Zeal Education Society's

ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE – 41

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

NBA Accredited, NAAC Accredited with A+ Grade, ISO 21001:2018

DEPARTMENT OF ELETRICAL ENGINEERING

Curriculum Structure and Syllabus of

S.Y. B. Tech. – Electrical Engineering

(With effect from - Academic Year 2025 - 26)
(2024 Pattern)

VISION OF THE INSTITUTE

To be a premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.

MISSION OF THE INSTITUTE

- To achieve academic excellence through innovative teaching and learning process.
- To imbibe the research culture for addressing industry and societal needs.
- To inculcate social attitude through community engagement initiatives.
- To provide conducive environment for building the entrepreneurial skills.

DEPARTMENT OF ELECTRICAL ENGINEERING

VISION:

To be premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.

MISSION:

M1: To achieve academic excellence through innovative teaching and learning process.
M2: To imbibe the research culture for addressing industry and societal needs.
M3: To inculcate social attitude through community engagement initiatives.
M4: To provide conducive environment for building the entrepreneurial skills.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates will be able to apply their technical skill sets and knowledge to solve engineering based problems in industry, academic and diverse fields of Electrical Engineering.
PEO2: Graduates will demonstrate ethical and social responsibility while engaging in research, innovative practices and entrepreneurial activities, contributing positively to society and technological advancement.
PEO3: Graduates will embrace lifelong learning and adaptability, staying updated with emerging technologies, industry trends and advancements in electrical engineering.

PROGRAM OUTCOMES (POs):

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: To apply knowledge to build ability to design analyses and solve problems in the field of electrical engineering through power systems, electrical machines, control systems, electronics and automation.

PSO2: To develop solution to real time problems through appropriate techniques, modern engineering hardware and software tools related Electrical engineering.

DEPARTMENT OF ELECTRICAL ENGINEERING

LIST OF ABBREVIATIONS

Abbreviation	Description
BSC	Basic Science Course
ESC	Engineering Science Course
PCC	Programme Core Course
PEC	Programme Elective Course
MDM	Multidisciplinary Minor
OE	Open Elective - Other than a particular program
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
ENTR	Entrepreneurship
EC	Economics
MC	Management Courses
IKS	Indian Knowledge System
VEC	Value Education Courses
RM	Research Methodology
CEP	Community Engagement Project
FP	Field Project
PROJ	Project
INT	Internship
OJT	On Job Training
CC	Co-curricular Courses
HSSM	Humanities Social Science and Management
ELC	Experiential Learning Course
B. Tech	Bachelor of Technology
L	Lecture
P	Practical
T	Tutorial
H	Hours
CR	Credits
CIE	Continuous Internal Evaluation
ETE	End Term Evaluation
TW	Term Work
OR	Oral
PR	Project

DEPARTMENT OF ELECTRICAL ENGINEERING

Second Year B. Tech. – Electrical Engineering: Semester - III

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)				Evaluation Scheme							
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
EEPC302	PCC	Network Theory	3	2	-	5	3	1	4	40	60	-	-	25	125
EEPC303	PCC	Analog & Digital Electronics	3	2	-	5	3	1	4	40	60	-	50	-	150
EEPC304	PCC	Power System - I	3	-	-	3	3	-	3	40	60	-	-	-	100
EEMD301	MDM	Engineering Mathematics III	3	-	-	3	3	-	3	40	60	-	-	-	100
ALOE301	OE	Open Elective - I[#]	2	-	-	2	2	-	2	40	60	-	-	-	100
EEMC302	HSSM-MC	Project Management System - I	-	2	-	2	-	1	1	-	-	25	-	-	25
EEVS303	VSEC	Problem Solving Technique - I	-	2	-	2	-	1	1	-	-	25	-	-	25
EEVS304	VSEC	Programming & Data Structure	-	2		2	-	1	1	-	-	25	-	-	25
EECE301	CEP	Project Based Learning	-	2	-	2		1	1	-	-	25	-	-	25
EEIN302	ELC - INT	Internship - II	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**14**	**10**	**-**	**24**	**14**	**8**	**22**	**200**	**300**	**125**	**50**	**25**	**700**

 # - Select any one course from the given Open Elective Courses

Course Code	Course Type	Open Elective - I
ALOE301A	OEC	Digital Literacy and Applications
ALOE301B		Environmental Studies
ALOE301C		Green Energy and Sustainability
ALOE301D		Basics of Consumer Electronics
ALOE301E		Renewable Energy Systems

BoS Chairman

ZES's Zeal College of Engineering & Research PU/PN/Engg./285/2007 Narhe, Pune-41

Director
ZES's Zeal College of Engineering & Research Narhe, Pune - 41 1041.

DEPARTMENT OF ELECTRICAL ENGINEERING

Second Year B. Tech. – Electrical Engineering: Semester - IV

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
EEPC405	PCC	Theory of Electrical Machines - I	3	2	-	5	3	1	4	40	60	-	25	-	125
EEPC406	PCC	Power Electronics and its Application	3	2	-	5	3	1	4	40	60	-	25	-	125
EEPC407	PCC	Computational Methods & Programming	3	2	-	5	3	1	4	40	60	-	25	-	125
EEMD402	MDM	Microcontrollers: Architecture and Interfacing	2	2	-	4	2	1	3	40	60	-	-	-	100
ALOE402	OE	Open Elective - II[#]	2	-	-	2	2	-	2	40	60	-	-	-	100
EEMC403	HSSM-MC	Quality Management System - II	-	2	-	2	-	1	1			25		-	25
EEAE401	AEC	Problem Solving Technique - II	-	2	-	2	-	1	1			25		-	25
EEVS405	VSEC	Electrical Workshop	-	2	-	2	-	1	1			50		-	50
EEIN403	ELC - INT	Internship - III	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**13**	**14**	**-**	**27**	**13**	**11**	**22**	**200**	**300**	**125**	**75**	**-**	**700**

# - Select any one course from the given Open Elective Courses		
Course Code	**Course Type**	**Open Elective - II**
ALOE402A	OEC	Cyber Security and Laws
ALOE402B		Sustainability and Climate Change
ALOE402C		Energy Audit and Electrical Safety
ALOE402D		Digital Marketing
ALOE402E		Entrepreneurship and Innovations

BoS Chairman

ZES's Zeal College of Engineering & Research, PU/PN/Engg./285/2007, Narhe, Pune-41

Director

ZES's Zeal College of Engineering & Research Narhe, Pune - 411041.

DEPARTMENT OF ELECTRICAL ENGINEERING

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SYLLABUS

SEMESTER - III

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)							**Semester:** III		
Course: Network Theory							**Code:** EEPC302		
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**
03	02	-	04	40	60	-	-	25	125

Prerequisites:

Engineering Physics, Basic Electrical Engineering, Basic Calculus (Differentiation, Integration), Algebra and Linear Equations, First order, second order differential equation, Laplace transform.

Course Objectives:

1. To build a strong foundation in the basic concepts and classifications of electrical networks.
2. To develop analytical skills in solving electrical circuits using various network theorems.
3. To understand and analyze the transient behavior of electrical circuits using classical method and Laplace transform techniques.
4. To apply network laws and two-port network theory for the analysis of electrical circuits.

Course Outcomes: After completion of this course, students will able to -

CO1	Classify various types of electrical circuits, analyze those using node, and mesh analysis techniques.
CO2	Apply network theorems to simplify complex AC circuits.
CO3	Analyze transient response of RL, RC and RLC circuits using classical method.
CO4	Analyze transient response of RL, RC and RLC circuits using Laplace transform method.
CO5	Evaluate two-port electrical networks and assess their interrelationships.
CO6	Investigate and interpret network functions, including driving point and transfer functions.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Basics of Electrical Circuits:** Classification of circuits: Active, passive, unilateral, bilateral, linear, non-linear, lumped, distributed, time variant and time invariant, Types of sources: Dependent and independent voltage and current sources, source transformation, Concept of voltage and current divider, Node and Mesh Analysis: Node and mesh equation (KVL, KCL), matrix approach of complicated network containing dependent and independent voltage and current sources, Concept of super node and super mesh, concept of duality.	08
2.	**AC Network Theorems:** Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer, Millman's theorem to AC circuits (Circuits with dependent and independent sources).	07

3.	**Transient Analysis using Classical Method:** Transient behavior, concept of complex frequency, analysis of RC, RL and RLC networks with and without initial conditions with Classical method (derivation and numerical).	06
4.	**Transient Analysis using Laplace Transform Method:** Properties of Laplace transform: Linearity, time shifting, frequency shifting, time scaling, differentiation and integration in time domain, Initial value and final value theorem, Inverse Laplace transform using - partial fraction method and convolution theorem, analysis of RC, RL and RLC networks with Laplace transforms (derivation and numerical).	07
5.	**Two Port Network:** Z, Y, h and transmission parameters: condition for symmetry, condition for reciprocity and numerical, Interrelations between Z, Y, h and transmission parameters.	07
6.	**Network Functions:** Network functions for the one port and two port networks, Poles and zeros of network functions, Restrictions on poles and zeros locations for transfer functions and driving point function, Stability of active networks.	07
	TOTAL	**42**

List of Experiments:

Any eight experiments from the following list

1. Verification of Kirchhoff's laws in A.C. circuits.
2. Verification of Superposition theorem in A.C. circuits.
3. Verification of Thevenin's theorem in A.C. circuits.
4. Verification of Reciprocity theorem in A.C. circuits.
5. Verification of Millmans' theorem.
6. Verification of Maximum Power Transfer theorem in A.C. circuits.
7. Determination of time response of R-C circuit to a step D.C. voltage input. (Charging and discharging of a capacitor through a resistor)
8. Determination of time response of R-L circuit to a step D.C. voltage input. (Rise and decay of current in an inductive circuit)
9. Determination of time response of R-L-C series circuit to a step D.C. voltage input.
10. Determination of parameter of Two Port Network.

Text Books:

1. Van Valkenburg, M. E. "Network Analysis", 3rd ed. Prentice Hall of India Private Limited.
2. Mittal G. K, "Network Analysis & Synthesis", Khanna Publication.
3. Singh Ravish R. "Network Analysis and Synthesis", McGraw Hill.
4. Alexander and Sadiku, "Introduction to Electric Circuits", McGraw Hill.
5. Chakraborty S., "Introduction to Electric Circuits", Dhanpat Rai & Co.
6. Gupta B. R. & Vandana Singhal, "Fundamentals of Electrical Networks", S. Chand Publication.
7. Ramesh Babu P, "Electrical Circuit Analysis", 2nd ed. SciTech Publication India Pvt. Ltd.

Reference Books:

1. Cramer, "Network Analysis", McGraw Hill Publication.
2. Hayt, William H., Jr. and Jack E. Kimberly, "Engineering Circuit Analysis", McGraw Hill Publication.
3. "Schaum's Outline of Electric Circuits". 7th ed. McGraw-Hill Education.
4. Choudhury D. Roy, "Networks and Systems", 2nd ed. New Age International Publishers, 2013.
5. Kelkar and Pandit, "Linear Network Theory", Pratibha Publication.

E- Resources:

1. NPTEL Course on "Basic Electrical Circuits", By Prof. Gajendranath Chowdary, IIT Hyderabad, https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2. NPTEL Course on "Network Analysis", By Prof. Tapas kumar Bhattacharya, IIT Kharagpur. https://archive.nptel.ac.in/courses/108/105/108105159/

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)							**Semester:** III		
Course: Analog and Digital Electronics							**Code:** EEPC303		
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**
03	02	-	04	40	60	-	50	-	150

Prerequisites:

Basic Electronics, Number system and algebra.

Course Objectives:

1. To learn semiconductor devices.
2. To understand transistor circuits.
3. To analyze combinational and sequential circuits.
4. To study Operational Amplifier.
5. To study digital memory.
6. To understand Regulators, Waveform generators & Filters.

Course Outcomes: After completion of this course, students will able to -

CO1	Study of semiconductor devices.
CO2	Study of transistor circuits.
CO3	Understand combinational and sequential circuits.
CO4	Learn Operational Amplifier & its applications.
CO5	Understand digital memory and logic family.
CO6	Analyze Regulators, Waveform generators & Filters.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Semiconductor devices:** Diode rectifier: Introduction, Single phase half wave rectifier with R, RL loads. Single phase full wave rectifier - Center tap and bridge rectifier supplying R and RL load and performance parameters. Three phase full wave bridge rectifier with R load, Special purpose diodes - Zener diode, Varactor, light emitting diodes, Laser diodes. Comparison of single phase half wave and full wave rectifiers.	07
2.	**Transistor circuits:** BJT amplifier: Introduction to Class A, Class B, Class AB and Class C amplifier, AC-DC load line analysis, Single stage and Multistage BJT amplifier, direct coupled, RC coupled and transformer coupled, Darlington pair, Push-Pull amplifier and differential amplifier, FET - construction, operation and V-I characteristics.	07
3.	**Combinational & Sequential circuits:** **Number system:** BCD code, Grey code, and excess – 3 code, binary weighted codes, signed numbers, Binary arithmetic: - addition and subtraction by 1's and 2's compliment.	08

	Combinational circuits: Boolean equations, canonical logic forms, sum of product & product of sums, two, three and four variable Karnaugh maps, Encoder, decoder, half and full adder, Mux and Demux. **Sequential circuits:** **Flip flops:** R-S, Clocked S-R, D latches, Edge Triggered D flip-flops, Edge triggered JK flip flops, JK Master - slave flip flop, **Register:** Shift registers, ring and twisted ring counters. **Counter**: Asynchronous counters, synchronous counter, up - down counter, N – module Counters.	
4.	**Operational Amplifier & Applications:** Op-Amp Basics, practical Op-Amp circuits, Block diagrams of IC 741, open loop and close loop configuration of Op-Amp. differential and Common mode operation, differential and cascade amplifier, Applications of Op - Amp- Comparator, Schmitt trigger, zero crossing detectors, V-I and I-V converters, Instrumentation amplifier, peak detector.	07
5.	**Digital memories and logic families:** A) Digital memories: RAM, ROM, SRAM, DRAM, EPROM. B) Digital logic families: PAL, PLA, CPLD, FPGA.	06
6	**Regulators, Waveform generators & Filters:** Voltage regulators using ICs 78xx, 79xx, LM 317, Waveform generation using Op-amp - sine, square, saw tooth and triangular generator, Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters, IC 555 –construction, working and modes of operation- Astable and mono stable multi vibrators, Sequence generator.	07
	TOTAL	**42**

List of Experiments:

Lab Experiments (Any Seven from Expt. No. 01 to 11, and any one case study from Expt. No. 12 and 13)

1. Design of single phase bridge rectifier with output voltage and specified ripple.
2. To measure voltage and observe waveforms at input and output terminals of single stage BJT common emitter amplifier circuits.
3. Design logical circuit to convert binary to EXCESS 3/Gray number system.
4. Design three-bit full adder using any open source software.
5. Design 3:8 decoder for binary to octal decoding.
6. Design of comparator and schmitt trigger.
7. Study of Instrumentation amplifier using three Op-amp, CMRR measurement.
8. Design sine, and triangular wave generator.
9. Find phase angle difference between same frequency signal using ZCD and AND gate.
10. Design astable multivibrator and monostable mutivibrator using IC555.
11. Design first order high pass and low pass filter.
12. Design digital clock or stop watch using decade counter. (IC74192). – Case study.

13. Design of logical circuit for display of decimal number on seven segment display – Case study.
Text Books:
1. R. P. Jain, "Digital Electronics", Tata McGraw Hill, New Delhi. 2. Floyd and Jain, "Digital Fundamentals", Pearson Education. 3. Mottershed, "Electronics Devices & Circuits", PHI New Delhi. 4. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd edition, Pearsons Education. 5. Floyd, "Electronics Devices", Pearson Education. 6. Malvino, "Digital Computer Electronics- An Introduction to Microcomputers," Tata McGraw Hill.
Reference Books:
1. P John Paul, "Electronics Devices and circuits", New Age International Publications. 2. Tokheim, "Digital Electronics-Principles & Application", 6th edition, Tata McGraw Hill, New Delhi. 3. A Jaico and Charles H. Roth Jr., "Fundamentals of Logic Design" Charles H Publication, 4th Edition. 4. K. R. Botkar, "Integrated Circuits", Khanna Publication, New Delhi. 5. P. S. Bimbhra, "Power Electronics", Khanna Publications. 6. Jacob Millman, and C.C. Halkias, "Electronic devices and circuits", TMH Publications.
E- Resources:
1. NPTEL Course on "Analog Electronic Circuit", By Prof. Shouribrata chatterjee, IIT Delhi, https://onlinecourses.nptel.ac.in/noc20_ee89/preview 2. NPTEL Course on "Digital Electronic Circuits", By Prof. Gautam Saha, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc20_ee32/preview

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)								**Semester:** III	
Course: Power Systems – I								**Code:** EEPC304	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Basic Electrical Engineering, Fundamentals of Power Generation System.

Course Objectives:

1. To study the fundamentals of electrical power systems and related terminology.
2. To gain insights into the mechanical and electrical design of overhead transmission systems.
3. To understand the resistance, inductance and associated effects in transmission lines.
4. To understand the capacitance of transmission lines, including calculations for different conductor configurations and the effects of transposition.
5. To study the performance and classification of transmission lines.
6. To understand the definition, types and characteristics of tariffs and apply numerical calculations related to different tariff structures.

Course Outcomes: After completion of this course, students will able to -

CO1	Analyze load curves, compute system parameters and evaluate interconnected power system performance.
CO2	Analyze the mechanical design of overhead transmission lines, including components, supports, insulators and sag calculations.
CO3	Evaluate the resistance and inductance of transmission lines for different conductor arrangements.
CO4	Evaluate the capacitance of transmission lines for different conductor arrangements.
CO5	Classify transmission lines and analyze their performance.
CO6	Identify different types of tariffs and calculate values based on tariff structures.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Structure of Electrical Power Systems:** Structure of Electrical Power Systems, Load Curve – Daily load curve, Monthly load curve, Yearly load curve, Important definitions – Connected load, Maximum demand, Demand factor, Average load, Load factor, Diversity factor, Plant capacity factor, Plant use factor, Types of load, Simple numerical based on above concepts, Load curve and selection of generation units, Concept of base load and peak load, Concept of interconnected grid system and its advantages.	07
2.	**Mechanical Design of Overhead Transmission Lines:** Components of overhead lines, Types of line supports, Insulators: Pin type insulator, Suspension type insulator, Strain insulator, Shackle insulator, Potential	07

	distribution over suspension insulator string, String efficiency, its mathematical expression and numerical based on it, Sag in overhead lines – Calculation of sag when supports are at equal and unequal level, Effect of wind and ice loading on sag.	
3.	**Resistance and Inductance of Transmission Line:** Resistance of transmission line, Skin effect and proximity effect, Factors responsible for production of these effects, Internal and external flux linkages of single conductor, Inductance of single phase two wire line, Necessity of transposition, Inductance of three phase line with Symmetrical and unsymmetrical spacing with transposition, Concept of G.M.R and G.M.D, Inductance of bundled conductors.	07
4.	**Capacitance of Transmission Line:** Electric potential at single charged conductor, Potential at conductor in a group of charged conductors, Capacitance of single phase line, Concept of G.M.R and G.M.D for capacitance calculations, Need of transposition for capacitance calculations, Capacitance of three phase line with symmetrical, and unsymmetrical spacing with transposition. Expression of capacitance for single circuit three-phase line, Expression of capacitance for double circuit three phase line, Numerical based on all above topics.	07
5.	**Performance of Transmission Line:** Classification of overhead transmission lines, Performance of short transmission lines with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Π' and 'Nominal T' circuits using R, L and C parameters, Determination of Generalized Constants for – short transmission, nominal Π, nominal T lines, Numerical based on all above topics.	07
6.	**Tariff:** Tariff – Definition, objective and desirable characteristics of tariff, Types of tariff – Simple tariff, Flat rate tariff, Block rate tariff, Two part tariff, Maximum demand tariff, Power factor tariff, Three part tariff, and numerical based on tariff.	07
	TOTAL	**42**

Industrial Visit:

Mandatory visit to LV/HV substation/ generating station.

Text Books:

1. V. K. Mehta, Rohit Mehta, "Principles of Power System", S. Chand Publication.
2. J. B. Gupta, "Transmission and Distribution", S. K. Kataria and Sons, New Delhi.
3. J. B. Gupta, "Generation and Economic Considerations", S. K. Kataria & Sons, New Delhi.
4. C. L. Wadhwa, "Electrical Power Systems", New Delhi: New Age International Publishers.
5. A Chakraborty, M. L. Soni, P.V. Gupta, U. S. Bhatnagar, "A text book on Power System Engineering", Dhanpatrai & Co, Delhi.
6. S. N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India.

Reference Books:

1. Weedy B. M. and Cory B. J., "Electric Power Systems" 4th Edition, Willey, India.
2. Grainger J. J. and Stevenson W. D., "Elements of Power System Analysis", Tata McGraw – Hill Publishing Company Limited.
3. D. Das," Electrical Power System", New Age Publication.
4. Nagrath & Kothari, "Power System Engineering", Tata McGraw Hill Publications.
5. NPTEL course on Power System Engineering, IIT Kharagpur.

E - Resources:

1. NPTEL course on "Power System Analysis" by, Prof. Debapriya Das, IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc22_ee120/preview
2. NPTEL course on "Modelling of Power System Analysis" by, Prof. Arindam Ghosh, IIT Kanpur. https://nptel.ac.in/courses/108104051

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)								**Semester:** III	
Course: Engineering Mathematics – III								**Code:** EEMD301	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites: Calculus (differentiation, integration, and series), basic ordinary differential equations, fundamental algebra including partial fractions and introductory probability and statistics concepts.

Course Objectives:

1. To study the fundamentals Differential equations.
2. To study the concept of Laplace transforms.
3. To understand concept of Fourier transforms.
4. Understand basic statistics and probability.

Course Outcomes: After completion of this course, students will able to -

CO1	Solve higher-order linear differential equations to model and analyze electrical circuits.
CO2	Apply Laplace Transform to solve differential equations in engineering problems.
CO3	Apply Inverse Laplace Transform to solve engineering problems.
CO4	Apply Fourier Transform concepts in signal processing.
CO5	Evaluate Z-Transform techniques to analyze discrete-time systems.
CO6	Apply statistics and probability to analyze data and model uncertainty in engineering**.**

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Linear Differential Equations (LDE):** Linear Differential Equation of n^{th} order with constant coefficients, Complementary Function, Particular Integral, Method of variation of parameters, Cauchy's and Legendre's Differential Equation, Simultaneous Differential Equation. Modeling of Electrical circuits.	07
2.	**Laplace Transforms:** Definition, Properties and Theorems of Laplace Transform, Laplace Transform of derivative of f(t), Laplace Transform of Integral of f(t), Laplace Transform of t.f(t), Laplace Transform off(t)/t, Convolution Theorem, Unit-step Function. Dirac-Delta Functions, Periodic Functions.	07
3.	**Inverse Laplace Transforms:** Definition, Properties and Theorems, multiplication by S, division by S, First Shifting Property, Second Shifting Property, Inverse Laplace Transform of derivatives, Inverse Laplace Transform of Integrals, Partial Fractions Method, Inverse Laplace Transform by Convolution, Application of LT to solve LDE.	07

4.	**Fourier Transforms:** Fourier Transform (FT): Complex Exponential Form of Fourier Series, Fourier Integral Theorem (without proof), Fourier Transform, Inverse Fourier Transform, Fourier Sine transform, Fourier Cosine transform, Inverse Fourier Sine Transform, Inverse Fourier Cosine Transform.	07
5.	**Z- Transforms:** Introductory Z-Transform (ZT): Definition, Standard Properties of Z-transform, Z-transform of Standard Sequences Change of Scale, Shifting Property, Multiplication by k, Division by k, Inverse of Z-transform by Binomial Expansion and Partial Fraction.	07
6.	**Statistics and Probability**: Measures of Central Tendency, Arithmetic Mean, Median, Mode, Standard Deviation, Covariance, Karl Pearson's coefficient of correlation, Lines of Regression. **Probability:** Concept of probability, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution. Hypothesis testing-Chi square test.	07
	TOTAL	**42**

Text Books:

1. Wartikar P. N. & Wartikar, J. N. "Applied Mathematics" Volume I and II, Pune Vidyarthi Griha Prakashan, Pune.
2. Ramana, B.V. ""Engineering Mathematics", Tata McGraw-Hill Publication.
3. Grewal B. S. "Higher Engineering Mathematics" Khanna Publication, Delhi.

Reference Books:

1. O'Neil Peter V., "Advanced Engineering Mathematics", Cengage Learning..
2. Greenberg M. D., "Advanced Engineering Mathematics", Pearson Education Publication.
3. Wylie C.R. & Barrett L.C., "Advanced Engineering Mathematics", McGraw-Hill Publication.
4. Kreyszig Erwin , "Advanced Engineering Mathematics", Wiley Eastern Ltd.
5. Dass H.K., "Higher Engineering Mathematics" , S. Chand Publication
6. Harman Thomas L. , Dabney James and Richert Norman , "Advanced Engineering Mathematics with MATLAB", Brooks/Cole-Thomson Learning Publication.

E-Resources:

NPTEL Online Courses:

1. https://onlinecourses.nptel.ac.in/noc25_ma85
2. https://onlinecourses.nptel.ac.in/noc25_ma90

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)								**Semester:** III	
Course: Project Management System – I								**Code:** EEMC302	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical.

Course Objectives:

1. To acquire basic knowledge of Problem-solving techniques.
2. To understand the structured way of solving problems with the right tools.

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

CO1	Know the project and its importance.
CO2	Understand the structured way of project execution process.
CO3	Understand on how to project, goals and timeline.
CO4	Know the key principles of project management.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Project & Management System:** What is a project, What is Project Management, Types, Importance and its benefits	06
2.	**Project Management Process:** Planning, Execution, Monitoring & Control, Deliverables, Stakeholders.	06
3.	**Principles:** 12 Principles of Project Management.	16
	TOTAL	**28**

Text Books:

1. K. Nagarajan, "Project Management", New Age International Publishers.
2. Joseph Heagney, "Fundamentals of Project Management", AMACOM.
3. Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Wiley.

Reference Books:

1. "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", Project Management Institute.
2. B. B. Goel, "Project Management: Principles and Techniques", Deep & Deep Publications Pvt. Ltd.

E-Resources:

1. Dr. Nimisha Singh, "Introduction to Project Management: Principles & Practices", NPTEL Course - https://onlinecourses.swayam2.ac.in/imb25_mg167/preview
2. Prof. Raghu Nandan Sengupta, "Project Management", NPTEL Course - https://onlinecourses.nptel.ac.in/noc25_mg78/preview

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)									**Semester:** III
Course: Problem Solving Techniques – I									**Code:** EEVS303
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical.

Course Objectives:

1. To acquire basic knowledge of Problem-solving techniques.
2. To understand the structured way of solving problems with the right tools.

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

CO1	Know the problem and types of problem.
CO2	Understand the structured way of solving a problem.
CO3	Understand the basic tools and its application.
CO4	Apply the learning to solve simple problem cases as a team.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Problem Understanding:** Define problem, Types of Problem, What is problem solving? Structured way of Problem solving – Step by Step.	06
2.	**Problem Solving Approach:** Structured step by step working model, Principles to think and apply.	06
3.	**Basic Tools for Problem Solving:** Knowing the tools and applying the right tools at the right step of problem solving, Problem solving case study.	16
	TOTAL	**28**

Text Books:

1. M.T. Somashekara, "Problem Solving and Programming Concepts", PHI Learning.
2. Dheeraj Sharma, "Problem Solving and Decision Making", McGraw-Hill Education.

Reference Books:

1. Willian Henderson, "Master Critical Thinking, Creative, Logic & Problem solving skills", Peak Publish LLC.
2. Sharma Narender, "Handbook 7 QC tools", Shakehand with Life.

E-Resources:

1. Coursera: "Creative Problem Solving" - https://www.coursera.org/learn/creative-problem-solving.
2. MindTools – "Problem Solving Techniques", https://www.mindtools.com/cx4ems0/problem-solving.

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)						**Semester:** III			
Course: Programming & Data Structure						**Code:** EEVS304			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Course Objectives:

1. Understand the fundamentals of computers including hardware components.
2. Develop algorithmic thinking by learning problem-solving strategies.
3. Gain proficiency in C++ programming language, covering core concepts.
4. Understand and implement structures and classes to support object-oriented programming principles.
5. Explore pointers and dynamic memory allocation to manage memory effectively

Course Outcomes: After completion of this course, students will able to -

CO1	Design algorithms for solving simple mathematical problems including computing, searching and sorting.
CO2	Compare and contrast algorithms in terms of space and time complexity to solve simple mathematical problems.
CO3	Explore the internals of computing systems to suitably develop efficient algorithms.
CO4	Examine the suitability of data types and structures to solve specific problems.
CO5	Apply control structures to develop modular programs to solve mathematical problems.
CO6	Understand the concept of abstract data types and apply them in real-world applications.

Course Contents:

Unit	**Description**
1.	**Fundamentals of Computers:** Components of computers, Problems, Flowcharts, Memory, Variables, Values, Instructions, Programs. Algorithmic approach, characteristics of algorithm, Problem-solving strategies: Top-down approach, Bottom-up approach, Number systems and data representation.
2.	**Elements of C++ programming language:** Data types, constants, and variables, expressions and assignment statements, input and output statements, conditional and branch statements: If-else, Switch case constructs, iteration statements: while, do-while, for, Arrays – Single and Multi-Dimensional Arrays, strings. Bit-wise operations.
3.	**Functions and Recursion:** Modular approach for solving real time problems, user defined functions, library functions, parameter passing - call by value, call by reference, return values, passing arrays as parameters to functions Recursion. Structures and Classes - Declaration, member variables, member functions, access modifiers, function overloading, Problems on Complex numbers, Date, Time, Large Numbers.

4.	**Pointers and Files:** Introduction to pointers and dynamic allocation, String processing, File operations- create, read and write.
5.	**Searching and Sorting:** Linear and binary search, selection sort, bubble sort, insertion sort, merge sort, quick sort.
6.	**Data structures:** Abstract Data Types (ADTs) – Stack ADT – Array-Based Implementation of Stack – Applications, Queue ADT – Array-Based Implementation – Applications

List of Experiments: (Any 8)

1. Develop a C++ program to compute electricity bills using slab rates based on energy consumption.
2. Write a C++ program to calculate electrical parameters (V, I, R) using Ohm's Law for given inputs.
3. Implement matrix operations (addition and multiplication) for 3-phase voltage and current data to compute total power.
4. Design a structure to store details of electrical appliances and calculate daily energy consumption.
5. Develop a C++ class to model transformer specifications and compute efficiency and voltage transformation ratio.
6. Use recursion and user-defined functions to compute electrical values like factorial (for harmonic order) and total resistance in parallel circuits.
7. Demonstrate pointer operations in C++ to process voltage/current sensor data stored in arrays.
8. Perform file operations to log daily energy meter readings and compute the total monthly consumption.
9. Implement sorting algorithms (bubble, insertion) to organize electrical loads based on power ratings.
10. Simulate stack and queue data structures to manage electrical system tasks such as postfix evaluation and appliance load scheduling.

Text Books:

1. Walter Savitch, "Problem Solving with C++", Pearson, 2014, Ninth Edition.
2. Cay Horstmann, "Timothy Budd, Big C++", Wiley, 2009, Second Edition.

Reference Books:

1. R.G. Dromey, "How to solve it by Computer", Pearson, 2008.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 2006, Third Edition**.**

E-Resources:

1. Prof. Partha Pratim Das, "Programming in C++", IIT Kharagpur https://nptel.ac.in/courses/106105151
2. Prof. Abhiram Ranade, "An Introduction to Programming Through C++", IIT Bombay https://nptel.ac.in/courses/106101208

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)								**Semester:** III	
Course: Project Based Learning								**Code:** EECE301	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Course Objectives:

1. Enable students to apply fundamental concepts of Electrical Engineering to real-world solutions.
2. Strengthen interdisciplinary integration by combining knowledge of hardware and software tools (such as simulation platforms, embedded systems and microcontrollers) to build simple engineering prototypes.
3. Enhance critical thinking and collaborative problem-solving by encouraging students to design, implement and test solutions within defined project constraints.
4. Cultivate problem-solving, teamwork, communication and time management skills essential for engineering practice and professional development.

Course Outcomes: After completion of this course, students will able to -

CO1	Analyze the basic engineering problem to determine possible solutions.
CO2	Apply knowledge of mathematics, basic sciences and electrical engineering fundamentals to develop project solutions.
CO3	Collaborate effectively in teams to plan and execute project tasks.
CO4	Recognize and appreciate the strengths and skills within themselves and their team members.
CO5	Synthesize information from diverse sources to summarize the key findings.
CO6	Demonstrate project results clearly and confidently using verbal explanations, visual aids, and written documentation.

Procedure:

1. A group of **3 to 4 students** will be assigned to a faculty member as their mentor.
2. Under the guidance of a mentor, the group will identify a project problem based on their fundamental engineering knowledge and relevant societal or industry challenges.
3. The mentor will assist the group in planning the project by defining clear expected outcomes and dividing the work into specific tasks with set targets and deadlines.
4. Weekly meeting will be conducted with mentor to assess progress, discuss completed tasks and provide further guidance.
5. The project will conclude with a final presentation, project demonstration and the submission of a comprehensive report.
6. Students are encouraged to take part in competitions.

Assessment:

The department and mentors are dedicated to assessing both student performance and the overall effectiveness of the Project-Based Learning (PBL) approach. The progress of each PBL activity is monitored weekly by the mentor, who, along with relevant authorities, conducts continuous assessment and evaluation of both individual and group performance throughout the process. Students must uphold a culture of authentic collaboration, self-motivation, peer learning and personal accountability.

To support this, the institution and department should provide necessary guidance through orientation programs and ensure access to appropriate resources and support services. Active participation from both, mentors and students is essential in the assessment and evaluation process. Student groups may showcase their learning outcomes through a solution to the identified problem, a public product, a detailed report, and/or a formal presentation.

Assessment will include:

- **Individual assessment:** Evaluating each student's understanding, role, and level of involvement in the project.
- **Group assessment:** Reviewing task distribution, defined roles, team communication, and overall collaboration.
- **Documentation and presentation:** Assessing the quality of project documentation and effectiveness of the final presentation.

Evaluation and Continuous Assessment:

All activities related to Project-Based Learning (PBL) should be regularly assessed and documented in a designated PBL workbook. This workbook must be systematically updated and maintained by mentors and the department to ensure accurate tracking of student progress and performance.

Detailed rubric structure based on:

- **Weekly Attendance & Reporting:** 10 Marks
- **Review 1:** 30 Marks
- **Review 2:** 30 Marks
- **Average of both reviews:** Scaled to 15 Marks
- **Final Total** = **Weekly Attendance & Reporting** + **Average of both reviews**: **25 Marks**

Evaluation scheme:

Weekly Attendance & Reporting (10 Marks)

Objective: Ensure regular student participation, guidance seeking, and record maintenance.

Criteria	Max Marks
Weekly attendance /guidance sessions	04
Weekly progress	03
Maintenance of PBL workbook	03
Total	**10**

Review 1 Evaluation Rubric (30 Marks)

Purpose: To assess the understanding of the problem, background work, and initial progress.

Criteria	Max Marks
Understanding of the problem and objectives	05
Literature review and relevance	05
Methodology and planning	05
Individual role clarity and involvement	05
Technical depth and preliminary implementation	05
Communication skills during a review	05
Total	**30**

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Review 2 Evaluation Rubric (30 Marks)

Purpose: To assess progress made, technical outcomes, documentation, and presentation.

.Criteria	Max Marks
Project implementation and progress	05
Technical knowledge/ innovation	05
Team coordination and collaboration	05
Report/documentation quality	05
Presentation (content, delivery, structure)	05
Participation in any competition	05
Total	**30**

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)						**Semester:** III			
Course: Internship – II						**Code:** EEIN302			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	-	-	02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

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

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 4 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the

standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

DEPARTMENT OF ELECTRICAL ENGINEERING

SYLLABUS

SEMESTER - IV

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)							**Semester:** IV		
Course: Theory of Electrical Machine - I							**Code:** EEPC405		
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	02	-	04	40	60	-	-	25	125

Prerequisites:

Basic Electrical Engineering, Magnetic Circuit Law, Flemings Rule.

Course Objectives: The objectives of this course are

1. To understand energy conversion process.
2. To understand selection of machines for specific applications.
3. To understand the construction, principle of operation of transformers, DC Machine & Induction Machine.
4. To test & analyse the performance of machine.

Course Outcomes: After completion of this course, students will able to -

CO1	Evaluate the single-phase transformers performance
CO2	Analyze different winding connections, vector groups and operation of 3-phase transformer.
CO3	Explain the construction and working principles of DC machines and performance under all conditions.
CO4	Analyze the characteristics, starting methods and speed control techniques of DC shunt and series motors.
CO5	Evaluate the performance of 3-phase induction motor using power flow, loss analysis.
CO6	Analysis of different phenomena impact of unbalanced supply and harmonics for Induction Motor.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Single Phase Transformer:** Concept of ideal & practical transformer. Types of Transformers, Useful and leakage flux, its effects. Resistance, leakage reactance and leakage impedance of transformer windings; their effects on voltage regulation and efficiency. Equivalent circuits referred to L.V. and H. V. side of the transformer (Numerical). Phasor diagrams for no-load and on load (R, L, C Load) conditions. Voltage regulation, Transformer ratings, Losses in a transformer, Efficiency and condition for maximum efficiency (Numerical). All day Efficiency (Numerical). Auto transformers, their ratings and applications. Comparison with two winding transformers with respect to saving of copper and size (Derivation). Parallel operation, Cooling and Maintenance. Testing of single phase transformer.	08

2.	**Three Phase Transformers:** Need and advantages of three-phase transformers, Comparison between single-phase bank and three-phase transformer. Types of Connections- Star-Star (Y–Y), Delta-Delta (Δ–Δ), Star-Delta (Y–Δ) and Delta-Star (Δ–Y), Zigzag connections (Numerical). Vector groups and phase shift between primary and secondary, Applications of various connections. Descriptive treatment of Parallel operation of three phase transformers. Scott connection and V connections. Three winding (tertiary windings) transformers. Three-Phase Transformer Testing. Protection mechanisms-Buchholz relay and conservator tank function	08
3.	**D.C. Machines – Part I:** Basic construction of DC machines, types of DC machines and method of excitation, lap and wave windings, EMF equation, armature reaction and methods of limiting armature reaction, Commutation process and methods for improving commutation, Basic performance of DC generators and their performance characteristics, permanent magnet DC motors, Brush less dc motors.	06
4.	**D.C. Machines – Part II:** Basic operation of DC motors, Torque equation, operating characteristics of DC motors, Starting of DC motors- 2point, 3 point and 4 point starters, speed control of DC motors, losses and efficiency of DC machines, testing of DC machines, direct testing, Swinburne's test and Hopkinson's test. Application of DC machines.	06
5.	**Three Phase Induction Motor – Part I:** Working principle, construction, comparison of slip ring and squirrel cage motors, steady state analysis, phasor diagram and equivalent circuit, power flow diagram, torque-speed and power-speed characteristics, Losses and efficiency, No load and block rotor test, circle diagram.	07
6.	**Three Phase Induction Motor – Part II:** Starting of squirrel cage and slip ring motors, power factor control, Cogging and Crawling, Double cage & Deep bar Induction Motor, impact of unbalanced supply and harmonics on performance, speed control, braking, Induction Generator. Applications.	07
	TOTAL	**42**

Industrial Visit:

Minimum one visit to above machines manufacturing industry (mentioned in syllabus) is recommended.

List of Experiments: (Minimum 08 Experiments are compulsory)

1. Polarity, Voltage Ratio and Load Test on Single / Three Phase Transformer.
2. OC and SC Test on Transformer. (Equivalent Circuit parameter, Regulation and efficiency)
3. Sumpner's Test on two Identical Transformers. (Back to Back)
4. Scott-Connection. (Three phase to two phase conversion)
5. Parallel operation of two transformers. (Polarity check at Secondary winding terminal and Load sharing)
6. Starting Methods of Induction Motor.

7. No-Load and Blocked Rotor test on Induction Motor. (Equivalent Circuit parameter and Plotting Circle Diagram)
8. Load Test on Induction motor. (Plot- Efficiency V/s Load Curve)
9. Study of different type of starter. (2-point, 3-point and 4-point)
10. Speed control of DC Motor.
11. Load Test on DC Shunt Motor.
12. Hopkinson's Test on two identical DC Machines.
13. Swinburne Test on DC shunt Motor.

Text Books:

1. Edward Hughes "Electrical Technology", ELBS, Pearson Education.
2. Ashfaq Husain, "Electrical Machines", Dhanpat Rai & Sons.
3. S. K. Bhattacharya, "Electrical Machine", Tata McGraw Hill publishing Co. Ltd, 2nd Edition.
4. Nagrath & Kothari, "Electrical Machines", Tata McGraw Hill.
5. Bhag S Guru, Husein R. Hiziroglu, "Electrical Machines", Oxford University Press.
6. K Krishna Reddy, "Electrical Machines- I and II", SciTech Publications (India) Pvt. Ltd. Chennai.

Reference Books:

1. A.E. Clayton and N. N. Hancock, "Performance and Design of Direct Current Machines", CBS Publishers, 3rd Edition.
2. A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", Tata McGraw Hill Publication Ltd., 5th Edition.
3. A.S. Langsdorf, "Theory and performance of DC machines", Tata McGraw Hill.
4. M.G. Say, "Performance and Design of AC. Machines", CBS Publishers and Distributors.
5. Samarjit Ghosh, "Electrical Machines", Pearson Education, New Delhi.
6. Charles I Hubert, "Electrical Machines Theory, Application & Control", Pearson Education, New Delhi, 2nd Edition.

E-Resources:

1. NPTEL course on "Electrical Machines – I", Prof. Tapas Kumar Bhattacharya, IIT Kharagpur, https://nptel.ac.in/courses/108105155

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)							**Semester:** IV		
Course: Power Electronics and Its Application							**Code:** EEPC406		
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	02	-	04	40	60	-	25	-	125

Prerequisites:

Knowledge of semiconductor material, basic electronics, diode, BJT, UJT, FET and its characteristics. Working of Diode based rectifier, concept of RMS and average value.

Course Objectives:

1. Understand the working and characteristics of power semiconductor devices.
2. Learn the operation and analysis of controlled rectifiers.
3. Study DC-DC converters and AC voltage regulators.
4. Explore inverter types and their applications.
5. Learn multilevel inverter techniques and control methods.
6. Apply power electronics in drives, EVs, and renewable systems.

Course Outcomes: After completion of this course, students will able to -

CO1	Analyze thyristor-based power devices and evaluate suitable protection techniques.
CO2	Compare transistor-based and wide bandgap power devices based on performance and applications.
CO3	Evaluate single-phase and three-phase controlled rectifiers for various loads.
CO4	Apply control methods in DC-DC converters and AC voltage regulators.
CO5	Analyze operation of single-phase and three-phase inverters for typical applications.
CO6	Understand multilevel inverter types and control techniques for industrial use.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Thyristor-Based Power Devices:** **SCR (Silicon-Controlled Rectifier):** Structure, working, static & dynamic characteristics, Triggering and commutation techniques, Snubber circuit design and protection schemes (over-voltage, over-current, thermal), Numerals based on snubber circuit for a Thyristor. **GTO** (**Gate Turn-Off**): Construction, operation, characteristics, applications. **TRIAC**: Four-quadrant operation, firing circuits, dynamic characteristics, AC power control applications. **Applications:** Light dimmers, heater control, fan regulators	07
2.	**Transistor-Based Power Devices:** **MOSFET** (Metal Oxide Semiconductor Field Effect Transistor): Structure, Working Principles, Characteristics, Types: Enhancement and Depletion mode,	07

	IGBT (Insulated Gate Bipolar Transistor)**:** Construction, operation, characteristics, Comparison with MOSFET & GTO. **Wide Bandgap (WBG) Semiconductor Devices:** Introduction to WBG materials, Silicon Carbide (SiC) & Gallium Nitride (GaN), **SiC MOSFET** (Metal-Oxide-Semiconductor Field-Effect Transistors)**,** **GaN HEMT** (High Electron Mobility Transistors), **Applications** in EVs, renewable energy systems, and high-frequency power supplies.	
3.	**AC-DC Converters (Controlled Rectifiers):** **Single Phase Converters**: Fully-controlled & half-controlled converters (R and RL load). Output voltage equations (Avg., RMS), power factor, THD, TUF. Numerical based on output voltage and current calculations, Single phase dual converter **Three Phase Converters**: Fully and half-controlled converters with R, RL loads. Output voltage derivation and performance metrics. **Application:** Speed control of DC motors.	07
4.	**DC-DC Converters and AC Voltage Regulators:** **DC-DC Choppers**: Principle of operation and quadrant classification (Types: A, B, C, D, E). Control techniques: CLC, TRC, PWM, FM. Step-up chopper analysis with RLE load. **Applications:** Battery charging, EVs. **AC Voltage Regulators**: AC Voltage regulator; operation with R and RL Load, derivation of Average and RMS output voltage. Concept of two stage AC voltage regulator.	07
5.	**DC-AC Converters (Inverters):** **Single Phase Inverters**: Full-bridge VSI operation, derivation of output voltage and current, Current source inverter, **Application:** UPS, induction heating. **Three Phase Inverters**: Three phase VSI: 120° and 180° mode operation and their comparison, **Application:** UPS Induction motor drives.	07
6.	**Multilevel Inverters and Control Techniques:** Voltage control and harmonic reduction methods: Single Pulse Modulation, Multilevel Control, Space Vector Modulation. **PWM based VSI** **Multilevel Inverter Types:** Neutral Point Clamped (NPC), Flying Capacitor (FC), Cascaded Multilevel Inverter (CMI), Performance comparison. **Application:** Speed control of 3-phase induction motors, renewable energy systems.	07
	TOTAL	**42**

List of Experiments:

Part A: Minimum Four experiments from the following list (either hardware or simulation):

1. Study of Static V-I Characteristics of SCR/ GTO.
2. Static VI characteristic of TRIAC.

3. Study of Gate firing circuits of SCR (R, RC & UJT).
4. Study of Output and Transfer Characteristic of MOSFET and IGBT.
5. Study of SiC/GaN Diodes.
6. Single phase Half controlled converter with R and RL load.
7. Single Phase fully controlled converter with and without Free Wheeling diode with RL load.

Part B: Minimum Four experiments from the following list (either hardware or simulation):

1. Three phase AC-DC fully controlled bridge converter R and RL load.
2. Study of DC step down chopper.
3. Single phase A.C. voltage regulator with R and RL load.
4. Study of PWM controls of a single-phase inverter.
5. Simulation and Analysis of Three phase voltage source inverter using 120^0 and 180^0 mode.
6. Simulation and Analysis of three phase Multi level Inverter (VSI).
7. Industrial Visit to Power Electronics manufacturing unit/Renewable energy power plant.

Text Books:

1. Dr. P.S. Bimbhra, "Power Electronics", 3rd Edition, Khanna Publication.
2. Muhammad H. Rashid, "Power Electronics Devices, Circuits, and Applications", 4th Edition, 2014.
3. Barry W Williams, "POWER ELECTRONICS, Devices, Drivers, Applications, and Passive Components", McGraw Hill Higher Education, 2006.
4. B. Jayant Baliga, "Wide Bandgap Power Semiconductor Devices", Springer, 1st Edition, 2013.
5. Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.

Reference Books:

1. Muhammad H. Rashid, "Power Electronics Handbook", Elsevier, 3rd Edition, 2011.
2. M. D. Singh and K. B. Khandchandani, "Power Electronics", Tata McGraw Hill.
3. Ned Mohan, Tore M. Undeland-, William P. Robbins, "Power Electronics: Converters, Applications, and Design", Wiley, 3rd Edition, 2003.
4. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.

E-Resources:

1. Power Electronics – Prof. G. Bhuvaneshwari, IIT Delhi.
   (SCR, TRIAC, MOSFET, IGBT, converters, inverters), https://nptel.ac.in/courses/108102145
2. Fundamentals of Power Electronics – Prof. L Umanand, IISc Bangalore.
   (Converters, switching devices, simulations), https://onlinecourses.nptel.ac.in/noc21_ee01
3. Power Electronics with Wide Bandgap Devices – Prof. Moumita Das, IIT Mandi.
   (SiC, GaN devices and applications), https://onlinecourses.nptel.ac.in/noc24_ee126
4. Advanced Power Electronics – Prof. Bhim Singh, IIT Delhi.
   (Multilevel inverters, control techniques, drives), https://onlinecourses.nptel.ac.in/noc25_ee02

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)									**Semester:** IV
Course: Computational Methods & Programming									**Code:** EEPC407
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**
03	02	--	04	40	60	-	25	-	125

Prerequisites:

Basic calculus and differential equations, linear algebra, and matrix operations.

Course Objectives:

1. Introduce the fundamental concepts of numerical computation and error analysis.
2. Develop the ability to apply numerical methods for solving systems of linear and nonlinear algebraic equations.
3. Develop techniques for root-finding, interpolation, and curve fitting.
4. Provide numerical solutions to ordinary differential equations and definite integrals.
5. Apply numerical methods to analyze and solve electrical engineering problems such as circuit analysis, load forecasting, system modeling, and instrumentation.

Course Outcomes: After completion of this course, students will able to -

CO1	Analyze numerical errors and assess their impact on computational accuracy in electrical measurements.
CO2	Apply direct and iterative numerical techniques to solve systems of linear algebraic equations.
CO3	Implement root-finding methods along with their convergence properties to solve polynomial and transcendental equations.
CO4	Utilize curve fitting and interpolation methods in Electrical Engineering applications.
CO5	Utilize numerical methods to solve ordinary differential equations.
CO6	Apply numerical integration to compute electrical quantities such as power and RMS values.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fundamentals of Numerical Computation and Error Analysis:** The basic principle of numerical computation; significant digits; floating point representation of numbers along with its arithmetic operations; Errors: different types of errors: absolute error, relative error, round-off errors, chopping error, truncation error, inherent errors; causes of occurrence, and remedies to minimize them; Absolute error in summation, subtraction, multiplication, and division; Generalized error formula (Derivation and Numerical); Application: errors in electrical measurements and instrumentation.	07
2.	**Solution Methods for Systems of Linear Algebraic Equations:** Direct methods - Gauss elimination method; concept of pivoting – partial and complete. Gauss-Jordan method; Iterative methods – Jacobi method and Gauss-	07

	Seidel method; Matrix Inversion using Gauss-Jacobi method; Applications: solution to mesh and nodal analysis of electrical networks, solution to power load flow, operation of different electrical applications.	
3.	**Root-Finding Techniques for Polynomial and Transcendental Equations:** Concept of the root of the equation; Descartes' rule of signs; Intermediate value theorem; Roots of Polynomial Equations using Birge-Vieta method (Derivations and numerical); Roots of Polynomial and Transcendental Equations using Bisection method (Derivations and numerical), Regula-Falsi method (Derivations and numerical), Newton Raphson method (Derivations and numerical), rate of convergence, conditions for convergence of all methods.	08
4.	**Curve Fitting and Interpolation Techniques:** Curve fitting using least square approximation – fitting a straight line (first order) and fitting a parabola (second order); Introduction to interpolation; Interpolation with equal Intervals - Newton's forward, backward interpolation formula (Derivations and numerical), Stirling's and Bessel's central difference formula (Only numerical); Interpolation with unequal intervals: Newton's divided difference formula and Lagrange's interpolation (Derivations and numerical). Applications: prediction of the performance of electrical motors and generators from their practical data, application to load forecasting and generation scheduling, prediction of solar intensity and wind velocity.	08
5.	**Solution Methods for Ordinary Differential Equations (ODEs):** Introduction, Euler's method, and Modified Euler's method (Derivations and numerical). Runge-Kutta fourth order methods (Numerical), Adams bash forth predictor method. Applications: DC and AC transient analysis of RL and RLC circuits, solution for generator oscillations, and deflection angle in MI-type instruments.	06
6.	**Numerical Differentiation and Integration:** Numerical differentiation using Newton's forward and backward interpolation formula (Derivation and numerical). Trapezoidal and Simpson's rules ($1/3^{rd}$ and $3/8^{th}$ rule) as special cases of Newton-Cote's quadrature technique for single integral (Derivations and numerical). Applications: average, RMS quantity determination of electrical measuring quantities, load demand calculations.	06
	TOTAL	**42**

List of Experiments:

The programs are to be executed in C/C++, MATLAB, or Python. Students are required to complete an online course related to the basics of C, or Python, or MATLAB through platforms such as Coursera, Udemy, MATLAB Onramp, or NPTEL. A copy of the course completion certificate is mandatory to be attached to the laboratory record/file.

- **Compulsory Experiments: 1, 4, 5, 6, 9, 10**
- **Anyone from 2 or 3 and anyone from 7 or 8.**
- **Mandatory: Course completion certificate**

1. Develop an algorithm, draw a flow chart, and write a program to implement the Birge-Vieta method.
2. Develop an algorithm, draw a flow chart, and write a program to implement Gauss elimination/Jordan.
3. Develop an algorithm, draw a flow chart, and write a program to implement Gauss Jacobi/Seidel in the following applications.
4. Develop an algorithm, draw a flow chart, and write a program to implement the following:
   a) for loop and while loop-- application in Descartes's rule of sign.
   b) if-else and functions-- application in Intermediate value theorem.
5. Develop an algorithm, draw a flow chart, and write a program to implement the Bisection/Regula-Falsi /Newton-Raphson method (single variable)
6. Develop an algorithm, draw a flow chart, and write a program to implement curve fitting using a least square approximation.
7. Develop an algorithm, draw a flow chart, and write a program to apply Newton's forward/backward interpolation method.
8. Develop an algorithm, draw a flow chart, and write a program to apply Newton's divided difference/Lagrange's interpolation method.
9. Develop an algorithm, draw a flow chart, and write a program to implement Modified Euler's/4th order RK method.
10. Develop an algorithm, draw a flow chart, and write a program to implement the trapezoidal/ Simpson 1/3rd rule.

Text Books:

1. S. Arumugam, A. Thangapandi Isaac, A. Somasundaram, "Numerical Methods" SciTech Publication.
2. M. K. Jain, S.R.K. Iyengar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computations," New Age Publications.
3. Dr. B. S. Grewal, "Numerical Methods in Engineering & Sciences," Khanna Publishers.
4. P.P. Gupta & G.S Malik, "Calculus of Finite Difference and Numerical Analysis," Krishna Prakashan Media Ltd, Meerut.

Reference Books:

1. Ward Cheney, David Kincaid, "Numerical Mathematics and Computing," Thomson Brooks/Cole, 6th edition, 2007.
2. Curtis F. Gerals, Patrick O. Wheatley, "Applied Numerical Analysis," 7th Edition, Pearson Publication.
3. Steven Chapra, Raymond P. Canale, "Numerical Methods for Engineers," Tata McGraw Hill Publication.
4. S.S. Sastry, "Introductory methods of Numerical Analysis," PHI Learning Private Ltd.
5. P. Thangaraj, "Computer oriented Numerical Methods," PHI Learning Private Ltd.

E-Resources:

1. NPTEL course on Numerical Analysis, IIT, Roorkee, https://nptel.ac.in/courses/111107062/
2. NPTEL course on MATLAB Programming on Numerical Computation, IIT Madras https://nptel.ac.in/courses/103106118/
3. NPTEL course on Python for Data Science, IIT Madras, https://nptel.ac.in/courses/106106212/

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)								**Semester:** IV	
Course: Microcontrollers: Architecture and Interfacing								**Code:** EEMD402	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**
02	02	-	02	40	60	-	-	-	100

Prerequisites:

Knowledge of numbering systems and Boolean algebra.
Knowledge of combinational and sequential logic circuits.

Course Objectives:

1. To explain the microcontroller architecture & describe the features of a typical microcontroller.
2. To use the 8051 addressing modes and instruction set and apply this knowledge to develop programs in assembly language and C language.
3. To define the protocol for serial communication and understand the microcontroller development systems.
4. To introduce students to Global System for Mobile Communication (GSM).
5. Explain the interrupt structure of the microcontroller and to develop programs related to interrupt handling.
6. To provide students with interfacing concepts and develop interfacing circuits for simple devices.

Course Outcomes: After completion of this course, students will able to -

CO1	Describe the architecture and features of various types of the microcontroller.
CO2	Illustrate addressing modes and execute programs in assembly language for the microcontroller.
CO3	Write programs in C language for microcontroller 8051.
CO4	Elaborate interrupt structure of 8051 and program to handle interrupt and ADC809.
CO5	Define the protocol for serial communication and understand the microcontroller development systems..
CO6	Interface input output devices and measure electrical parameters with 8051 in real time.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Microcontroller:** Concept of microcontroller, Intel 8051 Functional block diagram, Functions of pins of 8051, Memory organization of 8051, PSW and Flag Bits, Stack and Stack pointer. Overview of special function registers, Data transfer instructions and programs in assembly language.	06
2.	**8051 Assembly language programing**: Arithmetic and logical instructions and programs in assembly language. Boolean and Program Branching instructions and programs in assembly language. Addressing modes of 8051.	05

3.	**8051 C Programming:** Data types in C, Ports of 8051, their use and programming in C (Byte Level and Bit-level), Time delay programming in C, Timers and counters in 8051, Timer modes 0,1,2 and its programming in C and counter programming.	05
4.	**Interrupts**: structure of 8051 and SFR associated with interrupts. Programming of External hardware interrupts in C. Interfacing of ADC 0809 with 8051.	04
5.	**Serial port Structure in 8051:** Programming of Serial port for transferring and receiving data in C in mode 1.	04
6.	**Interfacing of 8051:** Measurement of electrical parameters such as voltage and current (Theoretical Treatment only). Interfacing of Stepper motor with 8051 and its programming in C. Interfacing and programming of single Key, LED and Relay with 8051 in C.	04
	TOTAL	**28**

Text Books:

1. Muhammad Ali Mazidi, J.G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearsons Publishers.
2. V Udayashankara and M S Mallikarjuna Swamy, "8051 Microcontroller, Hardware, software and applications", TATA McGraw Hill.
3. Ajay Deshmukh, "Microcontroller 8051" –TATA McGraw Hill.
4. Theagrajan," Microprocessor and Microcontroller", BS Publication.
5. K. J. Ayala, "The 8051 Microcontrollers- Architecture, Programming and Applications", Peram International Publications.
6. Subrata Ghoshal, "8051 microcontrollers", Pearsons Publishers.
7. Han-Way Huang," Embedded System Design with C8051", Cengage Learning.

Reference Books:

1. Scott Mackenzie, "8051 Microcontroller", Pearson Education.
2. Intel Microcontroller data book.
3. Intel Corporation 1990- 8 bit embedded controller handbook.

E-Resources:

1. NPTEL course on microcontroller 8051, IIT, Kharagpur, https://archive.nptel.ac.in/courses/108/105/108105102/

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)									**Semester:** IV
Course: Quality Management System – II									**Code:** EEMC403
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical and quality thinking.

Course Objectives:

To understand the QMS clauses and its PDCA way of working in an organization.

Course Outcomes: After completion of this course, students will able to -

CO1	Understand the organization and its functional alignment for QMS.
CO2	Understand the quality management system and processes.
CO3	Know the leadership drive and involvement in building quality culture.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	Scope, Normative References, Terms & Definition	04
2.	**Context of the Organization:** Understanding the organization and its context, Needs and expectations of interested parties, Determine the scope of the quality management system, Quality management system and its processes.	10
3.	**Leadership:** Accountability, Responsibilities and Commitment for QMS culture, Quality policy.	14
	TOTAL	**28**

Text Books:

1. Kanishka Bedi, "Quality Management", Oxford University Press.
2. Subburaj Ramasamy, "Total Quality Management", McGraw Hill Education.
3. Dale H. Besterfield, "Total Quality Management", Pearson Education.

Reference Books:

1. QMS ISO 9001:2015 Standards

E-Resources:

1. Dr. N.Venkateshwarlu, "Quality Engineering & Management", NPTEL Course, https://onlinecourses.swayam2.ac.in/nou25_me09/preview

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)								**Semester:** IV	
Course: Problem Solving Techniques – II								**Code:** EEAE401	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Interactive mind-set for practical.

Course Objectives:

1. To acquire basic knowledge of Problem-solving planning.
2. To understand the effectiveness check and sustenance.

Course Outcomes: After completion of this course, students will able to -

CO1	Know how to plan and execute the problem solving.
CO2	Understand the measure and monitoring of problem-solving plan and execution.
CO3	Understand the effectiveness measures of problem solving.
CO4	Understand the sustenance working plan and execution.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Planning & Execution:** What is planning? PDCA way of thinking and planning, Inputs requirement mapping.	08
2.	**Measure of Planning & Execution:** Key measures, How to measure and monitor? Reviews & Reporting with documentation.	08
3.	**Effectiveness measures & Sustenance:** Define effectiveness measures, How to measure and monitor? Importance of Sustenance, How to plan and execute sustenance activities.	12
	TOTAL	**28**

Text Books:

1. B. Mahadevan, "Operations Management: Theory and Practice", Pearson Education India.
2. L.M. Prasad, "Principles and Practices of Management", Sultan Chand & Sons.

Reference Books:

1. The PDCA Cycle for Industrial Improvement: Applied Case Studies (Synthesis Lectures on Engineering, Science, and Technology), Springer.

E-Resources:

1. Coursera, "Initiating and Planning Projects" - https://www.coursera.org/learn/project-planning

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)								**Semester:** IV	
Course: Electrical Workshop								**Code:** EEVS405	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	50	-	-	50

Prerequisites:

Basic Electrical Engineering, Electrical Measurements and Instruments, Fundamentals of Electronics

Course Objectives:

1. To develop foundational skills in electrical wiring.
2. To provide hands-on experience in motor control and protection circuits.
3. To impart practical knowledge of modern electrical distribution systems.
4. To familiarize students with various lighting technologies.
5. To introduce students to basic electronic circuit design and prototyping.
6. To enable students to interface and control electronic devices using Arduino.
7. To cultivate problem-solving and troubleshooting skills.

Course Outcomes: After completion of this course, students will able to -

CO1	Apply electrical wiring techniques in residential and industrial setups.
CO2	Design, assemble, and test electronic circuits using breadboards for analog and power applications.
CO3	Interpret datasheets and manuals to select appropriate components in electrical/electronic circuit design.
CO4	Develop and implement embedded system applications using Arduino for real-time control and automation tasks.
CO5	Demonstrate practical skills on electrical/electronic/Arduino-based circuits.
CO6	Develop circuits in the form of structured technical reports.

Course Contents:

Unit	**Description**
1.	**Group A - Electrical (Minimum 2 exercises from this group)** 1. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring) 2. Wiring of light/fan circuit using two way switches. (Staircase wiring) 3. Design and fabrication of single phase Induction/three phase motor stator. 4. Start delta starter wiring for automatic and manual operation. 5. Wiring of distribution box with MCB, ELCB, RCCB and MCCB. 6. Wiring of 40 W tube, T-5, LED, Metal Halide lamps and available latest luminaries. 7. Assembly of various types of contactors with wiring. 8. Assembly of DOL and 3-point starter with NVC connections and overload operation. 9. Study the various types of earthing for electrical appliances/systems, Practice of earthing and Measurement of Earth resistance of Campus premises. Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.

2.	**Group B - Electronics (Minimum 2 Exercise from this group)** 1. This group consists of electronic circuits which must be assembled and tested on general purpose PCB or bread boards. 2. Design and development of combined ±12 V, ±5 V regulated power supply. 3. Design and development of SCR based half controlled converter using RC triggering. 4. Design and development of first order/ second order low pass/high pass filters with an application. 5. Peak detector using op-amplifiers. 6. Zero crossing detector using op-amplifiers. 7. D.C. step down chopper. 8. Traffic light controller using time delay circuits. 9. Buck/boost converter using LM2596S.
3.	**Group C** (All interfacing circuits for Arduino boards must be assembled on general purpose PCB and tested.) 1. Arduino based D.C. Motor speed control. 2. Arduino based temperature measurement and display. 3. Arduino based ramp, saw tooth waveform generation. 4. Arduino based stepper motor control.

DEPARTMENT OF ELECTRICAL ENGINEERING

Program: B. Tech. (Electrical Engineering)						**Semester:** IV			
Course: Internship – III						**Code:** EEIN403			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	-	-	02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

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

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 3 to 5 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the

standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.