COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Electrical and Communication Engineering

Curriculum Structure with Evaluation Scheme
First and Second Year B. Tech. in

Electrical Engineering

(F.Y. Structure Effective from: A.Y. 2023-24)

(S.Y. Structure Effective from: A.Y. 2024-25)

Curriculum of F.Y. and S.Y. B. Tech. in Electrical Engineering

Program Educational Objectives (PEOs)

After the completion of the program

I. Student will be employable in the diversified sectors of the industry, government organizations, public sector and research organizations.

II. Student will pursue higher education in electrical engineering or other fields oftheir interests, at institutes of repute and high ranking.

III. Student will demonstrate effective communication, life long learning ability, integrity, team work, leadership qualities, concern to environment and commitment tosafety, health, legal and cultural issues in the fields they choose to pursue.

Program Outcomes (POs):

Engineering Graduate will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problem.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science, and engineering sciences.

PO3: Design/Development Solution: Design solution for complex engineering problems and design system component or process that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, social and environmental conditions.

PO4: Conduct Investigation of Complex Problem: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of dataand synthesis of the information to provide valid conclusion.

PO5: Method, Tool Usage: Create, select and apply appropriately technique, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with understanding the limitation.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to access societal health, safety, legal and cultural and consequent responsibility relevantto the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solution in societal and environmental context, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principle and commitment to professional ethics and responsibilities and norms of the engineering practices.

PO9: Individual and Team Work: Function effectively as an individual, and as themember or leader n diverse team and multidisciplinary setting.

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

PO11: Project management and Finance: Demonstrate knowledge & understanding of the engineering and management principles and apply these to ones work, as the member and the leader in a team to manage projects and in multidisciplinary environment.

PO12: Life Long Learning: Recognize the need for, and have the preparation and abilityto engage in independent and lifelong learning in broadest context of technological change.

Program Specific Outcome for Undergraduate (PSOs):

PSO13: To design and develop power electronics hardware and its control to cater the needs of industry such as electric vehicles, renewable interconnections, smart grid and micro-grid.

PSO14: To analyze and solve the problems related to smart grid using modern techniquesand tools.

PSO15: To design, simulate, and make prototype of special purpose machines for enhancing the Performance.

List of Abbreviations

Abbreviation	Title
BS	Basic Science Course
ESC	Engineering Science Course
PCC	Programme Core Course (PCC)
PEC	Programme Elective Course (PEC)
OE/SE	Open/School Elective (OE/SE) other than particular program
MD M	Multidisciplinary Minor (MD M)
VSEC	Vocational and Skill Enhancement Course (VSEC)
HSMC	Humanities Social Science and Management
IKS	Indian Knowledge System (IKS)
VEC	Value Education Course (VEC)
RM	Research Methodology (RM)
--	Internship
--	Project
CEA	Community Engagement Activity (CEA)/Field Project
CCA	Co-curricular & Extracurricular Activities (CCA)

F.Y. B. Tech.
Electrical Engineering
[Level 4.5, UG Certificate] Semester -I

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	BSC	*<tbd>*	Matrix Algebra, Calculus and Probability	2	1	0	1	3	30	10	60	--	--
02	BSC	*<tbd>*	Engineering Chemistry	2	0	2	1	3	30	20	50	CIE: 100	
03	BSC	*<tbd>*	Biology for Engineers	2	0	0	1	2	30	20	50	--	--
04	ESC	*<tbd>*	Elements of Electronics Engineering	2	0	2	1	3	30	20	50	CIE: 100	
05	ESC	*<tbd>*	Engineering Mechanics	2	0	2	1	3	30	20	50	CIE: 100	
06	ESC	*<tbd>*	Programming for problem solving	2	0	2	2	3	30	20	50	CIE: 100	
07	IKS	*<tbd>*	Indian Knowledge System	2	0	0	1	2	CIE: 100			--	--
08	CCA	*<tbd>*	Liberal Learning course - I	0	0	2	2	1	--	--	--	CIE: 100	
Total				**14**	**01**	**10**	**10**	**20**					

[Level 4.5, UG Certificate] Semester -II

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	BSC	*<tbd>*	Differential Equations and Complex Algebra	2	1	0	1	3	30	10	60	--	--
02	BSC	*<tbd>*	Engineering Physics	2	0	2	1	3	30	20	50	CIE: 100	
03	ESC	*<tbd>*	Basic Electrical Engineering	2	0	2	1	3	30	20	50	CIE: 100	
04	ESC	*<tbd>*	Engineering Drawing and Graphics	1	0	4	1	3	CIE: 100			CIE: 100	
05	PCC	*<tbd>*	Fundamentals of measurement and sensors	2	0	2	1	3	30	20	50	CIE: 100	
06	VSEC	*<tbd>*	Data Visualization and Pre-processing	1	0	2	2	2	CIE: 100			CIE: 100	
07	AEC	*<tbd>*	Communication Skills	1	0	2	0	2	CIE: 100			CIE: 100	
08	CCA	*<tbd>*	Liberal Learning course - II	0	0	2	2	1	--	--	--	CIE: 100	
Total				**11**	**01**	**16**	**09**	**20**					

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits
ISE-In-Semester-Evaluation, **ESE**-End-Semester-Evaluation , **MSE**-Mid-Semester-Evaluation, **TA**-Teachers' Assessment, **CIE**-Continuous-Internal-Evaluation

- Exit option to qualify for Certification, common at the School Level:
  - Printed Circuit Board (PCB) Design and Production (3 Credits)
  - Electrical Workshop (3 Credits)
  - Instrumentation Workshop (3 Credits)
  - *Note: Exiting students need to take one SEC from his/her discipline and the other of his/her choice.*

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School of Electrical and Communication Engineering

Curriculum Structure & Detailed Syllabus

F.Y. B. Tech.
Electrical Engineering, E & TC, Instrumentation and Control

(Effective from: A.Y. 2023-24)

F.Y. B. Tech. in
Electrical Engineering, E & TC, Instrumentation and Control

List of Abbreviations

Abbreviation	Title	No of Courses	Credits	% of Credits
BS	Basic Science Course	05	14	35
ESC	Engineering Science Course	05	15	37.5
PCC	Programme Core Course (PCC)	01	03	7.5
PEC	Programme Elective Course (PEC)	--	--	--
OE/SE	Open/School Elective (OE/SE) other than particular program	--	--	--
MD M	Multidisciplinary Minor (MD M)	--	--	--
VSEC	Vocational and Skill Enhancement Course (VSEC)	01	02	5
HSMC	Humanities Social Science and Management	01	02	5
IKS	Indian Knowledge System (IKS)	01	02	5
VEC	Value Education Course (VEC)	--	--	--
RM	Research Methodology (RM)	--	--	--
--	Internship	--	--	--
--	Project	--	--	--
CEA	Community Engagement Activity (CEA)/Field Project	--	--	--
CCA	Co-curricular & Extracurricular Activities (CCA)	02	02	5
	Total	**16**	**40**	**100**

Semester - I

[BS-01] Matrix Algebra, Calculus and Probability

Teaching Scheme
Lectures: 2 hrs/week
Tutorials: 1 hr/week
Self-study: 1 hr/week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-10 Marks
End Sem Evaluatio-60 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. **Define** matrices, linear equations, and determinants, **recall** basics of probability theory,probability distribution, **recall** basic concepts of linear algebra, **recall** double / triple integrals, vector differentiation, vector integration.
2. **Understand** basic concepts such as linear dependence / independence of vectors, rank, nullity, **concepts** of probability, probability distributions, **understand** basic concepts of co-ordinate systems, iterated integrals, gradient, divergence and curl.
3. **Analyze** and **calculate** eigen values, eigen vectors, rank, nullity of a matrix, **evaluate** probability of compound events, **find** probabilities using standard distributions, **evaluate** multiple integrals, **find** area / mass / volume using multiple integrals, **evaluate** line integrals and surface integrals.
4. **Prove** theorems, **apply** Green's / Stoke's / Divergence theorem to different type of problems, **perform** analysis of variance.
5. **Apply** concepts of Matrix Algebra, Calculus and Probability to various problems including real life problems.

Unit 1 **(8L+4T+4S)**

Matrices and Linear Equations: Matrices and Linear Equations: basic properties of matrices, row operations and Gauss elimination, Determinants, and their basic properties, Basic concepts in linear algebra: vector spaces, subspaces,linear independence, and dependence of vectors. Row and Column rank. Solutions of Systems of linear equations using Gauss Elimination method; Rank and Nullity; Eigen Values and Eigen Vectors
S: basic properties of matrices, row operations, Determinants, and their basic properties

Unit 2 **(12L+6T+6S)**

Integral Calculus: Double integrals in Cartesian and polar co-ordinates, iterated integrals, change of variables, triple integrals in Cartesian, spherical and cylindrical co-ordinates, substitutions in multiple integrals, Applications to Area, Volume, Moments, and Center of Mass. Vector differentiation, gradient, divergence and curl, line integral and arc length parameterization, surface integrals, path independence, statements, and illustrations of theorems of Green, Stokes and Gauss, applications.
S: Area, Volume, Moments, and Center of Mass

Unit 3 **(8L+4T+4S)**

Probability: Mean, median, mode, standard deviation, combinatorial probability, joint and conditional probability. Probability distributions, binomial distribution, Poisson distribution, normal distribution, exponential distribution.
S: exponential distribution

Textbooks:

- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley Eastern Ltd.

Reference Books:

- Erwin Kreyszig,"Advanced Engineering Mathematics" by, Wiley Eastern Ltd., 10th edition
- Serge Lang, "Linear Algebra" Springer , 3rd edition
- Gilbert Strang," Linear Algebra and its applications", Cengage Learnings RS, 4th edition
- Howard Anton and Chris Rorres ,"Elementary Linear Algebra ",John Wiley, and sons, 10th edition
- Ross S.M., "Introduction to probability and statistics for Engineers and Scientists", Elsevier Academic press, 8th Edition, 2014.
- Ronald E, Walpole, "Sharon L. Myers, Keying Ye, Probabilty and Statistics for Engineers and Scientists",Pearson Prentice Hall, 9th Edition, 2007.

Note 1:

- To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
- To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
- To measure CO3, questions will be based on applications of core concepts.
- To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
- To measure CO5, some questions may be based on self-study topics and also comprehension of unseen passages.

Note 2:

- All the Course outcomes 1 to 3 will be judged by 75% of the questions and outcomes 4 and 5 will be judged by 25 % of questions.

[BS-02] Engineering Chemistry

Teaching Scheme
Lectures: 2 hrs./week
Practical: 2hr / week
Self-study: 1 hr/week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-20 Marks
End Sem Evaluation-50 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Impart an understanding of Engineering chemistry's fundamental concepts, analytical methods and technological features.
2. Develop the capacity to analyze engineering problems based on the knowledge of chemistry.
3. Develop problem-solving ability.
4. Keep students abreast of the newest advancements and uses of contemporary materials

Unit 1 **(7hrs)**

Analytical Techniques for Engineers:

- Role of materials in engineering fields.
- Quality control and assurance in engineering contexts.
- Qualitative and quantitative analysis
- Emerging trends and applications of analytical techniques for engineering.
- Instrumental methods of analysis: spectroscopy (UV and IR), chromatography (GLC and HPLC), Microscopy: SEM, Thermo-gravimetry: TGA

Unit 2 **(6hrs)**

Corrosion and material protection

- Introduction to corrosion and its impact on engineering materials
- Mechanism, Types/forms of corrosion, Factors that enhance corrosion and choice of parameters to mitigate corrosion.
- Corrosion prevention techniques, advanced surface coatings and corrosion inhibitors
- Case studies and real-world applications in corrosion prevention

Unit 3 **(8 hrs)**

Electrochemical energy systems

- High energy electrochemical energy systems: Lithium-ion batteries principle, construction, working, advantages and applications, Na-ion Battery, fiber battery
- New emerging Fuel cells-working principles, advantages, applications
- Solar cells, Types Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells- working principles, characteristics and applications
- Green hydrogen technology

Unit 4 **(7hrs)**

Nanomaterials for electronics

- Nanomaterials, classification, Nanoscale phenomena and quantum effects
- Top-down and bottom –up approach, Synthesis methods: ball milling, RF sputtering, pulsed laser deposition, thin film deposition
- Applications of nanomaterials in electronics
- Fundamentals of Sensors and materials used in sensors, Synthesis of a sensor.
- Fundamentals of Super capacitor and materials used in super capacitor, Synthesis of a super capacitor

@ 13-15 lectures per credit per course

Self-study - Green Chemistry (12 principles and industrial case study)

List of Recommended Books:

- Willard Dean, Merrittee, "Instrumental Methods of Chemical Analysis",Tata McGraw Hill Limited.
- Gurdeep R. Chatwal,"Instrumental Methods of Chemical Analysis",Himalaya Publishing House.
- Jain and Jain "A textbook of Engineering Chemistry", Dhanpatrai Publication.
- S. S. Dara , "A textbook of Engineering Chemistry", S. Chand Publication 2010 ed.
- Shashi Chawla, "A textbook of Engineering Chemistry", Dhanpatrai Publication.
- Prof. Jianmin Ma, "Battery Technologies: Materials and Components", Wiley
- Charles P. Poole, Frank J. Owens "Introduction to Nanotechnology"
- Shripad Revankar, Pradeep Majumdar , "Fuel Cells"
- Fuel Cell Fundamentals-Ryan O'Hayre, Suk-Won Cha
- SuddhasatwaBasu, "Recent Trends in Fuel Cell Science and Technology"

Engineering Chemistry: Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2hr / week	CIE:100 Marks

Course Outcomes:

Students will demonstrate the ability to

1. Apply theoretical knowledge for practical use and solve engineering problems.
2. Design and carry out scientific experiments, accurately record and analyze the results of experiments.

List of Experiments

1. Preparation and standardization of analytical reagents
2. pH-metric analysis of a sample solution
3. Analysis of inorganic solution by spectroscopic method (Calorimetry)
4. Corrosion testing of electronic integrated circuits
5. Finding the Calorific value of fuel by Bomb calorimeter (GCV, LCV)
6. Flash point-fire point and cloud point-pour point of fuel/lubricant
7. Synthesis of nanomaterials by green route (co-precipitation method)
8. Synthesis of nanomaterial by Ball-milling technique
9. Synthesis of thin films by Spin-coating
10. Characterization of material obtained by Ball-milling technique

Course Educational Objectives:

CEO1: To impart an understanding of Engineering chemistry's concepts, analytical methods and technological features.

CEO2: To acknowledge Laboratory Safety rules.

[BS-03] Biology for Engineers

Teaching Scheme
Lectures: 2 hrs./week
Self-study: 1 hr/week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-20 Marks
End Sem Evaluation-50 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand the overlapping areas between biology and engineering
2. Observe the principles of biological organization with lessons of increasing efficiency of engineered technologies
3. Analyze the analogies between biological and engineering processes
4. Explore the basic biological principles as guiding elements for engineering structures and processes
5. Appreciate the technological optimization of living systems

Unit 1 **(4 hrs)**

Crosstalk between Biology and Engineering:

a) Biologically inspired technologies: Case studies of designs in nature and inspired technologies, Biomemetics: Nature inspired material and mechanisms, Self-cleaning surfaces; Self-healing Bioconcrete, Biomining, Algorithms in nature,

b) Contribution of engineering in biological domain: Contribution of Microscope, Imaging techniques, Bio-medical Instruments, Mechanisms (Ergonomics)

Unit 2 **(8 hrs)**

Organization of Living Machines:

Biomolecules and manufacturing of Biopolymers:

- Carbohydrates (structure-based function and engineering applications)
- Lipids (structure-based function and engineering applications)
- Proteins (structure-based function and engineering applications)
- Nucleic Acids (structure-based function and engineering applications)

Organization of life forms: Cell to organism

Bioenergetics- Energy dynamics in biological system- principles of energy conservation and optimization

Unit 3 **(6 hrs)**

Analogy of biological organ/system and engineering Device/Mechanism:

Organ & system: Brain & CPU, Eye & Camera, Kidney & Filtration system, Lungs & purification system, Heart & Pumping system

Process: Photosynthesis & solar cells, Xylem & plumbing, Thermoregulation in human body & heat transfer in machine, Defense mechanism in organism, signaling processing in biology and electronics

Unit 4 **(6 hrs)**

Concepts in Bioengineering:

Biomechanics: Mechanical properties of tissues, Prosthesis and rehabilitation

Bioprinting: 3D printing of biological tissues and organ engineering and transplanting

Biomaterials: Types, properties and applications

Tissue Engineering: Principle, Components, Methods of Scafold synthesis, properties and applications

Unit 5 (6 hrs)

Application areas of Bioengineering:

Databases & Biocomputing: Acquisition, storage, processing and transmission of biological data and its applications like PCR
Bioinstrumentation: Diagnostic and Therapeutic devices
Bioimaging: Principle, types and examples
Biosensors: Principle, types and examples
Computational biology and application of Artificial Intelligence in bio-medical field

Suggested learning resources:

1. Lodish H, Berk A, Zipursky SL, et al. (2000)" Molecular Cell Biology" W. H. Freeman
2. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000),"*Lehninger principles of biochemistry"* New York: Worth Publishers
3. Lewin B. (2000) "Genes VII" Oxford University Press
4. Rao CNR, et.al. , "Chemistry of Nanomaterials: Synthesis, Properties and Applications"
5. Eggins BR. (1006) , "Biosensors: An Introduction", John Wiley & Sons Publishers
6. Palsson B.O. and Bhatia S.N. (2009) "Tissue Engineering" Pearson

[ES-01] Elements of Electronics Engineering

Teaching Scheme
Lectures: 2 hrs./week
Practical: 2hr / week
Self-study: 1 hr/week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-20 Marks
End Sem Evaluation-50 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Illustrate the band theory of solids and the carrier concentration in solids.
2. Articulate and estimate the charge distribution and charge transfer process in semiconductors.
3. Analyze the characteristics of PN junction diode and junction transistor.
4. Exemplify the applications of diode.
5. Design logic expressions using gates.

Unit 1 **(8 hrs)**

Semiconductor Physics

Classification of Solids, intrinsic and extrinsic semiconductors, equilibrium carrier concentration, Mass action law, Fermi-Dirac probability function, Temperature dependence of carrier concentration, direct and indirect band-gap semiconductors, Carrier Transport: diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations, Diffusion length and mean life time, Tunneling process.

Unit 2 **(6 hrs)**

Semiconductor Diodes

Formation of p-n junctions, position of Fermi level in equilibrium, V-I characteristics in forward and reverse bias, Capacitances in p-n junction diode, Zener diode, Zener diode as a voltage regulator, Applications of special purpose diodes viz. PIN diode, Schottky diode, Gunn diode, LED, Laser Diode, photo diode, Tunnel diode, and solar cell, Diode Circuits: clipping, clamping, voltage multiplier and rectifiers.

Unit 3 **(6hrs)**

Junction Transistors

Structure of NPN and PNP Transistors, BJT Configurations, Operation of BJT Common Emitter Configuration, V-I characteristics, Introduction to FET and MOSFET, Application as a switch.

Unit 4 **(6hrs)**

Fundamentals of Digital Electronics

Difference between analog & digital signals, Basics of Boolean algebra, logic Gates: Symbols, Truth tables, Boolean Expressions; Boolean Laws, Standard representation for logic functions(SOP and POS forms), Minimisation of logic expressions using Boolean Laws and K-map, Number Systems: Binary, octal, decimal, hexadecimal; Introduction to Combinational logic design: Adder/Subtractor, Multiplexers/de-multiplexers; Introduction to Sequential Circuits: Flip-Flops using NAND gates S-R flip flop, clocked S-R flip flop, J-K flip flop.

Textbooks:

- Millman &Halkies, "Electronic Device and Circuits", 4th edition, Tata McGraw Hill.

- R.P.Jain, "Modern Digital Electronics", 4th edition, Tata McGraw Hill.

Reference Book:

- Millman Halkies, "Integrated Electronics", Tata McGraw Hill.
- Boylestead&Nashelsky, "Electronic devices and Circuits Theory", 8th edition, PHI
- Streetman, Ben G., and Sanjay Banerjee. "Solid state electronic devices", 6th edition. New Jersey: Prentice hall.
- M Morris Mano, "Digital Design", 4th edition, Pearson.

Elements of Electronics Engineering: Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2hr / week	CIE:100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Design basic circuits using diodes
2. Identify and characterize basic devices such as BJT and FET from their package information by referring to manufacturers' data sheets.
3. Design, simulate, built and debug simple combinational circuits using gates

List of Experiments:

1. Introduction to various electrical passive components such as Resistors, inductors and capacitors, introduction to active components, introduction to breadboard, Measurement of resistance using the colour code, series and parallel connection of the resistances and its implementation on breadboard. Exposure to usual electronic equipment/instruments such as Multi-meter, Oscilloscope, Function generator, Power supply.
2. To Design clipping circuits - Single ended clipping, Double ended clipping, and clamping circuits.
3. To observe the effect of Variation of Frequency and Load Regulation for Voltage Multiplier.
4. To observe the output voltage of a half wave rectifier and center tapped full wave rectifier with and without capacitor filter. Calculate V_{dc} and I_{dc}.
5. To observe Input and Output Characteristics of BJT in CE configuration and Find h parameters from characteristics.
6. To observe Transfer and Drain Characteristics of MOSFET and Find gm, rd and μ from characteristics.
7. To simplify and implement a Boolean function using k -map technique e.g. code converter
8. To design and implement logic using Multiplexers and Demultiplexer.

[ES-02] Engineering Mechanics

Teaching Scheme
Lectures: 2 hrs/ week
Practical: 2hr / week
Self-Study: 1 hr/ week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-20 Marks
End Sem Evaluation-50 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Apply Mechanics principles to find resultant and equilibrium of 2D force system
2. Evaluate forces in statically determinate trusses and cables using equations of static equilibrium
3. Apply laws of dry friction for engineering problems
4. Solve engineering problems on motion of a particle

Unit 1 **(7 hrs)**

Force system: Forces, Free-Body Diagrams, Moment, Couples, Resultant and Equilibrium of Two-dimensional force System, Equivalent Force system

Unit 2 **(7hrs)**

Structures in Equilibrium: Beams, Trusses, and Cables, Dry Friction for inclined planes, Belt friction

Unit 3 **(7 hrs)**

Motion of a Point: Position, Velocity and Acceleration, Straight Line motion, Curvilinear Motion, Cartesian coordinates, normal & tangential coordinates and, polar coordinates. Relative motion

Unit 4 **(7 hrs)**

Forces, Mass and Acceleration: Newton's second law, Work-Energy Principle, Impulse-Momentum Principle, Direct central impact.

Textbooks:

- Hibbeler R. C., "Engineering Mechanics - Statics", Prentice Hall ,14th Edition
- Hibbeler R. C., "Engineering Mechanics - Dynamics", Prentice Hall ,14th Edition
- Beer F. P., Johnston E. R. et al., "Vector Mechanics for Engineers: Statics Dynamics", McGraw-Hill Publication, 12th Edition

Reference Books:

- Meriam J. L., Kraige L. G., "Engineering Mechanics - Statics ", John Wiley and Sons, 8th Edition
- Meriam J. L., Kraige L. G., " Engineering Mechanics - Dynamics ", John Wiley and Sons, 8th Edition
- Bedford and W. Fowler, "Engineering Mechanics - Statics and Dynamics", Pearson Publications

Engineering Mechanics Laboratory

Teaching Scheme:
Practical:2 hr /week

Examination Scheme:
CIE: 100 marks

Course Outcomes:

Students will demonstrate the ability to:

1. Verify principles of mechanics through experiments.
2. Solve simple engineering problems using graphical solution techniques.
3. Solve simple engineering problems using computer programs.

Contents:

PART A: Experiments (Any six)

1. Verification of law of polygon of forces
2. Verification of law of moments
3. Study of Space force system
4. Determination of beam reactions
5. Belt friction
6. Determination of shear force and bending moment of beam
7. Verification of Newton's second law of motion
8. Curvilinear motion
9. Direct central impact

PART B: Assignments

There will be six assignments, based on graphical and computer solutions of Engineering Mechanics problems.Each assignment shall have a minimum of two problems.

[ES-03] Programming for Problem Solving

Teaching Scheme
Lectures: 2 hrs./week
Laboratory: 2 hrs./week
Self study: 2 hrs./week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-20 Marks
End Sem Evaluation-50 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Represent real life data using data types and variables provided by programming language.
2. Write flow chart, using standard notation, for given problems.
3. Solve a given problem using expressions, conditional statements, arrays and loops.
4. Design a modular solution using functions, by breaking down the problem into parts, using programming language.
5. Demonstrate the ability to process files of various types.

Unit1 **(4 hrs)**

Basic programming constructs:

Understanding a problem: Framing a problem in simple terms – mathematical, graphical, other abstractions. Number systems.Syntax errors and runtime errors.

Manual solutions to real life problems.Algorithms, Properties/characteristics of Algorithms, Flowchart and Pseudo code, Algorithmic representation of the solutions

Basic steps in program execution: Editing, compiling/interpreting/running programs, OS view and programmer's view.

Unit 2 **(6 hrs)**

Introduction to problem solving using computers:

BasicProblems: Basic Data types (Numerical,String).Variables.Expressions.Statements.I/O statements for keyboard handling. Decision Making Statements (if-Statements, if-else Statements, Nested if Statements, Multi-way if-elif-else Statements), Conditional statements, Exchange values of two variables.Finding maximum of three numbers.

Unit 3 **(6 hrs)**

Iterative Problems without arrays: Introduction to iterative constructions in language. Find Sum, average of a given set of numbers. Loop design techniques: While loop - *body, iterative step, loop condition.*Emphasis on while loop against for loop.Factorial. Sine function computation.Fibonacci sequence generation.Some problems to read data from files.

Array techniques: Arrays as homogenous collection of elements.Arrayproperties.Reversing elements of an array.Findingmaximum.Finding second maximum. Algorithms for substring search.

Search problems: linear search. linear search in sorted array. binary search.

Unit 4 **(4hrs)**

Modular Solutions

Functions: Introduction to functions.Importance of design of functions.Rewriting earlier solutions using functions.Taking care of all possible values of arguments, Parameters, return

values, signature, local and global scope, Modular code, Reusability.

Unit 5 **(4 hrs)**

Recursion:

Basic rules of recursion: recursive formulation, terminating case, handle all cases, recursion leading to terminating case. Factorial: iterative vs. recursive.

Recursive formulation for: multiplication, gcd, towers of Hanoi, binary search. Recursion vs. iteration in general.When to use recursion.

Unit 6 **(4 hrs)**

Sorting: Insertion, Bubble, selection sorts

Textbooks:

- R. G. Dromey, "How to solve it by Computer", Pearson Education, ISBN 0-13-433995-9
- Maureen Sprankle, "Problem Solving and Programming Concepts", Pearson Education, ISBN-978-81-317-0711-1

Reference Books:

- Stephen G. Krantz, "Problem Solving Techniques" , Universities Press.
- Kernighan and Ritchie, "The 'C' programming language", Prentice Hall
- Reema Thareja, "Python Programming: Using Problem Solving Approach", Oxford University Press; First edition, 978-0199480173

Laboratory Course Outline

Examination Scheme
CIE: 100

The course involves writing code for solved, unsolved and practice programming problems given in the lab manual.

List of suggested experiments

- Write a program to enter two numbers and perform all arithmetic operations.
- Program to find area of a triangle using Heron's Formula
- Take two integers as input and divide the first by the second. Prevent division by zero.
- Write a program to print `n' terms of an Arithmetic series, with the first term `a' and a constant difference `d'. Take `a,d,n' from user.
- Take a real value `x' from the user and find the value of tan (x), log (x), square root of x
- Write a program to display all the prime numbers between 1 and 100
- Write a program to take as input, 10 integers and put them in an array and display their values. Then, find the sum of all elements in the array and the position of the largest element. (Hint: use the logic of the algorithm to find maximum)
- Declare a 3x3 matrix. Initialise it to zero using nested loops. Then fill some user-given values into it. Print the matrix in proper format to make sure the inputs are correctly taken.
- Write your own function to find the minimum element of an array of integers. (Input to the function is integer array, output is the position number of the minimum element)

- Declare an array of 10 integers. Declare a pointer and point it to the base of the array. Print all the elements of the array using this pointer and not using the original name of the array.
- Write a program to sort a given set of structures on a given key-pair, using bubble sort.
- Write a recursive function to raise a number to a given power.

The instructors are encouraged to update the list of assignments from time to time.

[HSMC-01]Indian Knowledge System

Teaching Scheme **Examination Scheme**
Lectures: 2 hrs./week CIE:100 Marks
Self-study: 1 Hr/week

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. *TBI*

Unit 1 **(4 hrs)**
Basics of Ancient Indian Knowledge and diverse fields from health (Yoga), Agriculture, performing arts etc.

Unit 2 **(8 hrs)**
Ancient Indian Knowledge in various Science streams like physics, chemistry, biology, forestry, mathematics etc.

Unit 3 **(8 hrs)**
Ancient Indian Knowledge in Civil Engineering, Metallurgy, Mechanical Sciences, Textile Technology etc

Unit 4 **(8 hrs)**
Ancient Indian Knowledge in Electrical, Electronics, Computational Studies, Instrumentation etc.

Reference Books:

- *TBI*

[CCA-01]Liberal Learning course - I

Teaching Scheme **Examination Scheme**
Practicals: 2 hrs./week CIE:100 Marks
Self-study: 2 Hr/week

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. *TBI*

Humanities & Social Sciences:
Agriculture, Defence, History, Holistic Health, Geography, Political Science, Interior Design etc.

Semester - II

[BS-04] Differential Equations, Complex Algebra

Teaching Scheme
Lectures: 2 hrs./week
Tutorial : 1 hrs / week
Self Study: 1 hrs / week

Examination Scheme
Mid Sem Evaluation-30marks
TA-10 marks
End Sem. Evaluation-60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. **Understand** basic concepts of complex number, Argand diagram, ODE and PDE
2. **List** types of ordinary differential equations and partial differential equations, **find** Laplace Transforms of simple functions
3. **Solve** different ODEs and PDEs, **find** square root of complex number, **find** solutions of quadratic equations in real and complex number systems
4. **Apply** concepts of Fourier Series to solve PDEs,
5. **Apply** concepts of complex numbers, ODE and PDE to solve real life application problems

Unit 1 (12L+ 6T+6S)

Ordinary Differential Equations: First order Ordinary Differential Equations - Variable Separable, Homogeneous, Linear; Higher order linear equations with constant coefficients Euler-Cauchy equations, non-homogeneous higher order linear differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters);Applications to Initial and boundary value problems: Orthogonal Trajectories Newton's Law of Cooling, Statement of Newton's Law of Cooling, Applications of Newton's Law of Cooling, Growth and Decay, Kirchhoff's Law, Simple Electrical Circuits, Heat Flow, Rectilinear Motion, Simple Harmonic Motion.

S: First order Ordinary Differential Equations - Variable Separable, Homogeneous, Linear

Unit 2 (12L+ 6T+6S)

Partial Differential Equations: Fourier Series; First order partial differential equations, Quasi-linear differential equations, second order differential equations and canonical form. Boundary value problem, fundamental solutions, Dirichlet principle, Poisson's formula, fundamental solution, initial boundary value problem by separation of variable method, boundary value problems: vibrations of a string, one dimensional heat equation, two-dimensional heat equation (Laplace Equation) under steady state conditions.

S: two-dimensional heat equation (Laplace Equation) under steady state conditions

Unit 3 (4L+ 2T+2S)

Complex Number Systems: Introduction to complex numbers as ordered pairs of reals. Representation of complex numbers and polar representation in a plane, Argand diagram; Algebra of complex numbers, modulus and argument (or amplitude) of a complex number, square root of a complex number. Properties of polar and exponential form, Triangle inequality; Quadratic equations in real and complex number systems and their solutions; The relation between roots and coefficients, nature of roots, the formation of quadratic equations with given roots.

S: The relation between roots and coefficients, nature of roots, the formation of quadratic equations with given roots.

Textbooks:

- Erwin Kreyszig , "Advanced Engineering Mathematics", Wiley eastern Ltd ,10th edition

Reference Book:

- Maurice D. Weir, Joel Hass, Frank R. Giordano , "Thomas' Calculus ", 14th edition Pearson Education

- K.D Joshi , "Calculus for Scientists and Engineers" , CRC Press
- Sudhir Ghorpade and BalmohanLimaye , "A course in Calculus and Real Analysis"1st edition, Springer-Verlag, New York
- P.N. Wartikar and J.N. Wartikar , "Applied Mathematics" Pune VidhyarthiGrihaPrakashan Pune ,Vol.1 (Reprint July 2014)

Note 1 :

- To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
- To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
- To measure CO3, questions will be based on applications of core concepts.
- To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
- To measure CO5, some questions may be based on self-study topics and also comprehension of unseen passages.

[BS-05] Engineering Physics

Teaching Scheme
Lectures: 2 hrs./week
Practicals: 2 hrs./week
Self Study: 1 hrs / week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-20 Marks
End Sem Evaluation-50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Apply the concepts of Quantum mechanics to one dimensional motion of electrons
2. Classify solids on the basis of Band theory and to calculate carrier concentrations
3. Evaluate the electrical conductivity and identify the type of semiconductor
4. Implement the fundamentals of LASER for different applications

Unit 1 **(8hrs)**

Quantum Mechanics: Matter waves, Properties of matter waves, Physical significance of wave function. Schrödinger's time dependent and time independent equations, Operators, Eigen values and Eigen functions, Expectation values, Applications of Schrödinger's equation; Motion of a free particle, Electron in an infinite deep potential well (rigid box), Electron in a finite deep potential well (non-rigid box)

Unit 2 **(7 hrs)**

Solid State Physics: lattice parameters, Miller indices, inter planer distance of lattice plane, density of crystals (linear, planar and volume), Sömmerfield's free electron theory, Density of states (3D), Fermi-Dirac probability function, Nearly free electron theory (E-k curve), classification of solids on the basis of band theory

Unit 3 **(8 hrs)**

Semiconductor Physics: Electron and hole concentrations in semiconductors, intrinsic density, intrinsic andExtrinsic conductivity, Position of Fermi level in intrinsic and extrinsic semiconductors, Law of mass action, Temperature variation of carrier concentration in extrinsic semiconductors, Electrical conduction in extrinsic semiconductor, Hall Effect

Unit 4 **(7hrs)**

Laser Physics: Introduction to laser, Spontaneous and stimulated emission of radiations, Thermal equilibrium, Condition for Light amplification, Population inversion, Pumping (Three level and four level pumping), Optical resonator, Laser beam characteristics, Ruby laser, Nd-YAG Laser, He-Ne Laser, Semiconductor Laser, Engineering applications of Laser (Fiber optics, Laser material interaction)

Engineering Physics: Laboratory

Teaching Scheme **Examination Scheme**
Practical: 2hr / week **CIE:100 Marks**

[ES-04] Basic Electrical Engineering

Teaching Scheme	**Examination Scheme**
Lectures: 2 hrs./week	Mid Sem Evaluation-30 Marks
Practicals: 2 hrs./week	TA-20 Marks
Self Study: 1 hrs / week	End Sem Evaluation-50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. analyze AC and DC circuits
2. apply the principles of electric and magnetic circuits to solve engineering problems
3. compute the efficiency and regulation of a single-phase transformer
4. select motors for specific industrial applications
5. use relevant protective devices for electrical installations
6. measure various quantities by using common electrical measuring instruments

Unit 1 **(6 hrs)**

DC Circuits: Electrical circuit elements (R, L, and C), voltage and current sources, Kirchhoff's laws, analysis of simple DC circuits: Superposition, Thevenin and Norton theorems, Maximum Power Transfer theorem, Star-Delta transformation

Unit 2 **(6 hrs)**

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-C combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections, three-phase power, concept of electric grid

Unit 3 **(6 hrs)**

Magnetic Circuits and Transformers: Magnetic materials, B-H curve, hysteresis loop, series and parallel magnetic circuits, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Autotransformer and three-phase transformer connections

Unit 4 **(6 hrs)**

Rotating Electrical Machines: Construction, types, characteristics and applications of DC motors, three-phase induction motors

Unit 5 **(6 hrs)**

Electrical Wiring and Safety: Types of wires and cables, Copper conductor sizes and rating, earth wires, Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Lightning protection. Types and characteristics of Batteries, elementary calculations for energy consumption, and battery backup, inverter, UPS types and specifications

Electrical safety: Electrical safety measures, safety practices, Earthing and its importance, first aid treatment after electrical shock

Textbooks:

- D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2nd Edition 2019
- D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019

E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2010

Reference Books:

- Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd Edition, 2015.
- L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2nd Edition, 2003.

Basic Electrical Engineering: Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2hr / week	CIE:100 Marks

Experiments:

1. Overview of the Basic Electrical Engineering Lab (Equipment available: universal trolley, meters, transformers, loads, etc.) and safety precautions.
2. Verification of Network Theorems:
3. Connect a simple DC circuit with two loops and more than one source and measure all the branch currents and node voltages.
4. Solve the same circuit applying Thevenin's, Norton's, and Superposition Theorems.
5. Measure the voltage, current, and power in the R-L, R-C, and R-L-C series circuits and observe the phase difference between voltage and current using CRO.
6. Connect the three-phase induction motor in star and delta and measure the line and phase voltages and currents to verify the relationship between line and phase quantities.
7. Evaluation of Relative permeability and Magnetic reluctance of a 3-Limb core using an exciting coil of unknown number of turns.
8. Flux diversion in the 3-Limb core by generating circulating currents in short-circuited conductor loop placed around the central limb.
9. Determine the efficiency and regulation of a single-phase transformer by direct loading.
10. Starting, reversing and speed control of DC motor.
11. Starting and reversing of three-phase induction motor and measurement of slip at different load conditions.
12. Connect the single-phase load bank through a switch-fuse unit, MCB and ELCB and check their operation in case of overload, short circuit, and earth leakage.

[ES-05] Engineering Drawing and Computer Graphics

Teaching Scheme
Lectures: 1 hrs./week
Practicals : 4 hrs/week
Self Study: 1 hrs / week

Examination Scheme
CIE:100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Familiarize with different drawing tools, technical standards and procedures for construction of different geometries and engineering objects.
2. Develop the ability to visualize and communicate three dimensional shapes and their sections by representing three-dimensional objects into two-dimensional views using concept of orthographic projection.
3. Apply the visualization practices to draw isometric projection from a given orthographic views.
4. Draw the development of lateral surfaces of assembly and cut sections of different geometrical solids for engineering applications.
5. Draw 2D and 3D drawings using computer aided drafting tool

Unit 1 **(2 hrs)**

Introduction to Engineering Drawing: Drawing tools, drawing standards, line conventions, lettering , systems and rules of dimensioning

Unit 2 **(4 hrs)**

Orthographic Projections: Principles of Orthographic Projections, types of orthographic projections–First angle and third angle projections, Obtaining orthographic projections of given solids and machine elements by using first angle projection method along with sectional views. Basic drawing commands and its applications to draw 2D views using CAD software

Unit 3 **(4 hrs)**

Isometric Projections: Principles of Isometric projection – Isometric and natural Scale, Isometric views of simple and compound solids, drawing isometric views from given orthographic views. Basic drawing commands and its applications to draw 3D views using CAD software

Unit 4 **(4 hrs)**

Development of lateral surfaces (DLS) of solids

Industrial applications of development of lateral surface, methods of development, development and antidevelopment of lateral surfaces for cut section of Prism, Pyramid, and Cone

Textbooks:

- N.D.Bhatt, "Elementary Engineering Drawing", Charotar Publishing House, Anand (India)
- M.L.Dabhade, "Engineering Graphics" I, Vision Publications, Pune
- Dhananjay Jolhe , "Engineering Drawing", Tata McGraw Hill publishing company Ltd., New Delhi

Reference Books:

- Warren Luzzader, "Fundamentals of Engineering Drawing", Prentice Hall of India, New Delhi.

- Shah, M.B. & Rana B.C.), "Engineering Drawing and Computer Graphics", Pearson Education
- Agrawal B. & Agrawal C. M. , "Engineering Graphics", Tata McGraw Publication
- Suraj Singh , " Civil Engineering Building Practice ",

Practical Sessions

To draw 02 examples on each assignment on A3 size drawing sheet

Assignment 1:

Draw orthographic views of any machine elements along with sectional view.

Assignment 2:

Draw isometric view for given orthographic views.

Assignment 3:

Draw the development and antidevelopment of lateral surfaces of solids.

Assignment 4: (Programme specific assignment, One example only)

- Draw a plan, elevation, section of single storeybuilding.(For Civil Engineering)
- Conventional representation of piping layouts, pipe fittings, valves, joints. Stuffing box & glands, Expansion joints etc(For mechanical , Manufacturing , Metallurgy and Robotics and Automation)
- Engineering drawings such as complex circuits/schematic/layout drawings, process flow diagrams (PFDs), sensor diagrams(SDs) and piping and instrumentation diagrams(P & IDs) (For Electrical , Electronics and Instrumentation Engineering)

Complete the following assignment by using CAD software (04 exampleseach)

Assignment 1:

Draw orthographic views of any machine elements along with sectional view.

Assignment 2:

Draw isometric view for given orthographic views.(3D drawings)

Assignment 3: (Programme specific assignment, One example only)

- Draw a plan, elevation, section of single storey building. (For Civil Engineering)
- Conventional representation of piping layouts, pipe fittings, valves, joints. Stuffing box & glands, Expansion joints etc(For mechanical , Manufacturing , Metallurgy and Robotics and Automation) (For Electrical , Electronics and Instrumentation Engineering)
- Engineering drawings such as Complex circuit/schematic/layout drawings, process flow diagrams (PFDs), sensor diagrams (SDs) and piping and instrumentation diagrams (P&IDs)

[*PCC-0*1] Fundamentals of Measurement and Sensors

Teaching Scheme
Lectures:2 hrs./week
Practicals: 2 hrs./week
Self Study: 1 hrs./week

Examination Scheme
Mid Sem Evaluation-30 Marks
TA-20 Marks
End Sem Evaluation-50 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. List different types of sensor/measuring instruments used for displacement, velocity, acceleration, force and torque.
2. Define and describe working principles and characteristics of the sensors and Measuring Instruments.
3. Implement and sketch the electronic signal processing for the sensors
4. Select and defend suitable sensor/measuring system for a specific application

Unit 1 **(7 hrs)**

Introduction of measuring Systems: Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, standards and calibration. Introduction to Mesh analysis, nodal analysis and One port and two port networks

Unit 2 Resistance, Inductance & Capacitance Measurement: **(7 hrs)**

Wheatstone bridge, design, arrangement of ratio arms, sensitivity, errors, null type and deflection type, calibration adjustment, Kelvin bridge, Kelvin double bridge, series ohmmeter, shunt ohmmeter, DMM. Maxwell's bridge: design and applications, Hay's bridge: design and applications, Schering bridge: design and applications, LCR Q-meter

Unit 3 **(7 hrs)**

Displacement Measurement: Resistive: Potentiometer, Linear and rotary, Loading Effect types of strain gauges. Inductive: LVDT and Eddy current type Transducers. Capacitive: Capacitance pickups, Differential capacitive cells. Piezoelectric, Ultrasonic transducers and Hall effect transducers Optical transducers. Precision measuring instrument (gauges), Angular measurement: Combination protractor, universal bevel protractor, sine bar, clinometers, optical prism method

Unit 4 **(7 hrs)**

Velocity and Acceleration measurement: Standards, working principle, types, materials, design criterion: Moving magnet and moving coil, Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, stroboscopes and stroboscopic method, Shaft speed measurement.
Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type

Unit 5 **(5 hrs)**

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire

force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement

Textbooks:

- A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Sons, 12th ed., 2005
- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, 4th ed., 2016

Reference Books:

- E.O. Doebelin, "Measurement Systems", McGraw Hill, 6th ed., 2017
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, 2nd ed., 1999
- A. J. Bouwens, "Digital Instrumentation", McGraw-Hill, 6th reprint, 2008
- H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, 4th ed., 2017
- Albert D. Helfrick, William David Cooper, "Modern electronic Instrumentation and Measurement Techniques" Prentice Hall, Second ed., 1990

List of Experiements:

1. Determination of admittance and impedance of one port network.
2. Design and implementation of resistance measurement such as Wheatstone bridge, LCR meter, V-I Method.
3. Design, implementation of series and shunt ohmmeters. Evaluate its performance characteristics.
4. Characterization and calibration of potentiometer as displacement sensor. Study of loading effect on potentiometer (linear and rotary).
5. Characterization and calibration of LVDT based displacement measurement system.
6. Characterization of strain gauge using cantilever beam.
7. Characterization and calibration of piezoelectric measurement system.
8. Measurement using proximity sensors (inductive/Capacitive) for an application

[VSEC-01] Data Visualization and Pre-processing

Teaching Scheme
Lectures:1 hrs./week
Practicals: 2 hrs./week
Self Study: 2hrs / week

Examination Scheme
CIE - 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Identify the importance of data visualization and preprocessing
2. Select and use appropriate visualization Techniques
3. Apply data visualization techniques for analyzing the data
4. Interpret results of exploratory data analysis
5. Apply different preprocessing techniques on data

Unit 1 **(3hrs)**

Fundamentals of Data Visualization: Overview of data visualization and its importance, Principles of visual perception and cognition, Acquiring and Visualizing Data,Choosing appropriate visualizations for different data types, Simultaneous acquisition and visualization , exploratory data analysis techniques, Applications of DataVisualization

Unit 2 **(4 hrs)**

Data Visualization Techniques: Graphs and charts for categorical data, bar charts, gantt charts, stacked bars , line plots, scatter plots, area chart , pie chart and bubble charts, heatmaps, treemaps,box and whisker plots, histograms, word cloud , geo maps,interactive data visualization

Unit 3 **(3 hrs)**

Introduction to Dashboard Design: Introduction to dashboard design principles, exploring different types of dashboards, defining the purpose and objectives of the dashboard, data visualization style guide, visual hierarchy and layout design, performance and optimization of dashboard, dashboard deployment and distribution, dashboard evaluation methods

Unit 4 **(4hrs)**

Introduction to Data Pre-Processing : Importance and role of data preprocessing, challenges and issues in real-world datasets, preprocessing techniques- aggregation, sampling, dimensionality reduction, feature selection, discretization, data quality and cleaning techniques, handling missing data and outliers, data normalization and standardization, handling time series data

Textbooks:

- Schwabish, Jonathan, " Better data visualizations: A guide for scholars, researchers, and wonks" . Columbia University Press, 2021
- Salvador García, Julián Luengo, and Francisco Herrera , "Data Pre-processing in Data Mining" , Springer , 2014

Reference Books:

- Min Chen, Helwig Hauser, Penny Rheingans, "Gerik Scheuermann, 'Foundations of Data Visualization", Springer, 2020
- Andy Kirk, "Data Visualisation: A Handbook for Data Driven Design" , SAGE Publication, 2019

- Alexandru C. Telea, "Data Visualization: Principles and Practice", CRC Press, 2014
- Stephen Few, "Information Dashboard Design: Displaying Data for At-a-Glance Monitoring", Analytics Press; 2nd edition , 2013
- Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008
- Pang-Ning Tan, Michael Steinbach, Vipin Kumar "Introduction to Data Mining", Pearson Addison-Wesley, Second Edition

Laboratory Experiment

Examination Scheme

CIE - 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Classify and transform the given data into visual presentation using visualization tools
2. Prepare dashboard to visualize summarized data
3. Perform pre-processing operations on data

List of Experiments:

1. Download any free data set (from tableau/kaggleetc)in excel format and prepare the following:
   bar charts, area chart ,pie charts ,line plots,scatter plots
2. Download any free data set andprepare the following:
   Heat map,Tree map,Histogram
3. Study of any of the visualization tools like
   Tableau,Power BI,Domo,Excel
4. Use of Python libraries such as Matplotlib, Seaborn, Plotly to visualize data in the given dataset
5. Prepare a Dashboard using any one soursesoftware
   e.g. Tableau, Microsoft POWER BI, Google data Studio
6. Install WEKA on your system and study different features
7. Use WEKA tool for feature extraction and filtering

Resources:

- Kalilur Rahman, 'Python Data Visualization Essentials Guide: Become a Data Visualization expert by building strong proficiency in Pandas, Matplotlib, Seaborn, Plotly, Numpy, and Bokeh,BPB Publication, 2021
- Ryan Sleeper, 'Practical Tableau'O'Reilly Media Inc, 2018
- Bostjan Kaluza, 'Instant Weka How-to', Packt Publishing, 2013

[HSMC-02A] Communication Skills

Teaching Scheme
Lectures: 1 hr./week
Practicals: 2hrs./week

Examination Scheme
CIE - 100 Marks

Course Outcomes:
At the end of the course, students will demonstrate the ability to

1. Recall and use basic language skills-listening, speaking, reading and writing and attempt tasks using grammar and vocabulary efficiently
2. Understand the concepts/ principles of communication skills and structure conversations effectively
3. Develop the knack to make their point of view clear to the audience and portray their communicative competence efficiently in front of a large audience on a variety of relevant situations
4. Analyze, apply and present themselves competently in all formal spheres

Unit1 **(2hrs)**

Introduction to English for Engineers : Varieties and Registers of EnglishEnglish for Specific Purposes (ESP): Business English

Unit 2 **(4 hrs)**

Foundation of Communicative and Linguistic Ability Development: Types of Communication, Process of Communication, Barriers and ways to overcome them, Common Challenges: Phonological, Syntactic, Semantic and Pragmatic Errors

Unit 3 **(4 hrs)**

Advanced Speaking Skills: Nuances of Speaking Skills/ Public Speaking, Group Communication, Presentation Skills: The 4 P's of Presentation, Do's and Don'ts, Techniques for Effective Delivery

Unit 4 **(4 hrs)**

Business Writing Development: Techniques of Writing: Note-making, Drafting, Editing, Paraphrasing and Proof-reading, Business Letters, Emails and Brief Reports

[HSMC-02B] Practical
Activity and Exposure Oriented T & L Methodology

Teaching Scheme
Practial:2 hrs./week

Examination Scheme
CIE - 100 Marks

Unit 1 **(2 hrs)**

Foundation of Language Learning Skills: Receptive Skills: Listening and Reading; Productive Skills: Speaking and Writing; Grammaticality and Appropriateness; Vocabulary Development

Unit 2 **(4 hrs)**

Listening Skills: Stages of Listening (pre, while and post), Strategies to Develop Active Listening Skills, Problematic Sounds for Indian Users

Unit 3 **(4 hrs)**

Speaking Skills: Oral Communication, Sounds in English, Pronunciation, Stress, Intonation and Pauses, Formal and Informal Expressions, Situational Conversations, Group Discussion

Unit 4 **(4hrs)**

Reading and Writing Skills: Reading Techniques: Scanning and Skimming, Active Reading; Common Problems in Reading; Stages of Writing (pre, while and post), 7 Cs of Effective Communication; Letter/ Email writing- drafting, editing, summarizing

[CCA-02]Liberal Learning course - II

Teaching Scheme **Examination Scheme**

Practicals: 2 hrs./week CIE:100 Marks

Self Study: 2hrs./week

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. TBI

Performing Arts:

Music (Vocal), Music (Instrumental), Dance, Photography, Painting, Theatre & Film Appreciation, Clay Art & Pottery etc.

Exit Option

To qualify for Certification, Common at the School Level

Note: Exiting students need to take one SEC from his/her discipline and the other of his/her choice.

[VSEC-] Instrumentation Workshop

Teaching Scheme
Theory: 28 hrs
Practical: 17 hrs

Examination Scheme
Test and hands on practice - 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Describe working principles of various transducers/sensors
2. Interpret the characteristics of the transducers/sensors
3. List various standards used for selection of transducers/sensors
4. Select transducers/sensors for specific applications
5. Examine the operation of the final control elements, pneumatic and hydraulic components generally used in plants

Unit1 **(7 hrs)**

Temperature: Temperature scales, classification of temperature sensors, standards, working principle, types, materials, Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistor)

Unit 2 **(7 hrs)**

Pressure and Level: Definition, pressure scale, standards, working principle, types, materials, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, capacitive (delta cell), high-pressure sensors, low-pressure sensors, Standards, working principle, types, materials, design criterion: float, displacers, bubbler, ultrasonic, microwave, radar, resistance, thermal, solid level detectors.

Unit 3 **(7 hrs)**

Flow: Standards, working principle, types, materials, and design criterion: primary or quantity meters (positive displacement flow meter), secondary or rate meter (obstruction type, variable area type), electrical flow sensors (turbine type, electromagnetic type, and ultrasonic type), Flow switches

Unit 4 **(7 hrs)**

Actuators and accessories: Operation of control valve, Classification of control valves, Pneumatic Supply and its components: Filter Regulator Lubricator (FRL), Single acting & Double acting cylinder, Special cylinders, Operation of Direction Control valves, Types of pilot signal, operation of speed regulators, pressure control valve, Special valves like quick exhaust, pressure, time delay valve, Standard Symbols for pneumatic components, Hydraulic supply: reservoir, Types of filters, Function of accumulators, Hydraulic Actuators, Operation of Direction Control Valve, Standard symbols for hydraulic components

Textbooks:

- A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Sons, 12th ed., 2005.
- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, 4th ed., 2016.
- Pneumatic Instrumentation by Majumdhar, TMH
- D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.

Reference Books:

- E.O. Doebelin, "Measurement Systems", McGraw Hill, 6th ed., 2017.
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, 2nd ed., 1999.
- Control Valve Handbook, Fisher Controls International, Inc. third Edition, 2001

List of Experiments:

- Measure inner and outer diameter of pipe using vernier calipers & compare it with standards.
- Measure thickness of the metallic sheet with micrometer & compare it with standards.
- Identify different electronic components viz. Resistor, Capacitor, Inductor, transformer, fuse, diode, transistor.
- Identify various resistors tyopes andMeasure value of given resistor & compare it with theoretical value obtained using colour code.
- Identify various capacitors viz paper , silvered paper, mica, silvered mica, ceramic plastic foil,electrolytic
- Identify various inductors viz fixed and variable inductors.
- Identify Piezo electric crystal & study it's application
- Wire instrument panel with various accessories as per instrument hook-up diagram.
- Wire the MCB, ELCB to supply electrical power to instrument panel.
- Wire the MCB, ELCB, contactor, starter to supply electrical power to motor drive panel as per given wiring diagram for one application.
- Dismantle & assemble valve to identify it's components as per sketch .
- Dismantle, assemble & calibrate pressure gauge.
- Install any one instrument using screw type connection and flange type connection.
- Test pressure/flow/level/temperature switch.
- Study and operate mechanical switches, and electromechanical switches.
- Study and operate special components like DCVs, FRL, flow control valves, pressure regulating valve, exhaust valve, displays, relays and other accessories
- Implementation of Pneumatic circuits
- Implementation of hydraulic circuits
- Test proximity & limit switch.

[VSEC-] Printed Circuit Board (PCB) Design and Production

Teaching Scheme **Examination Scheme**

Test and hands on practice - 100 Marks

Theory: 28hrs
Practical: 17hrs

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand basics of PCB designing.
2. Apply advance techniques, skills and modern tools for designing and fabrication of PCBs.
3. Develop a PCB for any application provided.

Unit 1 **(6 hrs)**

Introduction to PCB designing concepts: Fundamental of electronic components, basic electronic circuits, Need for PCB, Types of PCBs: Single and Multilayer, Technology: Plated Through Hole, Surface Mount. PCB Material, Electronic Component packaging, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, Design Issues: Transmission line, Cross talk and Thermal management.

Unit 2 **(4 hrs)**

Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

Unit 3 **(8 hrs)**

Introduction to Electronic design automation(EDA) tools for PCB designing: Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design.

Unit 4 **(5 hrs)**

Introduction to PCB Prototyping and Production:PCB Prototyping: CNC Machine, Photo-Lithography process, Screen Printing process and chemical etching. PCB Mass Manufacturing Process: Gerber Generation, CAM, panelization, cleaning, drilling, plating, screen printing, etching, automated optical inspection, tinning, solder resist, legend printing, pcb testing.

Unit 5 **(5 hrs)**

PCB Technology Trends: Multilayer PCBs. Multiwire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.

PCB Design and Production Laboratory

List of Experiments:

Part A: Hands on experience experiment on PCB design which includes

- Study on types of PCB layers, through Hole and SMD Components.
- Schematic Creation and simulation of an electronic circuit
- Mapping Components of an electronic circuit
- Set Parameters for PCB Design.
- Laying Tracks on PCB.
- Create PCB Layout of an Electronic Circuit.
- Create Device Model and simulation

Part B: Hands on experience experiment on PCB production using SMT Line Setup that consists ofSolder Paste Printer (SPP), Screen Printing Process-Stencil Design, Solder paste Inspection (SPI), Pick and place Machine (PPM), Pick and place Feeders, Heads and Nozzles, P & P Programming concepts, Reflow Oven (RO), Reflow Heating Process, Reflow Solder Defects, Reflow profiling, Automatic Optical Inspection(AOI).

Textbooks:

- R. S. Khandpur, "Printed circuit board design ,fabrication assembly and testing", Tata McGraw Hill 2006.

Reference Books:

- Clyde F. Coombs, Jr, Happy T. Holden,"Printed Circuits Handbook", McGraw-Hill Education, 6th edition, 2016.
- Elaine Rhodes, "Developing Printed Circuit Assemblies: From Specifications to Mass Production", 2008.
- C. Coombs, "Printed Circuits Handbook", McGraw-Hill Professional, 6th edition, 2007.
- D. Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall, 2003.
- Open source EDA Tool KiCad Tutorial: http://kicad-pcb.org/help/tutorials/

[VSEC-] Electrical Workshop

Teaching Scheme
Theory: 15hrs
Practical: 30hrs

Examination Scheme
Test and hands on practice - 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. locate and repair faults in domestic and industrial wiring installations.
2. rewind small transformers.
3. wire up control panels for industrial applications.
4. construct and test small electronic circuits.
5. install an inverter/UPS, and batteries.
6. connect the solar panel to AC and DC loads in a standalone system.

Experiment 1:

Practice with various measuring instruments and tools for testing and maintenance.

- Use of a series test lamp, continuity tester, Megger, multimeter, phase sequence indicator, CRO, lux meter, etc.
- Use of personal protective equipment, hand tools and safety practices.

Experiment 2:

Prepare the test board/extension board and mount accessories like lamp holders, various switches, sockets, MCBs, indicating lamps, etc.

- Identify various electrical accessories and their ratings.
- Select the correct size of board to mount the specified accessories.
- Position the accessories and mount them on board.
- Wire up and test the test board or extension board.

Experiment 3:

Testing and fault detection of domestic and industrial wiring and repair.

- Detect and repair open circuit faults in domestic or industrial wiring.
- Detect and repair short circuit faults in domestic or industrial wiring.
- Detect and repair earth faults in domestic or industrial wiring.

Experiment 4:

Practice wiring a 415 V, 3 HP, 3-phase induction motor as per IE rules.

- Read and interpret the name plate details of the motor.
- Determine the size of the cable.
- Select suitable ICTP/MCB, DOL starter and other accessories.
- Calculate the size and length of conduit.
  Make connections and adjust the overload relay as per the motor rating.
- Start and stop the motor using the starter.

Experiment 5:

Practice winding a small transformer.

- Dismantle the transformer core.
- Measure and determine the size of winding wire for primary and secondary winding.
- Take the dimensions of a bobbin and prepare the bobbin from suitable materials.
- Wind the primary and secondary windings using a winding machine.
- Stack the laminations and fasten them.
- Terminate the winding ends on a terminal board.

Experiment 6:

Control panel wiring for simple control applications like forward, reverse, star-delta starters, and sequential control of motors.

- Study power and control circuit diagrams.
- Mount various control elements like contactors, relays, timers, circuit breakers, sensors, measuring instruments, etc.
- Mount the DIN rail and arrange the wiring by routing, bunching, and tying.
- Test the control panel.

Experiment 7:

Make a printed circuit board for a small electronic circuit.

- Prepare the layout of the PCB and transfer it to the copper-clad board.
- Punch component mounting holes.
- Paint and etch the copper-clad board.
- Drill holes, mount, and solder components.
- Test the circuit.

Experiment 8:

Installation and connection of an inverter or UPS with a battery for domestic wiring.

- Select the rating of the inverter or UPS for a given load and backup.
- Select a suitable place for the installation of an inverter and batteries in the house.
- Install the inverter and batteries and make connections to the load.
- Test the installation under the ON/OFF condition of the supply.

Experiment 9:

Connect the solar panel to the given AC and DC load.

- Select a suitable rating for the solar panel, charge controller, batteries, inverter, MCB, cables, and connectors for the given ac and dc loads.
- Install solar panels on the rooftop with a proper tilt angle.
- Make connections using standard cables and connectors.
- Test the installation for performance.

Experiment 10:

Service and repair of domestic appliances like electric iron, electric kettle, cooking range and geyser.

- Connect and test the given appliance for its functioning.
- Dismantle the appliance.
- Trace and identify (or locate) the faults.
- Replace the faulty parts, assemble the appliance, and test its functioning.

Experiment 11:

Plan and execute an illumination scheme for a given room according to the working situation.

- Design an illumination scheme for a given room and situation.
- Use the open-source software available for the design of illumination schemes.

Experiment 12:

Installation, testing, and maintenance of batteries

- Use of various types of cells.
- Grouping cells for specified voltage and current.
- Practice battery charging.
- Routine, care, maintenance, and testing of batteries.

COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Electrical and Communication Engineering

Curriculum Structure and Detailed Syllabus

S.Y. B. Tech.
Electrical Engineering

(Effective from: A.Y. 2024-25)

S. Y. B. Tech. Electrical Engineering

[Level 5, UG Diploma] Regular Students Semester -III

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	*<tbd>*	Signals and Systems	2	1	0	1	3	30	10	60	--	--
02	PCC	*<tbd>*	Electric Circuit Analysis	2	0	2	1	3	30	20	50	50	50
03	PCC	*<tbd>*	Analog and Digital Electronics	3	0	2	1	4	30	10	60	50	50
04	OE	*<tbd>*	Open Elective - I	2	0	0	1	2	30	20	50	--	--
05	HSMC	*<tbd>*	Indian language	2	0	0	1	2	CIE: 100			--	--
06	VEC	*<tbd>*	Environmental Studies	1	0	0	2	1	CIE: 100			--	--
07	CEA	*<tbd>*	Community Engagement Activity (CEA)/Field Project	-	-	-	-	2	--	--	--	CIE: 100	
08	HSMC	*<tbd>*	Entrepreneurship	2	0	0	1	2	30	20	50	--	--
09	HSMC	*<tbd>*	Design Thinking	-	-	2	1	1	--	--	--	CIE: 100	
			Total	**14**	**01**	**06**	**09**	**20**					

[Level 5, UG Diploma] Semester -IV

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	*<tbd>*	Microcontrollers and Applications	3	0	2	1	4	30	10	60	50	50
02	PCC	*<tbd>*	Electromagnetic Fields	2	0	0	1	2	30	20	50	--	--
03	PCC	*<tbd>*	Electrical Machines	3	0	2	1	4	30	10	60	50	50
04	PCC	*<tbd>*	Numerical Methods and Computer Programming	1	0	2	1	2	CIE:100			50	50
05	VEC-2	*<tbd>*	Constitution of India	1	0	0	2	1	CIE: 100			--	--
06	OE	*<tbd>*	Open Elective - II	2	0	0	1	2	30	20	50	--	--
07	VSEC	*<tbd>*	Cornerstone Project-I	0	0	4	2	2	--	--	--	50	50
08	MD M	*<tbd>*	Multidisciplinary Minor - I	2	0	2	1	3	30	20	50	50	50
			Total	**14**	**00**	**12**	**10**	**20**					

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits
ISE-In-Semester-Evaluation, **ESE**-End-Semester-Evaluation, **MSE**-Mid-Semester-Evaluation, **TA**-Teachers' Assessment, **CIE**-Continuous-Internal-Evaluation

Exit option to qualify for UG Diploma:

- Electrical Installation, Estimation and Costing (3 Credits)
- PLC for Industrial Automation (3 Credits)

S. Y. B. Tech. Electrical Engineering

[Level 5, UG Diploma] Lateral Entry Students- Semester -III

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	*<tbd>*	Signals and Systems	2	1	0	1	3	30	10	60	--	--
02	PCC	*<tbd>*	Electric Circuit Analysis	2	0	2	1	3	30	20	50	50	50
03	PCC	*<tbd>*	Analog and Digital Electronics	3	0	2	1	4	30	10	60	50	50
04	BS-06	*<tbd>*	Mathematics	3	0	0	1	3	30	10	60	---	---
05	OE	*<tbd>*	Open Elective - I	2	0	0	1	2	30	20	50	--	--
06	HSMC	*<tbd>*	Indian language	2	0	0	1	2	CIE: 100			--	--
07	VEC	*<tbd>*	Environmental Studies	1	0	0	2	1	CIE: 100			--	--
08	CEA	*<tbd>*	Community Engagement Activity (CEA)/Field Project	-	-	-	-	2	--	--	--	CIE: 100	
09	HSMC	*<tbd>*	Entrepreneurship	2	0	0	1	2	30	20	50	--	--
10	HSMC	*<tbd>*	Design Thinking	-	-	2	1	1	--	--	--	CIE: 100	
			Total	**17**	**01**	**06**	**11**	**23**					

[Level 5, UG Diploma] Semester -IV

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	*<tbd>*	Microcontrollers and Applications	3	0	2	1	4	30	10	60	50	50
02	PCC	*<tbd>*	Electromagnetic Fields	2	0	0	1	2	30	20	50	--	--
03	PCC	*<tbd>*	Electrical Machines	3	0	2	1	4	30	10	60	50	50
04	PCC	*<tbd>*	Numerical Methods and Computer Programming	1	0	2	1	2	CIE:100			50	50
05	VEC-2	*<tbd>*	Constitution of India	1	0	0	2	1	CIE: 100			--	--
06	OE	*<tbd>*	Open Elective - II	2	0	0	1	2	30	20	50	--	--
07	VSEC	*<tbd>*	Cornerstone Project-I	0	0	4	2	2	--	--	--	50	50
08	MD M	*<tbd>*	Multidisciplinary Minor - I	2	0	2	1	3	30	20	50	50	50
09	HSMC	*<tbd>*	Communication Skills	1	0	2	0	2	CIE:100			CIE:100	
			Total	**15**	**00**	**14**	**10**	**22**					

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits
ISE-In-Semester-Evaluation, **ESE**-End-Semester-Evaluation, **MSE**-Mid-Semester-Evaluation, **TA**-Teachers' Assessment, **CIE**-Continuous-Internal-Evaluation

Exit option to qualify for UG Diploma:

- Electrical Installation, Estimation and Costing (3 Credits)
- PLC for Industrial Automation (3 Credits)

Open Electives

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	OE-I	*<tbd>*	Electrical Machines and Drives	2	0	0	1	2	30	20	50	--	--
02	OE-II	*<tbd>*	Principles of Electronic Communication	2	0	0	1	2	30	20	50	--	--
03	OE-III	*<tbd>*	Sensors and Actuators	2	0	0	1	2	30	20	50	--	--
			Total	**6**	**0**	**0**	**3**	**6**					

Additional Credits for Exits
After Completion of Second Year

Sr. No.	Course Code	Course Title	L	T	P	Cr	Category
01	VSEC-02	Electrical Installation, Estimation and Costing	1	0	4	3	VSEC
02	VSEC-03	PLC for Industrial Automation	1	0	4	3	VSEC
		Total	**02**	**00**	**08**	**06**	

SEMESTER III

[PCC-02] Signals and Systems

Teaching Scheme
Lectures: 2 Hrs./week
Tutorial: 1 Hr / week
Self Study:1 Hr / week

Examination Scheme
Mid Sem Evaluation - 30 Marks
TA-10 Marks
End Sem Exam- 60 Marks

Course Outcomes:
At the end of the course, students will demonstrate the ability to
1. Classify signals based on their characteristics and perform basic operations on signals.
2. Interpret system characteristics and analyze LTI systems.
3. Analyze the spectral properties of signals using Fourier analysis.
4. Apply Z- transform to study discrete-time signals and systems.

Unit 1 **(5 Hrs)**
Introduction to Signals:
Definition of Signals, Classification of Signals, elementary signals, basic operations on signals

Unit 2 **(6 Hrs)**
System Classification and Properties:
Introduction to Systems, Classification of Systems, Properties of Systems, Impulse response characterization and convolution for CT- LTI and DT-LTI systems, LTI systems characterized by Differential and difference equations.

Unit 3 **(6 Hrs)**
Fourier analysis of Continuous Time Signals:
Fourier analysis for Continuous time signals, Continuous time Fourier Transform, its properties, frequency response..

Unit 4 **(5 Hrs)**
Fourier Analysis of Discrete Time Signals:
Fourier analysis for Continuous time signals, Continuous time Fourier Transform, its properties, frequency response.

Unit 5 **(5 Hrs)**
Z-Transform:
Representation of Signals Using Discrete-Time Complex Exponentials: Z-Transform, Significance and Properties of Region of Convergence, Properties of Z-Transform, Inverse Z-Transform, relationship of z-transform with Fourier transform, applications of Z-transform to solutions of difference equations, Properties of Z transform.

Text Books:
- Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley and sons
- Michael J. Robert, "Introduction to Signals and Systems", TMH, Second ed., 2003
- Tarun Kumar Rawat "Signals and Systems", Oxford University Press, first edition 2010

Reference Book:
- Alan V Oppenheim, Alan S Willsky, "Signals and systems" PHI, Second ed. 2009
- Shaila Dinkar Apte "Signals and Systems: Principles and Applications", Cambridge

University Press.

e Learning Resource:

- https://www.youtube.com/watch?v=TrgfP7QD3Nk Linear and Circular Convolution in DSP/Signal and Systems - (linear using circular, zero padding)
- https://onlinecourses.nptel.ac.in/noc21_ee28/preview,Signals and Systems, By Prof. Kushal K. Shah,IISER Bhopal

[*PCC-03*] Electric Circuit Analysis

Teaching Scheme	**Examination Scheme**
Lectures: 2 Hrs./week	Mid Sem Evaluation - 30 Marks
Practicals:2 Hrs/week	TA-20 Marks
Self Study:1 Hr / week	End Sem Exam- 50 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Analyze steady state and transient behavior of the circuit.
2. Compute Fourier series/spectra from different types of waveforms.
3. Analyze two port electrical network problems.
4. Solve electrical network excited by sinusoidal input.
5. Analyze network using graph theory.

Unit 1 **(5 Hrs)**

Network Topology:

Kirchhoff's laws to network analysis, choice between loop and nodal analysis. Concept of super loop and super mesh, dot convention for coupled circuits. Concept of duality and dual networks. Concept of graph, tree and co-tree, tie set and cut set matrices.

Unit 2 **(5 Hrs)**

Analysis of Transients in the circuit:

Initial and final conditions in network elements. Forced and free response, time constants steady state and transient state response. Classical solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits.

Unit 3 **(5 Hrs)**

Network Functions for one port and two ports:

Calculations of network functions for ladder and general network. Poles and zeros, restrictions on pole and zero locations for driving point and transfer functions.Time domain behavior from pole and zero plot. Stability of active network.

Two Port Network: Terminal pairs, relationship of two port variables - Z, Y, transmission parameters and hybrid parameters, interconnections of two port networks.

Unit 4 **(5 Hrs)**

Application of the Laplace Transformation:

Review of Laplace transform, inverse Laplace transform. Analysis of electrical circuits with and without initial conditions using Laplace transform for all standard input cases. Shifted and singularity functions, Laplace transform of various periodic and non-periodic waveforms.

Unit 5 **(5 Hrs)**

Sinusoidal steady state analysis of single phase and three phase circuits:

Power transfer and insertion loss of two port network. Effective or RMS values, average power and complex power. Problems in optimizing power transfer in electrical network.

Balanced and unbalanced load in three phase circuits.

Text Books:

- Alexander and Sadiku, "Electric Circuits", 5th edition, 2012. TMH
- M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 3rd edition

- D. Roy Chaudhary, "Network and Systems", New Age International Publications, 2nd edition**.**

Reference Book:

- William H. Hayt, Jack E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill international , 5th edition corrections), Jaico Publishing, 1998**.**

e Learning Resource:

NPTEL Video lectures BY Ankush Sharma IIT Kanpur and by Dr. S. C. Datta Roy IIT Delhi.

[*PCC-03*] Circuit Simulation Laboratory

Teaching Scheme	**Examination Scheme**
Practicals:2 hrs./week	In Semester Evaluation: 50 marks
	End Semester Evaluation: 50 marks

Course Outcomes:

At the end of this laboratory course the students will demonstrate the ability to:

1. Use MATLAB, Scilab, PSIM, and ATP/EMTP for circuit development and analysis.
2. Compute parameters of a given two port network.
3. Validate the circuit theorems experimentally.

List of Experiments:

1. Transient response in R-L and R-C Network: Simulation/hardware.
2. Transient response of RLC series and parallel circuits: Simulation/hardware.
3. To analyze the responses of RL, RC, and RLC circuit for step, impulse, and ramp input using PSIM software.
4. Determination of Impedance and Admittance parameters of two port network.
5. Fourier analysis of step, ramp, sinusoidal, triangular, saw-tooth, and square waveforms using MATLAB/Scilab and comparison with the computed results.
6. Verification and analysis of maximum power transfer theorem, reciprocity theorem, Tellegen's theorem, and compensation theorem using PSIM software.
7. Determination of Laplace transform and Inverse Laplace transformation using MATLAB.
8. Domain and Cascade connection of second order system using MATLAB.

[*PCC-05*] Analog and Digital Electronics

Teaching Scheme	**Examination Scheme**
Lectures: 3 Hrs./week	Mid Sem Evaluation - 30 Marks
Practical:2 Hrs / week	TA-10 Marks
Self-study:1 Hr/week	End Sem Evaluation- 60 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Analyze the characteristics of semiconductor devices and simple circuit.
2. Design and demonstrate the working of op-amp circuits.
3. Develop electronics circuit using Timer IC and voltage regulators.
4. Understand the digital logic families and Construct Combinational logic circuits.
5. Construct Sequential logic circuits.
6. Analyze various ADC/DAC for conversion of signals from analog to digital and vice-versa.

Unit 1 **(5 Hrs)**

Semiconductor Devices and Power Amplifiers:

Introduction to semiconductor devices, BJT, FET, MOSFET. BJT- CB, CE, CC configurations, biasing, FET biasing, MOSFET biasing, NMOS, PMOS, CMOS. Transistor as a switch, DC analysis of CB, CC, CE and FET amplifiers. Low and high frequency response of transistor and FET amplifier.

Unit 2 **(5 Hrs)**

Operational Amplifiers and its Applications:

The ideal Op-Amp, equivalent circuit of Op-Amp, ideal voltage transfer curve, open loop Op-Amp configurations, Op-Amp parameters, block diagram representation of feedback configurations, frequency response, high frequency Op-Amp. Active filters: low pass filter, high pass filter, band-pass filters, band reject filters, all pass filters, comparators and oscillators, DC and AC amplifiers, instrumentation amplifier, logarithmic amplifier, voltage current converter, current to voltage converter, the integrator, the differentiator.

Unit 3 **(5 Hrs)**

Specialized IC Applications:

The 555 Timer as monostable, astable multivibrator, phase locked loops operating principles, 565 PLL applications, voltage regulators- fixed, adjustable, switching, special, analog switch and analog multiplier.

Unit 4 **(5 Hrs)**

Digital Logic Families and Combinational Digital Circuits:

Introduction to digital logic families - TTL, CMOS logic, interfacing CMOS and TTL, Tri-state logic, Introduction to combinational digital circuits, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices

Unit 5 **(5 Hrs)**

Sequential Digital Circuits:

Introduction to sequential digital circuits, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, AsyncHrsonous counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit 6 **(5 Hrs)**

A/D and D/A Converters:

Digital to analog converters: weighted resistor/convertor, R-2R Ladder D/A converter, specifications, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters.

Text Books:

- S. Sedra and K. C. Smith, "Microelectronic Circuits", 7th edition, Oxford Publication, 2017.
- Millman, Halkias and Satyabrata Jit, "Electronic Devices and Circuits", 4th edition, McGraw Hill Education (India) Private Limited, 2015.
- Robert L. Boylestad and Louis Nashelsky, "Electronic devices and circuit theory", 11th edition, Prentice Hall India Ltd, 2015.
- Ramakant A. Gayakwad, "Op-Amps and linear integrated Circuits" 4th edition, Pearson Education, 2015.
- R. P. Jain and Kishor Sarawadekar , "Modern Digital Electronics", 5th edition, Tata McGraw Hill, 2022.
- Anand Kumar, "Fundamentals of Digital Circuits", Prentice-Hall India, 4th edition, 2016.

Reference Books:

- Thomas L. Floyed, "Electronic Devices", 10th edition, Pearson Education, 2018.
- James M. Fiore, "Op Amps and Linear Integrated Circuits-Concepts and Applications", 3rd edition, Cengage Learning, 2018.

- David A. Bell, "Electronic Devices and Circuits", 5th edition, Oxford University Press, 2008.
- Herbert Taub, Donald Schilling, "Digital Integrated Electronics", 1st edition, Tata McGraw Hill, 2017.
- Donald Leech, Albert Malvino, Goutam Saha," Digital Principles and Applications", 8th edition, McGraw Hill Education, 2014.

e Learning Resources:

- Prof. A. N. Chandorkar, IIT Bombay online lecture series on Analog Electronics http://nptel.ac.in/courses/117101106/
- Prof. S. Karmalkar, IIT Madras, online lecture series on Solid State Devices http://nptel.ac.in/courses/117106091/
- Prof. S. C. Datta Roy, IIT Delhi, online lecture series on Analog Electronic Circuits http://nptel.ac.in/courses/108102095/
- Prof. Goutam Saha, IIT Kharagpur, online lecture series on Digital Electronic Circuits https://nptel.ac.in/courses/108/105/108105132/

[*PCC-05*] Analog and Digital Electronics Laboratory

In Semester Evaluation: 50 marks
End Semester Evaluation: 50 marks

Course Outcomes:

At the end of this course students will demonstrate the ability to,

1. Evaluate the performance characteristics of different semiconductor devices.
2. Build and evaluate the performance of a wide variety of analog circuits using operational amplifier.
3. Use software packages like Proteus, Multisim, PSpice etc.
4. Apply the knowledge for implementation of different circuits using analog ICs.
5. Construct combinational and sequential circuits.
6. Understand the operation of various ADC/DAC.

List of Experiments:

Analog Electronics

The laboratory course can have any 5 experiments from following list. At least 1 experiment should involve simulation using Proteus or appropriate software.

1. To design, assemble and test the wave shaping circuits using diode - clipping and clamping circuits.
2. To determine the performance characteristics of BJT using DC biasing analysis of CE, CB and CC Configuration.
3. To determine the frequency Response of a BJT/FET single stage and multistage amplifier and to study the effect of coupling and bypass capacitor on the frequency.
4. To obtain the drain and transfer characteristics of JFET.
5. Analysis and applications of active circuits using Op-Amp: (i) Comparator (ii) Zero Crossing Detector, (iii) Integrator, (iv) Logarithmic amplifier, (v) Differentiator.
6. To design, assemble and test the active filters and oscillators using Op-Amp and determine their frequency stability: (i) Low pass, (ii) High pass, (iii) Band pass, (iv) Band reject, (v) All pass, (vi) Phase Shift oscillator, (vi) Wein Bridge Oscillator.
7. To design, assemble and test the Multivibrators using Op-Amp: (i) Schmitt Trigger, (ii) Monostable Multivibrator, (iii) Bistable Multivibrator, (iv) Astable Multivibrator.
8. To operate Timer IC 555/556 as (i) Schmitt Trigger, (ii) Monostable Multivibrator, (iii) Bistable Multivibrator, (iv) Sequence Timer.

Digital Electronics:

The laboratory course can have any 5 experiments from the following list.

1. Verify the truth tables of Logic Gates, Boolean laws and D Morgan's theorem.

2. Realization of combinational circuits (Decoders/Encoders/Code Converters).
3. Realization of Flip Flops using Logic Gates.
4. Design of counters using IC's: Up down, Decade, Synchronous, Binary, BCD counter.
5. Study of D/A and A/D converters (Any one of each class): R-2R ladder, weighted resistor method, successive approximation, voltage to frequency conversion.
6. Design of decoder driver to drive 7 segment LED display.
7. Interfacing of CMOS TTL logic families.
8. To design and test the given electronic application.

(OE-01) Electrical Machines and Drives

Teaching Scheme:
Lectures: 2 Hrs/week
Self Study:1 Hr / week

Examination Scheme:
Mid Semester Evaluation - 30 Marks
TA-20 Marks
End Semester Evaluation- 50 Marks

Course Outcomes:
At the end of this course, the students should be able to,

1. Compare the various power electronic devices on various parameters.
2. Select the appropriate power electronic converter for drives
3. Analyze the parameters, operating characteristics and performance of dc motor drives.
4. Analyze the parameters, operating characteristics and performance of AC drives.
5. Select suitable electrical drive as per industry applications.

Unit 1 **(04 Hrs)**
Power semiconductor Devices:
Basics of power semiconductor devices, Power MOSFET, IGBT, characteristics and triggering circuits, recent developments in devices -Sic, GaN based devices.

Unit 2 **(06Hrs)**
Power Converters:
Power converter topologies as per the application, AC-DC converter, AC-AC Converter, DC-AC Converter, DC-DC Converter, performance of converter with R,RL and RLE loads.Converters for solar supply systems, converters for battery charging

Unit 3 **(05 Hrs)**
DC Motor drives:
Electric drive parts, power and control circuit, DC motor emf and torque production, steady-state and transient characteristics, four quadrant operation, control of torque and speed, single phase and three phase full controlled separately excited dc drive, four quadrant chopper fed dc motor drives.

Unit 4 **(05 Hrs)**
Induction motor Drives:
Induction motor torque-speed and torque-slip characteristics, methods of starting of squirrel cage motors, induction motor drive, speed control, open loop and closed loop V/f control, scalar and vector control, slip power recovery schemes

Unit 5 **(05 Hrs)**
Electrical Drive Selection and Applications:
Electric drive power ratings and capabilities, drive characteristics, load requirements, Selection of motors for different applications.

Text Books:

- G.K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi , 2001

- Harish C.N.K.De and P. K. Sen, Electric Drives, PHI Learning Pvt. Ltd., New Delhi , 1999)

Reference books:

- S. K. Pillai, A First Course in Electrical Drives, New Age International, New Delhi , 1994
- Vedam Subrahmanyam, Electric Drives: Concepts and Applications, New Age International, New Delhi , 2005

e Learning Resources:

- https://archive.nptel.ac.in/courses/108/104/108104140/

SEMESTER IV

[*PCC-0*6] Microcontrollers and Applications

Teaching Scheme	**Examination Scheme**
Lectures:3 Hrs./week	Mid Sem Evaluation - 30 Marks
Practical: 2 Hrs / week	TA-10 Marks
Self Study:1 Hr / week	End Sem Evaluation- 60 Marks

Course Outcomes:

At the end of the course, students will be the able to

1. Differentiate amongst various architectures of microcontrollers
2. Impart microcontroller programming and design skills.
3. Undertake problem identification formulation and selection of appropriate microcontroller as per the applications
4. Interface and use different peripherals with microcontrollers
5. Compare and analyze different microcontrollers for the real world applications
6. Evaluate and compare the performance of microcontrollers

Unit 1 **(8 Hrs)**

Introduction to Microcontroller:

Numbering system, Microcontrollers Vs Microprocessors, RISC and CISC architecture comparison. Von-Neumann vs. Harvard architecture, comparison between 8-bit, 16-bit, 32-bit microcontroller. Stack and use of stack pointer. Memory structure, Data Memory, Program Memory and execution of programs.

Unit 2 **(8 Hrs)**

Programming with microcontroller:

Programming: Concept of assembler directives, editor, linker, loader, debugger, simulator, emulator. Instruction set, basic programming using assembly instructions. Introduction to embedded-C, Integrated Development Environment (IDE), cross compiler, ISP, software delay generation.

Unit 3 **(8 Hrs)**

8 Bit micro-controller:

Introduction to 8 bit microcontroller, Addressing Modes & Instruction Set, architecture and PIN description, Interrupts and Operating Modes, Analog Input-Output and PWM, Digital Input-Output, Memory Mapping (internal as well as external) of microcontroller.

Unit 4 **(6 Hrs)**

I/O Interfacing:

I/O programming, interfacing with simple switch, LED, Keypad programming. Timers, various modes of operations of timers, counters, PWM programming.

Unit 5 **(6 Hrs)**

Communication Protocols:

Serial peripheral interface (SPI), SPI based memory interfacing, Universal Serial Communications Interface (USCI) interfacing and programming, Interrupt understanding and interfacing, I2C based RTC interfacing , WDT (Watch dog timer).

Unit 6

External Peripheral Interfacing: **(6 Hrs)**

Analog to digital convertor, interfacing with external serial and parallel ADC's, Digital to analog convertor (DAC), Interfacing with DAC, Interfacing with stepper motor and DC motor, Comparative analysis of different 8 bit microcontrollers.

List of Recommended Books:

Text Books:

- Mazidi, "8051 microcontroller & embedded system" 3rdEdition ,Pearson
- Mazidi, "PIC microcontroller & embedded system" 3rdEdition ,Pearson
- Kenneth J. Ayala, "8051 Microcontroller: Programming, Architecture and Interfacing", Thomas Delmar Learning, Third ed., 2007.
- Newnes, 1st Edition, 2010 "MSP430 Microcontroller Basics" by John H Davies

Reference Books:

- Kenneth J. Ayala, "The 8051 Micro-controller – Architecture, Programming & Applications", Penram International & Thomson Asia, Second Edition.
- John B. Peatman, "Design with PIC Micro-controllers", Pearson Education Asia, Low Price Edition
- MSP430 Technical Reference Manual
- Newnes Publication, 2009 *Texas Instruments MSP 430 microcontroller, Guide and Datasheet

Muhammad A. Mazidi, "AVR Microcontroller and Embedded Systems: Assembly and C", Pearson; 1st edition, 2015

[*PCC-06*] Microcontrollers and Applications: Laboratory

In Semester Evaluation: 50 marks
End Semester Evaluation: 50 marks

Course Outcomes:

At the end of the course, students will be the able to

1. Understand and apply the fundamentals of assembly/embedded 'c' level programming of microprocessors and microcontroller
2. Analyze problems and apply a combination of hardware and software to address the problem.

List of Experiments

1. GPIO toggling.
2. Seven segment LED interfacing with microcontroller
3. Keypad interfacing with microcontroller.
4. ADC interfacing with microcontroller with the help of waveform generation.
5. Timers and counters.
6. UART interfacing.
7. Interrupts in microcontrollers.
8. PWM generation using a microcontroller.
9. DC/stepper motor interfacing with a microcontroller.
10. I2C and SPI based peripheral interfacing.

(*PCC-07*) Electromagnetic Fields

Teaching Scheme
Lectures:2 Hrs./week
Self Study :1 Hr/week

Examination Scheme
Mid Sem Evaluation - 30 Marks
TA – 20 Marks
End Sem Evaluation - 50 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Intuitively visualize and explain ideas related to Static and dynamic electromagnetic (EM) fields, energy, and power.
2. Analyse and calculate the capacitance, force and energy in Electrostatic devices.
3. Solve and analyse the problems related to magnetic field.
4. Compute and analyze performance and behavior of (economically important applications) electromechanical devices such as motors, generators and transformers.
5. Apply Maxwell's field equations to analyze and improve the performance of electromechanical devices and to develop space-related thinking ability.
6. Analyze and apply the process of energy conversion and energy transfer of electromechanical devices

Unit 1 **(6 Hrs)**

Vector Analysis:

(A) Vector Algebra & Coordinate system- Review (scalars & vectors) , Vector algebra (vector addition and subtraction), Position and distance vectors, Vector Multiplication -The Dot product and cross product, Triple Product, components of vector, Transformation of vectors, The coordinate systems (Cartesian, cylindrical and spherical).

(B) Vector Calculus: Introduction, differential length, area and volume, line, surface and volume integrals, Del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stokes's theorem, Laplacian of a scalar, classification of vector fields.

Unit 2 **(6 Hrs)**

Electrostatic Fields :

Introduction, Coulomb's law and field intensity, electric field due to continuous charge distributions, a line charge, surface charge, volume charge, Streamlines and Sketches of Fields. Electric Flux Density, Gauss's Law and Divergence, applications of Gauss's law, point charge, infinite line charge, infinite surface charge, uniformly charged sphere. Energy and Potential: Energy Expended in Moving a Point Charge in an Electric Field, The Line Integral, Definition of Potential Difference and Potential, The Potential Field of a Point Charge, The Potential Field of a System of Charges: Conservative Property, Potential Gradient, Relationship between E and V - Maxwell's Equation .The Electric Dipole and flux lines, Energy Density in the Electrostatic Field

Unit 3 **(6 Hrs)**

Electric Field in Material Space and Electrostatic Boundary Value Problem:

Introduction, properties of materials, convection and conduction currents, conductors, polarization in dielectrics, dielectric constant and strength, Poisson's and Laplace's equations, uniqueness theorem, general procedures for solving Poisson's and Laplace's equation, resistance and capacitance, parallel plate, coaxial and spherical capacitors, Capacitance of a Two-Wire Line, Using Field Sketches to Estimate Capacitance in Two-Dimensional Problems.

Unit 4 **(6 Hrs)**

Magnetostatic fields:

The Steady Magnetic Field: Bio-Savart Law, Ampere's Circuital Law-Maxwell's equation, Curl, Stokes' Theorem, Magnetic Flux and Magnetic Flux Density, The Scalar and Vector Magnetic Potentials, Derivation of the Steady-Magnetic-Field Laws. Magnetic Forces: Force on a Moving Charge, Force on a Differential Current Element, Hall Effect, Force between Differential Current Elements, Force and Torque on a Closed Circuit, forces due to magnetic fields, magnetic torque and moment and magnetic dipole. Materials and Inductance: The Nature of Magnetic Materials, Magnetization and Permeability, Magnetic Boundary Conditions, The Magnetic Circuit, Potential Energy and Forces on Magnetic Materials, inductors and inductances, Self and Mutual inductance of simple configurations, magnetic energy, magnetic coupled circuits, force on magnetic materials

Unit 5 **(6 Hrs)**

Time Varying Fields and Maxwell's Equations:

Faraday's law-Maxwell's Equation, Displacement current and current density, Maxwell's equation in point form and integral form. Time varying potentials, time harmonic fields Boundary condition for time varying field, transformer and motional, electromotive forces, stationary loop in time varying B field (transformer emf), moving loop in static B field (motional emf), Magnetic Brake, Magnetic Levitation, electromagnetic launcher.

Unit 6 **(4 Hrs)**

Transmission Lines & Numerical techniques:

Transmission Lines: distributed parameter circuits, traveling and standing waves, impedance matching, Smith chart, analogy with plane waves. Transients and pulse propagation on transmission line. Numerical Techniques: Advantages of numerical techniques Separation of variable method, Method of images, Finite difference method (FDM), Finite Element method (FEM), Application of numerical techniques.

Text Books:

- Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University publication, 6th edition, 2014.
- A.Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2nd edition, 2009.
- A.Pramanik, "Electromagnetism – Problems with solution", Prentice Hall of India, Pvt. Ltd., 2nd edition, 2012.

Reference Books:

- G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1st edition, 1954.
- W. J. Duffin, "Electricity and Magnetism",McGraw Hill Publication, 3rd edition(Rev),1980.
- W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Inc. US,1968.
- E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 3rd edition, 1966.
- B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley, Educational Publishers Inc, International Edition, 1971.
- William Hayt, "Engineering Electromagnetics", Tata McGraw Hill Education Pvt. Ltd., 7th edition, 2012.

e - Learning resource:

• nptel course on Electromagnetic Fields by Prof. Harishankar Ramachandran Department of Electrical Engineering IIT Madras
https://archive.nptel.ac.in/courses/108/106/108106073

[*PCC-0*8] Electrical Machines

Teaching Scheme	**Examination Scheme**
Lectures:3 Hrs./week	Mid Semester Evaluation - 30 Marks
Practical:2 Hrs/week	TA – 10 Marks
Self Study :1 Hr/week	End Semester Evaluation - 60 Marks

Course Outcomes:

At the end of this course, the students should be able to,

1. Explain the principles of operation of transformer, dc machine and three phase and single phase induction motors.
2. Select a suitable transformer, dc machine, induction machine as per various industrial applications.
3. Evaluate and analyze the steady state parameters, operating characteristics and performance of transformers of dc machine and induction machine

4. Test the performance of transformers and ac / dc and machines

Unit 1 **(8 Hrs)**

Single Phase and Three Phase Transformer:

Review of transformer, phasor diagrams, efficiency, voltage regulation, parallel operation, per unit impedance, excitation, switching transients, auto transformers, three phase transformer construction, standard connections, vector groups, open delta and Scott Connection, Phase conversion, three winding transformers, on load tap changing of transformers, modern trends in transformers, type and routine tests, testing standards.

Unit 2 **(8 Hrs)**

Electromechanical Energy Conversion Principles:

Energy in a magnetic systems, field energy and mechanical force, energy in singly and multiply excited magnetic systems, determination of magnetic force and torque from energy and co-energy, Forces and torques in magnetic field systems, dynamic equations of electromechanical systems and analytical technique

Unit 3 **(8 Hrs)**

DC Machines :

Review, generator operation, armature and field systems, types, emf equation, armature windings, characteristics and applications, armature reaction – demagnetizing and cross magnetizing mmfs, commutation process, bad commutation and remedies.

DC motor operation, significance of back emf, torque equation, types, characteristics and selection criterions, starting, speed control, losses and efficiency, condition for maximum efficiency, braking, applications, type and routine tests

Unit 4 **(8 Hrs)**

Three Phase Induction Machine (Asynchronous Machines):

Introduction, construction , types, flux and MMF waveforms, equivalent circuit, no load and on load operation, phasor diagram, power factor, power output, OC and SC test, torque developed, starting methods, deep cage bars, speed control, cogging and crawling, circle diagram, maximum torque and power estimation, efficiency, breaking, testing and applications, Induction generator operation, testing IS, energy efficient motors

Unit 5 **(8 Hrs)**

Fractional Kilowatt Machines:

Fractional kilowatt motors, basics of single phase motors, construction, types, double revolving field theory, circuit model, phasor diagram, determination of parameters, losses and efficiency, applications, two phase induction motor

Text Books:

- D. P. Kothari and I. J. Nagrath, "Electric Machines", Tata Mc Graw Hill Publication, 4th edition 2010, Reprint 2012.
- E. Fitzgerald, C. Kingsley, S. D. Umans, "Electrical Machinery", Tata Mc Graw Hill, 6th edition, 2002.
- P. S. Bimbhra: Electrical Machinery – Khanna Publishers, 7th edition, 2011
- B. L Thareja, A. K. Thareja,, " A text book of Electrical Technology, Vol. II, AC and DC Machines" S. Chand Publication, Multicolour edition, Reprint 2004

Reference Books:

- Nasser Syed, "Electrical Machines and Transformers", A New York, MacMillan 1984.
- Langsdorf A. S., "Principles of DC Machines", 6th Edition, McGraw Hill Book Company 1959.
- P. C. Sen., "Principles of Electric Machines and Power Electronics", 2nd edition, John Wiley and Sons Inc., 1997.
- M. G. Say, "Alternating Current Machines", 5th edition, Low price edition, ELBS, Reprinted 1994

- Bhag S. Guru and Huseyin R. Hiziroglu, "Electric Machinery and Transformers", 3rdIndian edition, Oxford University Press, Reprint 2014.

e Learning resource:
- https://nptel.ac.in/courses/108105017; NPTEL: Electrical Engineering, Electrical Machines –I and Electrical Machines -II.

[*PCC-0*8] Electrical Machines Laboratory

Examination Scheme
In Semester Evaluation: 50 marks
End Semester Evaluation: 50 marks

Course Outcomes:
At the end of laboratory course the students will be able to,
1. Differentiate between various types of transformers, dc machines and induction motors and appreciate constructional details.
2. Select a suitable motor as per the application.
3. Determine transformer, dc machine and induction machine parameters by testing.
4. Estimate practically losses in transformers, dc machine and induction motors.
5. Obtain practically efficiency curves of transformers, dc machines and induction motors by direct /indirect load tests.
6. Control speed of various dc motor and induction motors.
7. Operate machines in compliance with industry guidelines

List of Experiments:
From following list minimum 8 experiments are to be performed by the student;
1. To perform open circuit (OC) and short circuit (SC) test on single phase transformer to estimate its core loss, copper loss and equivalent circuit parameters. Verification and analysis of no load current waveform of single phase transformer.
2. To perform direct load test on single phase transformer to obtain its % efficiency and % voltage regulation at various loading conditions.
3. Parallel operation of two single-phase transformers to study their load sharing under various operating conditions.
4. Determination of magnetization or open circuit characteristic and on load external and internal characteristics of a separately excited generator. Determination of efficiency of a separately excited dc generator at various loading conditions.
5. Speed control of a separately dc motor by- (i) armature voltage control and (ii) Field current control method.
6. Direct load test on separately excited dc motor to determine on load Efficiency and speed regulation.
7. To perform load test on three phase squirrel cage induction motor to estimate losses and Efficiency.
8. Perform no load and blocked rotor test on three phase squirrel cage induction motor to estimate its equivalent circuit parameters and efficiency, losses and various torques using circle diagram.
9. To perform no load and blocked rotor test on single phase induction motor to estimate its circuit parameters and various torques.
10. To study and understand the wiring and operation of various Induction motor starters, DOL, Star-Delta, Auto transformer, Soft starters, VFD

[*PCC-04*] Numerical Methods and Computer Programming

Teaching Scheme	**Examination Scheme**
Lectures:1 Hrs./week	CIE:100
Practical: 2 Hrs/week	In Semester Evaluation: 50 marks
Self-study:1Hrs/week	End Semester Evaluation: 50 marks

Course Outcomes:

At the end of the course, students will be able to

1. Understand the importance and applications of numerical methods.
2. Apply various numerical methods for analysis of Electrical Engineering problems.
3. Solve non-linear equations of higher order which are frequently used in solving practical engineering problems.
4. Apply mathematics in engineering problems.
5. Develop C, C++ or MATLAB/Python programs for numerical methods.

Unit 1 **(2 Hrs)**

Introduction:

Mathematical modeling in engineering problem solving, Approximations and different types of errors, Introduction to MATLAB programming, introduction to Scilab.

Unit 2 **(4 Hrs)**

Simultaneous Algebraic Equations:

Roots of algebraic and transcendental equations, Bracketing methods – bisection method, false position, Open methods – Newton Raphson, application: Analysis of electrical circuits using above methods,

Cramer's rule, Gauss elimination – pit falls and remedies, Gauss-Seidal, Gauss-Jordan method, Newton Raphson method, Application: solving resistive networks.

Unit 3 **(3 Hrs)**

Curve Fitting:

Interpolation , Extrapolation- Newton's polynomial, Lagrange polynomial

Unit 4 **(5Hrs)**

Numerical Differentiation and Integration:

Euler's method, Modified Euler's method, Runge-kutta methods.

Integration: Trapezoidal rule, Simpson's Rule, Application: calculation of RMS values.

Text Books:

- Steven Chapra, Raymond P. Canale," Numerical Methods for Engineers", Tata McGraw-Hill Education, 8th Edition
- Santosh K. Gupta,"Numerical Methods for Engineers", New Age Publishers, 4th edition.
- S. S. Sastry, "Introductory Methods of Numerical Analysis", Prentice India Learning Pvt. Ltd., 5th edition.

Reference Books:

- E.Bala Guruswamy,"Numerical Methods", Tata McGraw-Hill Education, 2009.
- Rudra Pratap, "MATLAB:An Introduction with Applications", Wiley Publishers, 4th Edition.

e Learning Resources:

- http://www/nptelvideos.in/2012/11/numerical-methods-and-programming.html.
- http://www.nptelvideos.in/11/numerical-methods-and-computation.html.
- https://npte.ac.in/courses/122106033.

Term work:

It shall comprise of minimum 10-12 programs in MATLAB/Phyton/C++ for solving problems demonstrating use of various numerical methods learned in above 6 units.

(OE-02) - Principles of Electronic Communication

Teaching Scheme
Lectures:2 Hrs./week
Self Study:1 Hr / week

Examination Scheme
Mid Semester Evaluation- 30 Marks
TA – 20 Marks
End Semester Evaluation - 50 Marks

Course Outcomes
Upon completing this course, the student will be able to:

1. Understand modulation need and techniques in communications and overview of electromagnetic spectrum.
2. Analyze Analog, pulse modulation, and digital modulation techniques.
3. Distinguish Various Local Area Networks and their structure.
4. Conceptualize principles and applications of satellite and optical communications.
5. Understand various cellular telephone systems and wireless technologies.

Unit 1 **(4 Hrs**

Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

Unit 2 **(10 Hrs)**

Simple description on Modulation: Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

Unit 3 **(6 Hrs)**

Telecommunication Systems:
Telephones Telephone system, Paging systems, Internet Telephony.
Networking and Local Area Networks: Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

Unit 4 **(6 Hrs)**

Satellite Communication:
Satellite Orbits, satellite communication systems, satellite subsystems,
Ground Stations Satellite Applications, Global Positioning systems.
Optical Communication: Optical Principles, Optical Communication Systems, Fiber Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

Unit 5 **(6 Hrs)**

Cellular and Mobile Communications:
Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA. Wireless Technologies: Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB..

Text Books:

- Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
- Electronic Communications systems, Kennedy, Davis 4e, MC Graw Hill Education, 1999.

Reference Books:

- Theodore Rapp port, Wireless Communications - Principles and practice, Prentice Hall, 2002.
- Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
- Introduction to Data Communications And Networking, Wayne Tomasi, Pearson Education, 2005.

(VSEC-02) Cornerstone Project – I

Teaching Scheme
Lab :4 Hrs/week

Examination Scheme
In Semester Evaluation: 50 marks

Self Study:2 Hr / week **End Semester Evaluation: 50 marks**

Course Outcomes:

At the end of this course, the students should be able to,

1. demonstrate adaptability and flexibility in approaching new technologies, methodologies, and work environments, enhancing their employability
2. Gains hands-on experience in designing and constructing electrical systems.
3. Use the software tools for design and simulation.
4. Develop technical skills in component selection, system integration, and troubleshooting.
5. Learn about safety standards and regulations in electrical engineering practice.
6. Enhance teamwork and project management skills to become
7. Appreciate concern for environment and society with interdisciplinary aspects
8. Students will be able to communicate project-related activities and findings effectively.

Course content:

Student may develop solution for a real life concept/ problem as a micro project. Students are required to learn and understand the user requirements. The paper design, simulation and fabrication will be part of the work. They may design, fabrication and use of various circuit elements and components (like transformer, motors, sensors, power supply, processor module, interfacing module, display and signal conditioning module etc.) as per the standards and practices. Students may also work on embedded software and programming.

Exit course after Second Year to qualify Diploma certificate

EE (EE)-Electrical Installation, Estimation and Costing

Teaching Scheme	**Examination Scheme**
Lectures:3 Hrs./week	Mid Semester Evaluation- 30 Marks
Practcals:4hrs./week	TA – 10 Marks
	End Semester Evaluation - 60 Marks

Course Outcomes:

At the end of this course students will be able to:

1. Interpret the electrical wiring and single line diagrams.
2. Design and construct simple wiring circuits
3. Design and estimate residential and commercial electrical installations as per IE rules
4. Interpret the public Tender document.
5. Design motor control circuits.
6. Understand and comply with electrical codes, regulations, and standards relevant to electrical installations.

Unit 1 **(5 Hrs)**

Electrical components, Symbols and Standards:

Need of electrical symbols, list of symbols, electrical diagrams, methods of representations for wiring diagram, single line diagram of power distribution system, wiring materials, Wires, cables, MCBs, MCCBs, Motor starters, Earthing system, single phase-three phase Energy meter connections, IE Rule

Unit 2 **(5 Hrs)**

Design of Simple Electrical Circuits:

Light and Fan Circuits, Alarm Circuits, Introduction to simple light and fan circuits, design of illumination system for a residential and industrial hall, System of connection of supply and

accessories, staircase wiring, Introduction to simple alarm circuits with and without relay, Schematic and wiring diagrams for alarm and signal circuits without relays, Alarm circuit with relays, Design of Small Transformer and Chokes, overload and short circuit protections

Unit 3 **(8 Hrs)**

Design Considerations of Electrical Installations:

Design and Drawing of Panel Boards, Introduction, Design conditions, standard sizes of boards, Electric supply systems, Three phase four wire distribution systems, Protection of electric installation against overload, short circuit and earth fault, Earthing, General requirements and testing of electrical installations, Neutral and earth wire, Types of loads, Systems of wiring, Service connections, Service mains, Sub circuits, Location of outlets, Location of control switches, Location of main board and distribution boards, Load assessment, Guidelines for installation of fittings, Permissible voltage drops and sizes of wires, Estimating and costing of electrical installations.

Unit 4 **(8 Hrs)**

Electrical Installations and Estimates:

Electrical Installations for different types of buildings and small industries, Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations and estimates for small industries.

Unit 5 **(8 Hrs)**

Purchasing techniques:

Spot quotations, floating enquiry, typical example of quotation form, preparation of comparative statement, analysis of comparative statement, tender types(Single tender, Open tender), Earnest money, Security deposit, various steps involved in complete purchase, typical order formats, various criteria for selecting the supply, general considerations in order for procedures to be allowed for submitting the tenders and quotations.

Unit 6 **(8 Hrs)**

Motor Control Circuits:

Starting of 3-phase squirrel cage induction motor, Starting of multi-speed squirrel cage motors, Starting of wound rotor motor, Starting of synchronous motors, Stopping of motors, Contactor control circuit components, Basic control circuits, Motor protection Schematic and wiring diagrams for motor control circuits, Study of Lift/elevator operation – Case study, Study of agricultural motor pump installation- A case study, Study of MCC design using software – A case study.

Text Books:

- S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 6th edition, 2009.
- K. B. Raina and S. K. Bhattacharya, "Electrical Design, Estimating & Costing", New age International Publisher, Reprint, 2009.
- Surjeet Singh, "Electrical estimating and costing", Dhanpat Rai and Co., Second edition, 2001, reprint 2008.

Reference Books:

- Web site for IS Standards.
- Technical manual of Switchgear Industry.

e-Learning resources:

- MPTC-EEE Series of lectures on Industrial Installation Estimation and Costing
- https://www.youtube.com/watch?v=wqQfkIjVwM0&list=PL9ea1TdWq27iPeICoB5HLSH2q9ujv5Fql

[EE] PLCs for Industrial Automation

Teaching Scheme	**Examination Scheme**
Lectures:2 Hrs./week	Mid Semester Evaluation- 30 Marks
Practical:4Hrs/week	TA – 20 Marks
	End Semester Evaluation - 50 Marks

Course Outcomes:

At the end of the course, students will be able to

1. Identify the building blocks and develop architecture for designing a given automation system
2. Develop ladder diagram for a given application
3. Select appropriate PLC and design system for specific application
4. Identify HMI for particular automation examples.
5. Develop skills that are highly relevant to industries employing PLC-based automation systems, such as manufacturing, process control etc.

Unit 1 **(7Hrs)**

Introduction to Industrial Automation:

Importance of Industrial Automation, historical development, Automation Hierarchy, Building blocks of automation systems, description of each component. Types of automation systems:- fixed and programmable. Different systems for Industrial automation, examples of automation such as cement plant etc., Introduction to various sensors,

Unit 2 **(7Hrs)**

PLC Fundamentals:

Building Blocks of PLC: CPU, Memory organization, Input-output modules (discrete and analog), Special I/O Modules, Power supply. Fixed and Modular PLC and their types, Redundancy in PLC module. I/O module selection criteria Interfacing different I/O devices with appropriate I/O modules.

Unit 3 **(7Hrs)**

PLC Programming:

PLC I/O addressing. PLC programming Instructions: Relay type instructions, timer instructions: Comparison Instructions. Data handling Instructions. Ladder Programming, communications systems such as LAN, CANBUS, Profibus, fieldbus etc

Unit 4 **(7Hrs)**

PLC Applications:

Simple Programming examples using ladder logic: Timer, Motor sequence control, Traffic light control, elevator control, Tank level control, conveyor system, Specifications of various PLC available in the Market

List of Recommended Books:

- Petruzella, F. (2023). Programmable Logic Controllers (6th ed.). Tata-McGraw Hill India.
- Fundamentals of Programmable Logic Controllers , January 2019by Vijay Singh (Author)
- Webb, J. W., & Reis, R. A. (1999). Programmable Logic Controllers: Principles and Applications.
- Erickson, K. T. (2016). Programmable Logic Controllers: An Emphasis on Design and Application.

e-Learning resources:

- Nptel course on Industrial Automation and Control, IIT Kharagpur by Prof. S. Mukhopadhyay, Prof. S. Sen

(MDM-02)-Electrical Installation, Estimation and Costing

Teaching Scheme
Lectures:2Hrs./week
Practcals:2hrs./week
Self Study: 1hrs./week

Examination Scheme
Mid Semester Evaluation- 30 Marks
TA – 20 Marks
End Semester Evaluation - 50 Marks

Course Outcomes:

At the end of this course students will be able to:

7. Interpret the electrical wiring and single line diagrams.
8. Design and construct simple wiring circuits
9. Design and estimate residential and commercial electrical installations as per IE rules
10. Interpret the public Tender document.
11. Design motor control circuits.
12. Understand and comply with electrical codes, regulations, and standards relevant to electrical installations.

Unit 1 **(5 Hrs)**

Electrical components, Symbols and Standards:

Need of electrical symbols, list of symbols, electrical diagrams, methods of representations for wiring diagram, single line diagram of power distribution system, wiring materials, Wires, cables, MCBs, MCCBs, Motor starters, Earthing system, single phase-three phase Energy meter connections, IE Rule

Unit 2 **(5 Hrs)**

Design of Simple Electrical Circuits:

Light and Fan Circuits, Alarm Circuits, Introduction to simple light and fan circuits, design of illumination system for a residential and industrial hall, System of connection of supply and accessories, staircase wiring, Introduction to simple alarm circuits with and without relay, Schematic and wiring diagrams for alarm and signal circuits without relays, Alarm circuit with relays, Design of Small Transformer and Chokes, overload and short circuit protections

Unit 3 **(8 Hrs)**

Design Considerations of Electrical Installations:

Design and Drawing of Panel Boards, Introduction, Design conditions, standard sizes of boards, Electric supply systems, Three phase four wire distribution systems, Protection of electric installation against overload, short circuit and earth fault, Earthing, General requirements and testing of electrical installations, Neutral and earth wire, Types of loads, Systems of wiring, Service connections, Service mains, Sub circuits, Location of outlets, Location of control switches, Location of main board and distribution boards, Load assessment, Guidelines for installation of fittings, Permissible voltage drops and sizes of wires, Estimating and costing of electrical installations.

Unit 4 **(8 Hrs)**

Electrical Installations and Estimates:

Electrical Installations for different types of buildings and small industries, Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations and estimates for small industries.

Unit 5 **(8 Hrs)**

Purchasing techniques:

Spot quotations, floating enquiry, typical example of quotation form, preparation of comparative statement, analysis of comparative statement, tender types(Single tender, Open tender), Earnest money, Security deposit, various steps involved in complete purchase, typical order formats, various criteria for selecting the supply, general considerations in order for procedures to be allowed for submitting the tenders and quotations.

Unit 6 **(8 Hrs)**

Motor Control Circuits:

Starting of 3-phase squirrel cage induction motor, Starting of multi-speed squirrel cage motors, Starting of wound rotor motor, Starting of synchronous motors, Stopping of motors, Contactor control circuit components, Basic control circuits, Motor protection Schematic and wiring diagrams for motor control circuits, Study of Lift/elevator operation – Case study, Study of agricultural motor pump installation- A case study, Study of MCC design using software – A case study.

Text Books: **(4 Hrs)**

- S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 6th edition, 2009.
- K. B. Raina and S. K. Bhattacharya, "Electrical Design, Estimating & Costing", New age International Publisher, Reprint, 2009.
- Surjeet Singh, "Electrical estimating and costing", Dhanpat Rai and Co., Second edition, 2001, reprint 2008.

Reference Books:

- Web site for IS Standards.
- Technical manual of Switchgear Industry.

e-Learning resources:

- MPTC-EEE Series of lectures on Industrial Installation Estimation and Costing
- https://www.youtube.com/watch?v=wqQfkIjVwM0&list=PL9ea1TdWq27iPeICoB5HLSH2q9ujv5Fql

(MDM-02)-Electrical Installation, Estimation and Costing Laboratory

Examination Scheme
In Semester Evaluation: 50 marks
End Semester Evaluation: 50 marks

1. Testing of Fuse
2. Testing of MCCB and MCB
3. Electrical Wiring installation and Testing
4. Earthing resistance Measurement
5. Measurement and testing of a cable and Wires
6. Study of line tester
7. Study of Electric lift system
8. Study of Inverter installation and sizing