SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV – Semester
(ELECTRICAL AND ELECTRONICS ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1.	BS401MT	Engineering Mathematics-IV	3	1	-	4	30	70	3	3
2.	PC401EE	Electrical Circuits - II	3	1	-	4	30	70	3	3
3.	PC402EE	Electrical Machines-I	3	1	-	4	30	70	3	3
4.	PC403EE	Power Systems-I	3	-	-	3	30	70	3	3
5.	PC404EE	Power Electronics	3	1	-	4	30	70	3	3
6.	PC405EE	Linear Integrated Circuits	3	-	-	3	30	70	3	3
7.	HS401BM	Managerial Economics & Accountancy	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
8.	PC451EE	Digital Electronics and Integrated Circuits Lab	-	-	2	2	25	50	3	1
9.	PC452EE	Computer Aided Electrical Drawing Lab.	-	-	2	2	25	50	3	1
			21	**04**	**04**	**29**	**260**	**590**		**23**

Engineering Service Courses Offered to other Departments

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1.	ES422EE	Electrical Circuits & Machines (For ME & PE)	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
2.	ES461EE	Electrical Circuits & Machines Lab (For ME & PE)	-	-	2	2	25	50	3	1

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>BS401MT</td><td colspan="6">Engineering Mathematics - IV
(Common to all branches)</td><td rowspan="2">Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td><td>Credits</td></tr>
<tr><td>NIL</td><td>3</td><td>1</td><td>0</td><td>0</td><td>30</td><td>70</td><td>3</td></tr>
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Course Objectives

- To introduce transforms like Laplace, Fourier, Z-transforms and their properties
- To introduce a few numerical methods to solve certain types of problems
- To understand curve fitting, correlation and regression

Course Outcomes

At the end of the course students will be able to

- solve differential equations using Laplace and Fourier transforms
- solve difference equation using Z-transforms
- find numerical solution of algebraic, transcendental equations and ordinary differential equations.
- perform a regression analysis and to compute and interpret the coefficient of correlation

UNIT- I

Laplace transforms: Introduction of Laplace transforms, sufficient condition for existence of Laplace transform, Laplace transform of Derivatives, Laplace transform of integrals, Translation theorems (I & II shifting theorems), Differentiation of Laplace transform (Multiplication by t), Integration of Laplace transform(Division by t), convolution theorem, Solving initial value problems using Laplace transform.

UNIT- II

Fourier transforms: Introduction, Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier sine and cosine transforms, Finite Fourier sine and cosine transforms, Properties of Fourier transforms, Convolution theorem for Fourier transforms.

UNIT- III

Z-Transforms: Introduction, basic theory of Z-transforms, Z-transforms of standard sequences, existence of Z-transform, linearity property, translation theorem, scaling property, initial and final value theorems, differentiation of Z-transform, convolution theorem, solution of difference equations using Z-transforms.

UNIT- IV

Numerical methods: Solution of Algebraic and Transcendental equations**:** Bisection method, Newton-Raphson method, Solution of linear system of equations: Gauss elimination method, Gauss- Seidel iteration method, Interpolation: Lagrange's interpolation, Newton's divided difference interpolation, Newton's Forward and Backward difference interpolations, Numerical differentiation, Numerical solutions of ordinary differential equations : Taylor's series method, Euler method, Runge-Kutta method of 4^{th} order.

UNIT- V

Curve fitting:

Curve fitting by method of least squares**,** correlation and regression, types of correlations, Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, equal ranks, equations to the lines of regression.

Suggested Reading:

1. R.K.Jain, S.R.K Iyengar, *Advanced Engineering Mathematics*, Narosa Publication, 4^{th} Edition, 2014.
2. B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 43^{rd} Edition, 2014.
3. Vasishtha, Gupta, *Integral Transforms*, Krishnan Prakashan Publications, 2014.
4. Erwin Kreyszig, *Advanced Engineering Mathematics*, 9^{th} Edition, 2012.

Course Code	Course Title						Core / Elective
PC401EE	Electrical Circuits - II						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	1	0	0	30	70	3

Course Objectives

- To acquire knowledge in circuits and to understand the Fourier series and Laplace transformation.
- To be able to understand the techniques of electric network synthesis.

Course Outcomes

At the end of the course students will be able to

- Examine the behavior of linear circuits using Fourier transform, Laplace transforms and transfer function of single port network.
- Obtain two port network parameters and applications of graph theory to electric circuits.
- Synthesize a network in terms of RL, RC and RLC parameters.

UNIT I

Fourier Series and Integral: Fourier series representation of periodic functions, Symmetry conditions, Exponential Fourier series, Discrete spectrum, Fourier integral and its properties, Continuous spectrum, Application to simple networks

UNIT II

Laplace Transform Method of Analysis of Networks: Definition of Laplace pair, Evaluation of Laplace transform of common time function, Laplace properties and theorems, Convulution theorem, Waveforms synthesis, Partial fraction method of inverse transforms, Application to networks, Transfer functions.

UNIT III

Two port network parameters: Open circuit impedance, Short circuit admittance, Transmission, Hybrid parameters & inter-relationships, Series, parallel and cascade connection of two port networks, System function, Impedance and admittance functions

UNIT IV

Topological Description of Networks: Graph, tree, chord, cut-set, incident matrix, circuit matrix and cut-set matrix, Formulation of node equations, loop equations, cut-set equations for RLC networks.

Network synthesis of driving point functions, Positive real function, properties of PR functions, Testing of PR functions,

UNIT V

Synthesis of LC, RC, RL functions, Properties of LC, RC and RL networks, Minimum functions, Synthesis of RLC networks, Brune's method, Properties of networks in terms of poles and zeros.

Suggested Reading:

1. Van Valkenburg M.E, *Network Analysis*, Prentice Hall of India, 3rd Edition, 2000.
2. William Hayt H, Kimmerly Jack E. and Steven Durbin M, *Engineering Circuit Analysis*, McGraw Hill, 6th Edition, 2002
3. Jagan N.C, Lakshrninarayana C., *Network Analysis*, B.S. Publications, 3rd Edition, 2014.
4. Chakravarthy A., *Circuit Theory*, Dhanpat Rai & Co., First Edition, 1999

Course Code	Course Title						Core / Elective
PC402EE	Electrical Machines - I						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	1	0	0	30	70	3

Course Objectives

- To learn and understand electromechanical energy conversion devices.
- To be able to understand in detail about DC machines. Construction, principle, performance characteristics and testing.

Course Outcomes

At the end of the course students will be able to

- understand construction, operating principle and characteristics of different types of DC motors and generators
- test and calculate performance parameters of DC motors and generators
- select appropriate DC machines for a specific application

UNIT I

Electromechanical energy conversion: Principle of energy conversion, Flow of energy in electromechanical devices, Coupling-field reaction, Singly excited magnetic system – Electric energy input, Magnetic field energy stored, Mechanical work done – with slow, instantaneous and transient movement of armature, Calculation of mechanical force, Doubly excited magnetic systems, electromagnetic and reluctance torques.

UNIT II

DC Machines: Simple loop generator, Essential parts of DC machine, Details of Lap winding & Wave winding, EMF equation, Armature reaction — Remedies, Ampere turns, Commutation — reactance voltage, Methods of improving commutation — High resistance brushes, shifting of brushes, Interpoles, Compensating winding.

UNIT III

DC Generators; Classification & types of DC generators, Open circuit, Internal & External characteristics — Critical resistance & critical speed, Voltage regulation, Conditions for self excitation, Causes of failure of voltage buildup, Parallel operation Series, Shunt and Compound generators, Applications.

UNIT IV

DC Motors: Classification & Types of DC motors, Back emf, Speed regulation, Armature torque, Armature reaction, Operating characteristics, Performance curves, Basic speed control methods Shunt and Series motors, Three & four-point starters, Calculation of step resistances, Applications.

UNIT V

Testing, Losses and Efficiency: Power losses — Copper losses and Rotational losses, Power flow, Efficiency, Testing - Brake Test and Swinburne's test, Hopkinson's test, Field's test, Retardation test, Heat run test.

Suggested Reading:

1. D.P. Kothari, I.J. Nagrath , *Electric Machines*, Tata McGraw Hill, 4th Edition, 2010
2. Bhimbra P.S., *Electrical Machinery*, Khanna Publications, 2000
3. Gupta J.B., *Theory and Performance of Electrical Machines,* S.K.Kataria & Sons, Delhi, 2005.
4. AE Clayton and NN Hancock, *The Performance and Design of Direct Current Machines,* 3rd edition, 1959.

Course Code	Course Title						Core / Elective
PC403EE	Power Systems- I						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	1	0	0	30	70	3

Course Objectives

- To be able to learn and understand the conventional and renewable generating power stations and economics of generation.
- To be able to understand design concepts of transmission lines and cables .

Course Outcomes

At the end of the course students will be able to

- The students will acquire knowledge in conventional renewable generating power stations and economics of generation
- The students will acquire knowledge regarding the design concepts of transmission lines and cables.

UNIT I

Economics of Power Generation: Load Curve, Load Demand and Diversified factors, Base Load and Peak load operation, Types of costs and depreciation fund calculations, Methods of power factor improvement, Economics of power factor improvement, Tariffs, Distribution: 2 wire and 3 wire distributors, Ring mains, AC distribution calculations.

UNIT II

Steam Power Stations: Choice of site, Layout & various parts of station, Boilers, Turbines, Super Heaters, Economizers, Air pre-heaters etc. and their Pulverized fuel, Coal handling.

Hydro-Electric Power plants: Estimation Hydrograph, Flow duration curve, Mass curve, Storage and pondage, Types electric plants and layouts, Prime movers for hydro-electric plants.

UNIT III

Nuclear Power Plants: Fissile materials, Working principle of nuclear plants and reactor control, Shielding, Types of reactors.

Non-Conventional Energy Sources – Basic principles of Wind, solar and gas turbines..

UNIT IV

Over-Head Lines: Supports sag and tension calculations, Effect of wind and ice, Erection conditions, Insulators: Types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, Testing of insulators. Insulated Cables: Conductors for cables, Insulating materials, Mechanical protection, Low voltage cables, Grading of cables, Three phase high voltage cables and Super voltage cables, Capacitance of three-core cables.

UNIT V

Inductance and Capacitance of Transmission Lines: Inductance and capacitance of overhead line conductors, Single phase and three phase with symmetrical composite conductors, GMR and GMD Spacing, Transposition, Bundled conductors, Effect of earth capacitance.

Suggested Reading:

1. Wadhwa C.L., *Electrical Power Systems*, New Age International (P) Ltd., 4th Edition, 2007.
2. Wadhwa C.L., *Generation, Distribution and Utilization of Electrical Energy*, New Age International (P) Ltd., 4th Edition, 2006.
3. Singh S.N., *Electrical Power Generation*, Transmission and Distribution, Prentice Hall of India, Pvt. Ltd., New Delhi, 2003.
4.V.K.Mehta, *Principles of Power Systems* , S. Chand and Co., 2007.

Course Code	Course Title						Core / Elective
PC404EE	Power Electronics						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	1	0	0	30	70	3

Course Objectives

- 1. To be able to understand various power switching devices, characteristics and applications.
- 2. To learn and understand the various converters like rectifiers, choppers and inverters principle operation, characteristics and applications.

Course Outcomes

At the end of the course students will be able to

UNIT-I

Power Semiconductor Diodes and Transistors: Types of power diodes- General purpose diodes -Fast recovery diodes -Their characteristics and applications. Bipolar Junction transistors, Power MOSFETs P-Channel, N- Channel. IGBTs -Basic structure and working, Steady state and switching characteristics-Comparison of BJT, MOSFET and IGBT -Their applications. SCRs-Static and dynamic characteristics, Two transistor analogy.

UNIT-II

Turn on and turn off mechanisms : BJT , Power MOSFET, IGBTs .SCR trigger circuits-R, RC and UJT triggering circuits. Triggering circuits for Single phase bridge rectifier and Choppers. Driver Circuits for MOSFET, IGBT and BJT. Protection of SCR's, Difference between forced and line commutation

UNIT-III

Principles of controlled rectification -Study of Single phase and three-phase half controlled and full controlled bridge rectifiers with R, RL, RLE loads. Effect of source inductances. Dual converters- circulating current mode and circulating current free mode-control strategies.

UNIT-IV

Classification of Choppers : Class A, B, C, D and E, Switching mode regulators-Study of Buck, Boost and Buck-Boost regulators, Cuk regulators . Principle of operation of Single phase bridge type Cyclo converters and their applications. Single phase AC Voltage Controllers with R, L and RL loads.

UNIT-V

Principle of operation of Single phase Inverters -Three phase bridge Inverters (1800 and 1200 modes)-voltage control of inverters-Single pulse width modulation- multiple pulse width modulation, sinusoidal pulse width modulation. Comparison of Voltage Source Inverters and Current source Inverters, Elementary Multilevel Inverters.

Suggested Reading:

1. Singh.M.D and Khanchandani.K.B, *Power Electronics*, Tata McGraw Hill, 2nd Edition, 2006.
2. Rashid.M.H, *Power Electronics Circuits Devices and Applications*. Prentice Hall of India, 2003
3. M.S.Jamil Asghar, *Power Electronics*, Prentice Hall of India, 2004 *With effect from Academic Year 2016-2017*
4. Bimbra.P.S, *Power Electronics*, Third Edition, Khanna Publishers, 1999
5. Mohan, Undeland, Robbins, *Power Electronics*, John Wiley, 1996

Course Code	Course Title						Core / Elective
PC405EE	Linear Integrated Circuits						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	0	0	0	30	70	3

Course Objectives

- To familiarize and able to understand Op-amps.
- To understand the different linear and non-linear applications of op-amp
- To understand the voltage regulators and active filters by using op-amps.

Course Outcomes

At the end of the course students will be able to

- Students will be able to design and use op-amps for various linear and non-linear applications.
- Ability to design and use voltage regulators and active filters

UNIT – l

Operational amplifiers : Characteristics, Open loop voltage gain, Output impedance, Input impedance, Common Mode Rejection Ratio - Offset balancing techniques - Slew rate, Frequency response - Basic applications - Inverter summer, Analog integrator, Differentiator, Current to voltage converter, Voltage to current converter, Voltage follower, a.c. amplifier.

UNIT – II

Circuits using Op-amps : Voltage limiter, Clipper and damper, Precision rectifier-full wave and half wave, Peak detector, Comparator, Zero crossing detector, Schmitt trigger, Monostable, astable and bistable multivibrators, Multiplier, Divider, Difference amplifier, Instrumentation amplifier.

UNIT – III

Waveform generation using Op-amps: Sine, Square, Triangular and Quadrature oscillators, 555 timer - Functional diagram, Operation as monostable and astable, Voltage to frequency converter using 555, 565.

UNIT – IV

Voltage regulators using Op-amp : Series voltage regulators - Shunt regulators using Op-amp - Switching regulators using Op-amp, Buck, Boost, Buck-boost regulators- Regulators using IC 723 - Dual voltage regulator - Fixed voltage regulators - Current sensing and current fold back protection.

UNIT – V

RC active filters : Butterworth - First order - Second order for low pass - High pass - Band pass - Band reject - Notch - State variable filter - Switched capacitor filter - Universal filter - Power amplifiers - Power boosters, Monolithic power amplifier features.

Suggested Reading :

1. Gayakwad W.A. *Op-Amps and Linear Integrated Circuits*, 4th Edition, Prentice Hall of India, 2002.
2. Malvino Albert Paul , *Electronic Principles*, 6th Edition, Tata McGraw Hill, 1999.
3. Roy Choudhury, Shail Jam - *Linear integrated Circuits*, New Age International, 2nd Edition, 2003.
4. William D. Stanley, *OP Amps with Linear Integrated Circuits*, Pearson, 2000.

Course Code	Course Title						Core / Elective
HS401BM	**Managerial Economics And Accountancy** (Common to all branches)						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	
	L	**T**	**D**	**P**			**Credits**
NIL	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- To learn important concepts of Managerial Economics and apply them to evaluate business decisions.
- To understand various parameters that determine the consumers' behavior.
- To evaluate the factors that affect production.
- To understand the concepts of capital budgeting and payback period.
- To study the concepts of various book-keeping methods.

Course Outcomes

At the end of the course students will be able to

Unit-I

Meaning and Nature of Managerial Economics: Managerial Economics and its usefulness to Engineers, Fundamental Concepts of Managerial Economics-Scarcity, Marginalism, Equimarginalism, Opportunity costs, Discounting, Time Perspective, Risk and Uncertainty, Profits, Case study method.

Unit-II

Consumer Behavior: Law of Demand, Determinants, Types of Demand; Elasticity of Demand (Price, Income and Cross-Elasticity); Demand Forecasting, Law of Supply and Concept of Equilibrium. (Theory questions and small numerical problem can be asked)

Unit - III

Theory of Production and Markets: Production Function, Law of Variable Proportion, ISO quants, Economics of Scale, Cost of Production (Types and their measurement), Concept of Opportunity Cost, Concept of Revenue, Cost-Output relationship, Break-Even Analysis, Price - Output determination under Perfect Competition and Monopoly (theory and problems can be asked)

Unit-IV

Capital Management: Significance, determination and estimation of fixed and working capital requirements, sources of capital, Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems. (Theory questions and numerical problems on estimating working capital requirements and evaluation of capital budgeting opportunities can be asked)

Unit-V

Book-keeping: Principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance, concept and preparation of Final Accounts with simple adjustments, Analysis and interpretation of Financial Statements through Ratios.

(Theory questions and numerical problems on preparation of final accounts, cash book, petty cash book, bank reconciliation statement, calculation of some ratios)

Suggested Reading:

1. Mehta P.L., Managerial Economics —Analysis, Problems and Cases , Sulthan Chand & Sons Educational Publishers, 2011
2. Maheswari S.N., Introduction to Accountancy , Vikas Publishing House, 2005
3. Pandey I.M., Financial Management , Vikas Publishing House, 2009

Course Code	Course Title						Core / Elective
PC451EE	Digital Electronics and Integrated Circuits Lab.						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	0	0	0	2	25	50	1

Course Objectives

- To Train the Students for acquiring practical knowledge in time response and frequency response of series / parallel RC, RL and RLC Circuits.
- To prepare the students for finds out parameters of a given two port network.
- To make the students for understanding the verification of theorems.

Course Outcomes

At the end of the course students will be able to

- Evaluate the time response and frequency response character sties of R,L,C Series and parallel circuits.
- Able to validate the network theorems.
- Able to find various parameters of a two-port network.
- Able to simulate electrical circuits using spice.
- Able to synthesize networks from a given transfer function

LIST OF EXPERIMENTS:

1. Generation of triangular, sine and square wave using IC's.
2. Voltage regulator IC **(Included instead of PLL)**
3. Design of astable multivibrator using 555 timer.
4. Active filters.
5. Instrumentation amplifier Sample and hold circuit.
6. Design of integrator and differentiator using Op-Amp.
7. Multiplexer application for logic realization and parallel to serial Conversions.
8. Synchronous counters.
9. Asynchronous counters.
10. Clippers and clampers using Op-Amps.
11. Monostable operation using IC's.
12. Bootstrap sweep circuit using Op-Amp.
13. Half adder, full adder and subtractor and realization of combinational logic.
14. A / D converters.
15. D / A converters.

Note: AT LEAST TEN EXPERIMENTS SHOULD BE CONDUCTED IN THE SEMESTER

Course Code	Course Title						Core / Elective
PC452EE	Computer Aided Electrical Drawing Lab.						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	0	0	0	2	25	50	1

Course Objectives

- To understand the terminology of electric circuit and electrical components.
- To be able to familiarize with electrical machines, apparatus and appliances.
- To acquire knowledge on various Electrical Engg. software's.

Course Outcomes

At the end of the course students will be able to

- Identify and draw different components of electrical systems
- Draw different control and wiring diagrams
- Draw winding diagrams of electrical machines.

Drawing of the following using Electrical CADD / Corel Draw / MS Word / PPT/Visio

1. Lines, Arcs, Curves, Shapes, Filling of objects, Object editing & Transformation.
2. Electrical, Electronic & Electro – mechanical symbols.
3. House – wiring diagrams and layout.
4. Simple power and control circuit diagrams.
5. Electrical machine winding diagrams. (A.C & D.C)
6. Transmission tower, Over head lines – ACSR conductors, Single circuit, Double circuit, Bundle conductor.
7. Constructional features of D.C motors, AC motors and Transformers.
8. D.C and A.C motor starter diagrams.
9. Lamps used in illumination
10. Single line diagram of Power System

Text Books:

1. KB. Raina, S.K. Bhattacharya, *Electrical Design, Estimating and Costing*, Wiley Eastern Ltd., 1991.
2. Nagrath, Kothari, *Electrical Machines*, Tata McGraw Hill Publishing Company Ltd., 2000.
3. A.K. Sawhney, *A Course in Electrical Machines Design*, Dhanpat Rai and Sons, 1996.

Course Code	Course Title						Core / Elective
ES422EE	Electrical Circuits and Machines (For Mechanical Engg.)						Core
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
NIL	3	0	0	0	30	70	3

Course Objectives

- To acquire knowledge in electrical circuits.
- To be able to understand the basic principle operation and performance of electrical machines.

Course Outcomes

- Students will know the basics of Electrical Engineering with good knowledge on underlying principles of operation.
- Students can relate these basics with daily experiences.

UNIT I

DC Circuits: Ohm's law, Network elements, Kichhoff's laws, Power in DC circuits, Series & parallel resistances, Thevinin's and Norton's theorems.

AC Circuits: Sinusoidal sources, Phasor representation of sinusoidal quantities, Average and RMS values, Form factor, Analysis of RLC circuits to sinusoidal inputs, Power factor, Active & reactive powers, energy stored in inductance and capacitance, Mutual inductance.

UNIT II

Three-Phase Circuits: Production of 3-phase voltages, balanced star and delta connections, Measurement of power by Two-wattmeter method.

Single Phase Transformers: Principle of operation, Transformer on No-load and Load, Equivalent circuit, Efficiency & regulation, O.C and S.C tests, Principle of autotransformer.

UNIT III

DC Machines: Construction and working principle of generator and motor, EMF in generator, Types of excitation, Characteristics of series and shunt generators, Applications, Torque in a DC motor, Characteristics of shunt and series motors, Speed control of dc shunt motors, Losses & efficiency, Three point starter.

UNIT IV

Three-Phase Induction Motors: Production of rotating magnetic field, Construction and principle of Induction motors, Torque-slip characteristics, Star delta and Autotransformer starters, Speed control by Stator voltage and Rotor resistance methods.

UNIT V

Single-Phase Motors: Capacitor start and Capacitor run motor, Universal motors.

Three - Phase alternators: Construction, emf equation, Regulation by synchronous impedance method.

Suggested Reading:

1. Naidu M.S, Kamakshiah S, *Introduction to Electrical Engineering*, Tata McGraw Hill, 1995
2. John Bird, *Electrical Circuit theory and Technology*, Routledge Taylor & Francis Group, Fourth Edition, 2012.
3. Mehta V.K., *Principles of Electrical Engineering and Electronics*, S.Chand & Co., 1995
4. A.Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, *Basic Electrical Engineering*, Tata McGraw Hill Education PVT LTD, 2009.

Course Code	Course Title						Core / Elective
EE 461EE	**Electrical Circuits & Machines Lab (For Mechanical Engg.)**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	
	L	**T**	**D**	**P**			**Credits**
NIL	**0**	**0**	**0**	**2**	**25**	**50**	**1**

Course Objectives

1. To learn practical electric AC & DC circuits.
2. To learn operation and performance characteristics of electrical machines by conducting various tests practically.

Course Outcomes

At the end of the course students will be able to

- Aware of various electric safety rules to be followed while working with electric circuits and equipments
- Explore themselves in designing basic electric circuits
- Identify requirements for electric machines for domestic and industrial purpose

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of Thevenin's and Norton's Theorems.
3. Study of Three-Phase Balanced Circuits.
4. Measurement of Power by Two-Wattmeter Method.
5. Study of Single-Phase RLC Series Circuits.
6. Magnetization Curve of a Separately Excited DC Generator.
7. Load Characteristics of Shunt Generator.
8. Performance Characteristics of Shunt Motor.
9. Speed Control of DC Shunt Motor.
10. O.C and S.C Tests on Single-Phase Transformer.
11. Load Test on Single-Phase Transformer.
12. Load Test on Three-Phase Induction Motor.

Note: Atleast ten experiments should be conducted in the Semester.