PLgwJf8NK-2e4mEQv0ttgW-am4wiqrpdX
	Counter	https://www.youtube.com/watch?v=NTCrCYPoA5A&list=PLgwJf8NK-2e6lcDg0NxW-_yO6Bl5dPBp8
Unit-IV	Finite state machines	https://www.youtube.com/watch?v=LOZxYBOKRLg

Course Code	PCC-EE-208B				
Category	Professional Core Courses				
Course Title	Power Systems-I				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To provide knowledge of the evolution, structure, and components of modern power systems, including substations, bulk grids, micro-grids, and AC/DC distribution systems. • To develop the ability to calculate line parameters, analyze transmission line models, voltage regulation, reactive power compensation, and evaluate distribution system performance. • To understand sag and stress analysis, effects of environmental conditions, and insulation design for reliable and safe power transmission. • To study cable types, corona effects, and HVDC transmission technology for efficient and advanced power delivery.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts, components, parameters, transmission systems, distribution systems, insulation systems, cables, and HVDC technologies used in power systems.	Level 1: Remember
CO2	Discuss the structure, operation, performance characteristics, mechanical design aspects, insulation requirements, and transmission technologies of power systems.	Level 2: Understand
CO3	Calculate transmission line parameters, performance indices, sag and stress values, cable characteristics, and voltage control measures for power system applications.	Level 3: Apply
CO4	Analyze power system components, transmission and distribution configurations, insulation systems, cable technologies, and HVDC transmission schemes based on operational and performance requirements.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

INTRODUCTION: Evolution and Growth of Power Systems in India. Deregulation in power, Environmental aspects of energy generation, Structure of a power system, Distributed generation, Bulk Power Grids and Micro-grids, indoor and outdoor substations, equipment for substations, layout, auxiliary supply.

BASIC TERMINOLOGY IN POWER SYSTEMS: Reserve generating capacity, maximum load, annual load factor, capacity factor, diversity factor, and tariffs.

DISTRIBUTION SYSTEMS: Radial, ring mains, and network distribution systems, comparison of various types of AC and DC systems.

Unit-II

CALCULATION OF TRANSMISSION LINE PARAMETER: Inductance of line: Definition, Inductance of 1- ϕ two-wire line, Inductance of composite conductor line, Inductance of 3- ϕ single line, Inductance of 3- ϕ double line, and Proximity effect. Resistance of line and Skin effect.

Capacitance of line: Definition, Capacitance of 1- ϕ two-wire line, Capacitance of 3- ϕ line with symmetrical and unsymmetrical spacing, Effect of earth on transmission line capacitance, Ferranti effect.

PERFORMANCE OF POWER TRANSMISSION LINE: Classification of transmission line: short, medium, and long transmission lines, Equivalent circuit, Interpretation of long line, tuned power line, power flow through a transmission line, method of voltage control, and Circle diagram.

Unit-III

MECHANICAL DESIGN: Catenary curve, Sag-tension calculation, effect of ice and wind, Sag at different support levels, stringing chart, dampers.

INSULATORS: Types, insulating materials, voltage distribution over the insulator string, and the method of equalizing the potential over the insulator in a string.

INSULATED CABLES: Insulating material and its requirement, EHV cables, grading of cables, insulation resistance of cable, capacitance of single core cable, and Current rating of cable. Types of cable, Comparison of overhead and underground cable.

Unit-IV

CORONA: Phenomenon of corona, derivation for critical disruptive voltage and visual critical disruptive voltage, power loss, factor affecting corona loss, advantages and disadvantages, radio interference, method of reduction in corona losses,

HVDC TRANSMISSION: Need for HVDC transmission; types of links (monopolar, Bipolar, and homopolar), advantages and limitations of HVDC transmission.

Suggested Readings

- Power System Analysis & Design by J. D. Glover, M.S. Sarma and T. J. Overbye, Cengage Learning India Pvt. Ltd.
- Power Systems Analysis by A.R. Bergen, & V. Vittal, Pearson Education.
- Power System Stability & Control by P. Kundur, Tata McGraw Hill, 2006.
- Electric Power Systems by B.M. Weedy, & B.J. Cory, Wiley India.
- Elements of Power System Analysis by J. J. Grainger, & W.D. Stevenson., Tata McGraw-Hill Publishing Company Limited.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Structure of Power systems	https://youtu.be/Yg6XsepGCKY?list=PLD4ED2FAF3C155625
Unit-II	Transmission line parameters	https://youtu.be/lr1jgbR5ca8?list=PLD4ED2FAF3C155625
Unit-III	Sag and Tension Analysis	https://youtu.be/Gz10k08xdDk
Unit-IV	Grading of cables	https://youtu.be/Csw1OTdWu_8?list=PLD4ED2FAF3C155625

Course Code	PCC-CSE-207B				
Category	Engineering Science Courses				
Course Title	Python Programming				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce Python programming basics, including syntax, data types, and control structures. • To develop skills in Python data structures, functions, and recursion. • To explore Python's graphical programming, image processing, and GUI development. • To explain object-oriented programming, exception handling, and multithreading concepts.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skill Demonstrated	RBT Level
CO1	Define key terminology of Python syntax, data types, control structures, data structures, libraries, and GUI tools.	Level 1: Remember
CO2	Explain the functionality of Python programming constructs, data handling techniques, and graphical modules.	Level 2: Understand
CO3	Use Python programs for data processing, file handling, numerical computing, graphics, and GUI applications.	Level 3: Apply
CO4	Analyze Python programming constructs, data structures, libraries, graphics, image processing, and GUI techniques to solve real-world problems effectively.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Introduction: Installing Python; basic syntax, interactive shell, editing, saving, and running a script; data types; variables, assignments; numerical types; arithmetic operators and expressions; Loops and selection statements, Control statements String manipulations: subscript operator, indexing, slicing a string; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file.

Unit-II

Lists, Tuple, dictionary and Design with functions: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; Tuple: creating tuples, accessing elements, tuple immutability, operations, tuple methods, tuples vs. lists; dictionary literals, adding, and removing keys, accessing and replacing values;

traversing dictionaries. Hiding redundancy, complexity; arguments and return values; Program structure and design. Recursive functions.

Unit-III

Introduction to NumPy: NumPy arrays, Array Indexing and Slicing, Array Operations, Array Manipulation, Linear Algebra with NumPy, Random Number Generation and Statistics.

Introduction to Pandas: Pandas Series, Pandas Data Frames, Data Frame Indexing and Selection, Data Cleaning and Preprocessing, Data Manipulation, Group by Operations, Merging, Joining, and Concatenating Data Frames, Input/Output Operations.

Unit-IV

Simple graphics and image processing: Simple graphics, Turtle operations, manipulating turtle screen, drawing two dimensional shapes, examining an object attribute, taking a random walk, Color and RGB scheme, Image processing: Image manipulation operations, properties of images, image module, copying, blurring and reducing image.

Graphical User Interfaces using Tkinter: Terminal based and GUI based programs, Introduction to Tkinter, Simple GUI-Based Programs, Windows and Window Components, Input and Output with Entry Fields, Defining and Using Instance Variables, Other Useful GUI Resources.

Suggested Readings:

- Fundamentals of Python: First Programs by Kenneth Lambert, Course Technology, Cengage Learning, 2012.
- Introduction to Computer Science Using Python: A Computational Problem-Solving by Dierbach, C. Focus, John Wiley & Sons, (2012).
- Let Us Python by A. Kanetkar, & Y. Kanetkar, BPB Publications.
- Python – The Complete Reference by M. C. Brown, McGraw Hill Education.
- Core Python Programming by R. N. Rao, Dream Tech Press.
- Python Programming: Using Problem Solving Approach by R. Thareja, Oxford University Press.
- Python Programming by S. Sridhar, J. Indumathi, & V. M. Hariharan, Pearson Education.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Variables and Input Statement	https://youtu.be/ruQb8jzkGyQ
Unit-II	List operators	https://youtu.be/jMShsdechMI
Unit-III	Graphical User Interfaces using Tkinter	https://youtu.be/-GhzpvvIXIM?list=PLS1QulWo1RIY6fmY_iTjEhCMsdtAjbZM
Unit-IV	Fundamentals of Object Oriented Programming	https://youtu.be/K3g4srbkUNM?list=PLLy_2iUCG87Ah844iZW3w3nzWSTA8KSZA

Course code	LC-EE-210B				
Category	Professional Core Courses				
Course title	Electrical Machines-II Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are • To study performance and circuits of induction and synchronous motors. • To explore speed control and voltage effects on motor performance. • To understand voltage regulation and load-sharing in generators. • To learn alternator synchronization and fault analysis techniques.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After studying this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Understand performance and circuits of induction and synchronous machines.	Level 2: Understand
CO2	Apply and demonstrate different load test and speed control methods for induction machines and synchronous machines.	Level 3: Apply
CO3	Analyze the different performance curves like torque-speed and V-curves to optimize machine performance.	Level 4: Analyze
CO4	Assess the operation of synchronous generators in parallel, perform synchronization, and determine key parameters like voltage regulation.	Level 5: Evaluate

List of Experiments

Sr. No.	Contents
1	To perform the open circuit test and block rotor test on 3 phase induction motor and draw the circle diagram
2	To perform the speed control of an induction motor by rotor resistance control.
3	To conduct the load test to determine the performance characteristics of the I.M.
4	To compute the torque v/s speed characteristics for 3-phase induction motor.
5	To perform the open circuit test and blocked rotor test on a single-phase induction motor and determine equivalent circuit parameters
6	To perform O.C. test on synchronous generator and determine the full load regulation of a three phase synchronous generator by impedance method.
7	To perform and Measure Synchronous Impedance and Short Circuit Ratio of Synchronous Generator.

8	Study of Power (Load) sharing between two Three Phase alternators in parallel operation Condition.
9	To plot V- Curve of synchronous motor.
10	Synchronization of two Three Phase Alternators by a) Synchro scope Method b) Three dark lamp Method c) Two bright one dark lamp Method.
11	Determination of sequence impedances of synchronous machine for various stator voltages.

Virtual Lab Links

Experiment Name	Virtual Lab Link
To Study No Load Test on Three Phase Induction Motor.	https://em-coep.vlabs.ac.in/exp/no-load-test-induction-motor/
To Study blocked rotor test on 3 Phase Induction Motor.	https://em-coep.vlabs.ac.in/exp/blocked-rotor-test-induction-motor/
To study the torque speed characteristics of a three phase induction motor.	https://bes-iitr.vlabs.ac.in/exp/three-phase-induction-motor/
To Study Open Circuit Test on Three Phase Alternator.	https://em-coep.vlabs.ac.in/exp/open-circuit-phase-alternator/index.html
To Study Short Circuit Test on Three Phase Alternator.	https://em-coep.vlabs.ac.in/exp/short-circuit-phase-alternator/index.html
To plot V Curves and Inverted V curves of Three Phase Synchronous Motor	https://em-coep.vlabs.ac.in/exp/synchronous-motor/
To Study Load Test on Three Phase Alternator	https://em-coep.vlabs.ac.in/exp/load-test-phase-alternator/index.html

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course code	LC-EE-212B				
Category	Professional Core Courses				
Course title	Digital Electronics Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are to • Understand digital logic fundamentals by studying basic and universal gates and minimising Boolean functions using K-map. • Analyse and design combinational circuits such as adders, subtractors, multiplexers, and demultiplexers. • Design and verify sequential circuits including flip-flops, counters, and sequence detectors. • Gain practical knowledge of data conversion through the design and verification of ADC and DAC.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Understand and demonstrate the working of basic logic gates and realize logic functions using universal gates.	Level 2: Understand
CO2	Analyze and simplify logic expressions up to five and six variables using the Karnaugh Map (K-Map) method for optimal circuit design.	Level 4: Analyze
CO3	Implement and validate the truth tables of S-R, J-K, T, and D type flip-flops to understand sequential circuit fundamentals.	Level 5: Evaluate
CO4	Design and test data conversion circuits, such as ADC and DAC for digital-analogue interfacing and 3-bit synchronous counters, synchronous UP/DOWN decade counters using JK flip-flops, and asynchronous counters.	Level 6: Create

List of Experiments

Sr. No.	Content
1	To study & design basic gates.
2	To study and realize logic functions with the help of universal gates.
3	To realize and minimize five & six variables using K-Map method.
4	To verify the operation of Multiplexer & De-multiplexer.
5	To perform Half adder and Full adder
6	To perform Half Subtractor and Full Subtractor.
7	To verify the truth table of S-R, J-K, T & D Type flip-flop.
8	To design & verify the operation of 3 bit synchronous counter.
9	To design & verify the operation of synchronous UP/DOWN decade counter using JK flip
10	To design & verify operation of Asynchronous counter.

11	To design and implement a circuit to detect a count sequence.
12	To design & verify operation of ADC & DAC.

Virtual Lab Links

Experiment Name	Virtual Lab Link
To study & design basic gates.	https://de-iitr.vlabs.ac.in/exp/truth-table-gates/
To verify the truth table of S-R, J-K, T & D Type flip-flop.	https://de-iitg.vlabs.ac.in/exp/truth-tables-flip-flops/
To perform Half adder and Full adder	https://de-iitg.vlabs.ac.in/exp/half-adder-full-adder/
To perform Half Subtractor and Full Subtractor.	https://de-iitr.vlabs.ac.in/exp/half-full-subtractor/

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course code	LC-EE-214B				
Category	Professional Core Courses				
Course title	Power Systems-1 Lab				
Scheme and Credits	L	T	P	Credits	Semester- IV
	0	0	2	1	
Course Objectives	The objectives of this course are • To enable the design and performance evaluation of transmission and distribution systems. • To enhance understanding of transmission line phenomena. • To develop proficiency in modeling and analyzing power system components using MATLAB. • To analyze and compare the performance of distribution systems under various configurations.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply Power system blocks in MATLAB, corona loss in transmission line, mechanical design of transmission line.	Level 3: Apply
CO2	Analyze the proximity and skin effect.	Level 4: Analyze
CO3	Assess Line Parameters, ABCD Parameters, performance of transmission line, Ferranti effect.	Level 5: Evaluate
CO4	Design long and short transmission lines using MATLAB.	Level 6: Create

List of Experiments

Sr. No.	Content
1	To synthesize the Power System blocks in MATLAB.
2	To design short and long transmission line using MATLAB.
3	To study and calculate the transmission line parameters.
4	To study the Corona loss in the power distribution system.
5	To study the proximity and skin effect.
6	To find ABCD parameters of a model of transmission line.
7	To study performance of a transmission line under no load condition & load at different power factors.
8	To observe the Ferranti effect in a model of transmission line.
9	To study performance characteristics of a typical DC distribution system in radial & ring main configurations.
10	To study mechanical design of the transmission line.

Virtual Lab Links

Experiment Name	Virtual Lab Link
To study the Power System blocks in MATLAB.	https://in.mathworks.com/help/sps/ref/powersystemssimulationonramp.html?utm
To design short and long transmission line using MATLAB.	https://support.mathworks.com/matlabcentral/fileexchange/43340-long-transmission-line-matlab-simulation-by-rohit-kanojia?utm
To study the corona loss in power distribution system.	https://vm-dei.vlabs.ac.in/index_home.php
To study the proximity and skin effect.	https://sa-nitk.vlabs.ac.in/exp/plc-normal-load-operation/theory.html?utm
To find ABCD parameters of a model of transmission line.	https://asnm-iitkgp.vlabs.ac.in/exp/two-port-network/procedure.html
To study performance of a transmission line under no load condition & under load at different power factors.	https://www.academia.edu/31466035/A_Virtual_Electric_Power_Transmission_Line_Lab
To study performance characteristics of typical DC distribution system in radial & ring main configuration.	https://sa-nitk.vlabs.ac.in/exp/monitoring-feeder-parameter/theory.html
To study mechanical design of transmission line.	https://Intedutech.com/power-transmission-line-engineering/?utm

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course code	LC-CSE-213B				
Category	Engineering Science Course (Lab Course)				
Course title	Python Programming Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Course Objectives	The objectives of this course are ● To introduce students to the basic syntax, data types, control structures, and functions in Python programming. ● To enable students to implement mathematical, searching, and sorting algorithms using Python programming constructs. ● To provide hands-on experience with file handling, object-oriented programming, and Python libraries such as Turtle, OpenCV, and Tkinter. ● To develop students’ ability to analyze algorithmic logic, debug programs, and optimize solutions using Python.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skill Demonstrated	RBT Level
CO1	Understand fundamental Python programming constructs such as input/output, operators, control flow, and functions.	Level 2: Understand
CO2	Write Python programming techniques to implement algorithms for mathematical operations, searching, and sorting.	Level 3: Apply
CO3	Apply file handling, libraries (Turtle, OpenCV, Tkinter) and OOP concepts in Python to solve practical problems.	Level 3: Apply
CO4	Analyze the logic, performance, and correctness of Python solutions for problems involving algorithms and data.	Level 4: Analyze

List of Experiments

Sr. No.	Content
1	Write a Program to compute the G.C.D of two numbers.
2	Write a Program to find the square root of a number.
3	Write a Program to find the power of a number.
4	Write a Program to find the maximum in a list of numbers.
5	Write a Program to implement linear search in a list.
6	Write a Program to implement binary search in a list.
7	Write a Program to sort the element using selection sort.
8	Write a Program to sort the element using insertion sort.
9	Write a Program to sort the element using merge sort.
10	Write a Program to first "n" prime numbers.
11	Write a Program to find the most frequent word in a text file.
12	Write a Program in Python for a random walk using turtle.
13	Write a Program in Python using Tkinter/OpenCV to rotate an image.

14	Create a GUI based login page in Python language.
15	Write a program to implement inheritance in Python.

Note: At least 10 experiments are to be performed by the students. Faculty members can add 2-3 extra experiments under topics beyond the syllabus.

Course Code	PEC-EE-216B				
Category	Professional Elective Courses				
Course Title	Wind and Solar Energy Systems				
Scheme and Credits	L	T	P	Credits	Semester- IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce the fundamentals of wind energy, including wind characteristics, energy conversion principles, turbine classification, and system components. • To understand modern wind turbine technologies and the characteristics of various electrical generators used in wind energy systems, such as induction and synchronous generators. • To provide knowledge of solar thermal energy systems, including solar radiation measurement, collector types, orientation, and thermal performance analysis for practical applications. • To familiarise students with solar photovoltaic technology, covering solar cell fundamentals, types, performance evaluation, and Maximum Power Point Tracking (MPPT) for efficient PV system design.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the fundamental concepts, components, technologies, characteristics, and performance parameters associated with wind and solar energy systems.	Level 1: Remember
CO2	Discuss the principles of wind energy conversion, wind turbine operation, solar thermal systems, photovoltaic energy conversion, and MPPT techniques.	Level 2: Understand
CO3	Apply energy conversion parameters, solar radiation quantities, wind turbine performance indices, and photovoltaic system characteristics for renewable energy applications.	Level 3: Apply
CO4	Analyze wind energy systems, wind turbine generators, solar thermal collectors, photovoltaic technologies, and energy conversion methods based on their characteristics and performance requirements.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Wind Energy: Basic History of wind power, Indian and Global statistics, Characteristics of Wind, principles of wind energy conversion, components of wind energy conversion system, classification of wind turbines- horizontal axis and vertical axis, Betz limit ratio, advantages and disadvantages of wind energy system.

Unit-II

Wind Turbine Technologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbine, Squirrel-cage Induction generator, Wound rotor induction generators, Doubly Fed Induction Generator, Synchronous Generators, Permanent Magnet Synchronous Generators and their characteristics.

Unit-III

Solar Thermal: Physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data. Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Unit-IV

Solar Photovoltaic: Photovoltaic energy conversion, solar cell fundamentals, solar cell classification- Amorphous, mono-crystalline, polycrystalline, performance of solar cell, V-I characteristics of a PV panel, Maximum Power point Tracking (MPPT) algorithm.

Suggestions Redding:

- Non-Conventional Energy Sources by G.D. Rai, Khanna publishers, 2014.
- Wind Energy Theory and Practice by Siraj Ahmed publisher PHI learning Pvt Ltd.
- Renewable Energy Sources and Emerging Technologies by D.P Kothari, K.C Singal, Rakesh Ranjan , PHI learning Pvt Ltd.
- Renewable Energy resources by Tiwari, & Ghosal, Narosa.
- Solar Photo Voltaics Fundamentals, Technology and application by Chetan Singh Solanki, PHI learning Pvt Ltd.
- Renewable Energy Resources by John Twidell and Tony Weir, Taylor and Francis.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Power Generation from Wind Energy	https://youtu.be/k7LX0a67V8A
Unit-II	Turbine Terms	https://youtu.be/z7HV-ixAjs4
Unit-III	Solar Radiation	https://youtu.be/Og4LEc7SpdQ
Unit-IV	Solar Collectors	https://youtu.be/_co3m8nVUg

Course Code	PEC-EE-218B				
Category	Professional Elective Courses				
Course Title	Electromagnetic Fields Theory				
Scheme and Credits	L	T	P	Credits	Semester- IV
	3	0	0	3	
Course Objectives	The objectives of this course are to • Familiarize yourself with various coordinate systems and electromagnetic vector fields. • Impart knowledge on the concepts of electrostatic, magneto static and electrodynamic Fields. • Disseminate concepts related to electromagnetic waves, Waveguides and applications of electromagnetic fields. • Understand transmission line equation and wave propagation in different medium.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fundamental concepts, vector operations, field quantities, electromagnetic laws, wave parameters, and Maxwell's equations used in electromagnetic field theory.	Level 1: Remember
CO2	Discuss the behavior of electrostatic, magnetostatic, and time-varying electromagnetic fields, including field interactions and wave propagation phenomena.	Level 2: Understand
CO3	Apply electromagnetic field quantities, potentials, forces, energies, and wave propagation parameters using appropriate field equations and theorems.	Level 3: Apply
CO4	Analyze electromagnetic field distributions, boundary conditions, material responses, and wave propagation characteristics based on their physical and mathematical properties.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Vector Analysis: Review of scalars, vectors, vector multiplication- dot and vector products, component of a vector, Co-ordinate system- Cartesian, cylindrical and spherical co-ordinate system. Transformation of different co-ordinate system. Gradient, Curl and Divergence. Divergence theorem, Stroke's theorem. Line integrals, Surface integrals, Volume integrals, Differential length, area and Volume in Cartesian, cylindrical and spherical co-ordinate system. Dirac- Delta function.

Unit-II

Electrostatic Fields: Overview of electrostatic field, Coulomb's Law and field intensity. Electric fields due to point charge, continuous charge distributions like line charge, surface charge and volume charge distributions.

Electric flux density, Gauss's Law, Electric potential, Relationship between E and V - Maxwell's equation. Scalar potential. Electric Dipole, Electric field intensity due to electric dipole. Electric flux lines. Properties of Electric flux lines due to point charge and dipole. Energy density in Electrostatic field.

Convection and Conduction currents and current densities. Conductors, Point form of Ohm's law, Continuity equation of current and Relaxation time. Electrostatic Boundary conditions, Poisson's and Laplace's equations.

Unit-III

Magneto Static Fields: Introduction to magneto static fields, Biot-Savart's law. Ampere's circuit law, Magnetic flux density, Magnetic scalar and vector potentials, Forces due to magnetic fields - Force on a charged particle, Force on a current element and Force between two current elements, Magnetic Dipole, Classification of magnetic materials, Magnetic boundary conditions. Inductance for simple geometry. Magnetic energy, Statement and Interpretation of Maxwell's equation.

Unit-IV

Time Dependent Fields: General introduction, Faraday's Law, Transformer and motional emf, stationary loop in time varying B field, Moving loop in static B field (Motional emf). Moving loop in time varying fields, Displacement current. Maxwell's equation in Final forms, Introduction of Electromagnetic wave propagation, waves in general, wave propagation in lossy dielectric. Plane waves in loss less Dielectric, Plane waves in free space, Plane waves in good conductors. Power and Poynting vector.

Suggestions Redding

- Engineering Electromagnetics by W H Hayt Jr, J A Buck, & M Jaleel Akhtar, McGraw Hill Education.
- Outline of Electromagnetics by Mahmood Nahvi, A. Joseph, & Edminister, Schaum's, McGraw Hill Education.
- Fundamental of Electromagnetic by Karl E. Lonngren, Sava Savov, & Randy J. Jost, Scitech Publishing Inc.
- Electromagnetics by J. Edminister, & Vishnu Priye, Schaum's Series.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Review of scalar and vector fields	https://www.youtube.com/watch?v=gEa38ldV_a0&pp=0gcJCdgAo7VqN5tD
Unit-II	Electric flux density,	https://www.youtube.com/watch?v=gJtxcGEg5R0
	Gauss's Law. Application of Gauss's law	https://www.youtube.com/watch?v=whv_d-fBCg0
Unit-III	Biot-Savart's law, Ampere's law	https://www.youtube.com/watch?v=4YEQ98NUWOY
	Forces due to magnetic fields; Vector potential	https://www.youtube.com/watch?v=NwnjlJSvf_nk
Unit-IV	Faraday's Law	https://www.youtube.com/watch?v=deI8cJiCKEo
	Maxwell's equation	https://www.youtube.com/watch?v=ibF0L6X53tg

Course Code	PEC-EE-220B				
Category	Professional Elective Courses				
Course Title	Special Electrical Machines				
Scheme and Credits	L	T	P	Credits	Semester- IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To learn the fundamental principles, constructional features, and performance characteristics of poly-phase and single-phase AC machines, including induction motors, commutator motors, servo motors, and synchronous motors. • To impart knowledge of advanced control techniques for efficient machine operation. • To familiarize students with special-purpose electrical machines and their applications. • To prepare students for industrial and research-oriented applications in modern electrical drives.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Recall the knowledge of advanced control techniques for efficient machine operation.	Level 1: Remember
CO2	Explain the construction, operating principles, and performance characteristics of various poly-phase and single-phase AC machines	Level 2: Understand
CO3	Apply different control techniques for achieving constant torque and constant power operation in induction motors.	Level 3: Apply
CO4	Analyze performance and characteristics of special-purpose machines for specific industrial and automation applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Poly-Phase AC Machines: Construction and performance of double cage and deep bar three phase induction motors, production of rotating magnetic field, induction motor action, e.m.f. induced in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power), stator voltage control, stator resistance control, frequency control, rotor resistance control, slip power recovery control, induction motor as an induction generator.

Unit-II

Single-Phase Induction Motors: Construction, equivalent circuit, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors.

Single-Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, applications.

Two Phase AC Servo Motors: Construction, torque-speed characteristics, performance and applications.

Unit-III

Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.

Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits.

Unit-IV

Permanent Magnet Machines: Permanent magnet DC motors, sinusoidal PM AC motors, brushless DC motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors.

Suggestions Redding:

- Principle of Electrical Machines by V K Mehta & Rohit Mehta, S Chand.
- Electric Machines by Ashfaq Hussain, Dhanpat Rai.
- Electric Machines by I.J. Nagrath, & D.P. Kothari, TMH, New Delhi.
- Generalized theory of Electrical Machines by P.S. Bhimbhra, Khanna Publication
- Electric Machinery by Fitzgerald, & Kingsley, MGH.
- Principles of Electrical Machines and Power Electronics by P.C. Sen, John Willey & Sons.
- Fundamentals of Electric Drives by G.K. Dubey, Narosa Publishing House.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Static Slip power Recovery	https://youtu.be/6DctdwIDKhc
Unit-II	Single phase Induction Motor	https://youtu.be/trlmCvmUybk
Unit-III	Variable Reluctance Motor	https://youtu.be/1iY6YIPHck
Unit-IV	Permanent Magnet Machines	https://youtu.be/dGvSJ25bor4

Course Code	PEC-EE-224B				
Category	Professional Elective Courses				
Course Title	High Voltage Engineering				
Scheme and Credits	L	T	P	Credits	Semester- IV
	3	0	0	3	
Course Objectives	The objectives of this course are • To develop a fundamental understanding of conduction and breakdown mechanisms in different dielectric media. • To impart knowledge of generation and measurement techniques for high voltages and currents. • To impart knowledge of generation and measurement techniques for high voltages and currents. • To familiarise students with high-voltage testing procedures for various electrical apparatus.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fundamental concepts, breakdown mechanisms, high-voltage generation methods, measurement techniques, insulation coordination principles, and testing procedures used in high-voltage engineering.	Level 1: Remember
CO2	Discuss the conduction and breakdown phenomena in dielectric materials, high-voltage generation and measurement techniques, overvoltage effects, and insulation coordination practices.	Level 2: Understand
CO3	Determine appropriate methods for high-voltage generation, measurement, insulation assessment, non-destructive testing, and testing of electrical apparatus.	Level 3: Apply
CO4	Analyze dielectric breakdown processes, overvoltage conditions, insulation performance, testing methods, and high-voltage equipment characteristics based on operational requirements and performance criteria.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts (preferably 1 from each Unit/section) of 1.5 marks each and remaining eight questions of 9 marks each to be set by taking two questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit-I

Conduction and Breakdown in Gases: Collision Process, Ionization Processes, Townsend's Current Growth Equation, Current Growth in the Presence of Secondary Processes, Townsend's Criterion for Breakdown, Experimental Determination of Coefficients α and γ , Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges.

Conduction and Breakdown in Liquid Dielectrics: Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids.
Breakdown in Solid Dielectrics: Introduction, Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown.

Unit-II

Generation of High Voltages and Currents: Generation of High Direct Current Voltages, Generation of High Alternating Voltages, Generation of Impulse Voltages, Generation of Impulse Currents, Tripping and Control of Impulse Generators.

Measurement of High Voltages and Currents: Measurement of High DC Voltages, Measurement of High AC and Impulse Voltages, Measurement of High DC, AC, and Impulse, Cathode Ray Oscillographs for Impulse Voltage and Current Measurements.

Unit-III

Overvoltage Phenomenon and Insulation Coordination in Electric Power Systems: Natural Causes for Over-voltages - Lightning Phenomenon, Overvoltage due to Switching Surges, System Faults and Other Abnormal, Principles of Insulation Coordination on High Voltage and Extra High Voltage Power Systems.

Non-Destructive Testing of Materials and Electrical Apparatus: Introduction, Measurement of Dielectric Constant and Loss Factor, Partial Discharge Measurements.

Unit-IV

HV Testing of Electrical Apparatus: Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers, Testing of Surge Arrestors, Radio Interference Measurements, Testing of HVDC Valves and Equipment.

Suggestions Redding

- High Voltage Engineering by M.S. Naidu, & V. Kamaraju, McGraw Hill Latest Edition.
- High Voltage Engineering Fundamentals by E. Kuffel, W.S., & J. Zaengl, Kuffel Newness Latest Edition.
- High Voltage Engineering by C.L. Wadhwa, New Age International Latest Edition.
- High Voltage Engineering by A.M. Farouk, Rizk CRC Press Latest Edition.

Useful Video Links

Unit No.	Topic	Link
Unit-I	Breakdown in dielectrics	https://youtu.be/5S6xQT05Cw4
Unit-II	Introduction to HVDC Transmission	https://youtu.be/yP7OACmLP48
Unit-III	Design and Selection of Insulation	https://youtu.be/ga8moSgeO34
Unit-IV	HV Testing of Equipment	https://youtu.be/sDBstxApMqE