ELECTRICAL CIRCUITS

UNIT I - INTRODUCTION TO ELECTRICAL CIRCUITS

Basic definitions - Evolution in human comforts, What is engineering ?, Matter, Charge, Voltage and current. **Circuit concepts -** Electric networks, Network terminology, Classification of electric network. **R-L-C Parameters** - Resistance parameter, Inductance Parameter, Capacitance parameter. **Constant voltage and current sources -** The ideal voltage source, Problems based on constant voltage source, Ideal current source, Problems based on constant current source, Types of sources. **Dependent and independent sources -** Electrical energy sources. **Voltage - Current relationship for passive elements -** V-I Relationship for different input signals, Problems based on V-I relationship of resistive element, Capacitive element, Problems based on V-I relationship of capacitive element, Inductive element, Problems based on V-I relationship of inductive element. **Ohm's law and Kirchhoff's laws** - Ohm's law, How to remember ohm's law, Limitations of Ohm's Law, Problems based on Ohm's law, Kirchhoff's laws, Branch current method, Problems based on Kirchhof's law. **Resistance in series and parallel -** Resistance in series, Problem based on resistances in series, Resistance in Parallel, Problems based on resistances in parallel. **Analysis of series parallel resistance -** Resistances in series and parallel combination, Problems based on equivalent resistance in series-parallel circuit. **Circuit transformation -** Star and delta connection. **Problems on circuit transformation -** Problems based on star to delta conversion, Problems based on delta to star conversion. **Mesh analysis for D.C. excitation –** Introduction, Mesh analysis of resistive circuits excited by D.C. sources, Problem based on mesh analysis with dc source. **Node analysis for D.C. and A.C. circuit -** Introduction, Node analysis of resistive circuits excited by D.C. sources, Procedure to form node basis matrix equation by inspection, Node analysis of resistive circuits excited by D.C. sources, Various steps to obtain the solution of node voltages and branch voltages in a circuit, Problem based on node analysis of dc source, Node analysis of reactive circuits, Problem based on node analysis of dc source. **Super mesh and super node analysis** - Supermesh analysis, Problem based on super mesh analysis, Supernode analysis, Problem based on super node analysis.

UNIT II - SINGLE PHASE A.C. CIRCUITS

Introduction to A.C. – Introduction, Generations of alternating current and voltage. **Definitions of alternating quantities -** Definitions of alternating quantities, Average value and root mean square (R.M.S) value, Calculation of average value by analytical method, Calculation of R.M.S value by analytical method, Sinusoidal waveform representation, Problem based on alternating quantities. **Phasor representation of alternating quantities -** Introduction to j-operator, Different forms of representing a complex number, Phase and phase difference, Conversion of rectangular into polar form, Problems, Conversion of polar into rectangular form, Problems. **Concept of reactance, impedance, susceptance and admittance -** Concept of reactance, impedance, admittance and susceptance. **Real and reactive power -** AC power circuit analysis, Effective values of current and voltage (rms value), Apparent power, Complex power. **Pure resistance in AC circuit -** Definition of

vector, Problems based on pure resistance in A.C. circuits, Exercise based on pure resistance in A.C. circuits. **Pure capacitance in A.C. circuits -** A.C. through pure capacitance, Problems based on pure capacitance in A.C. circuits, Exercise based on pure capacitance in A.C. circuits. **RL, RC and RLC series circuits -** A.C. through R-L circuit, Problems based on RL series circuits, Exercise based on RL series circuits, A.C. through R-C circuit, Problems based on RC series circuits, Exercise based on RC series circuits, A.C. through R-L-C circuit, Power factor, Problems based on RLC series circuits. **A.C. through RC parallel circuit** - A.C. through parallel R-C circuit**. A.C. through RL parallel circuit -** A.C. Through parallel R-L circuit. **Parallel RLC circuit -** Parallel RLC circuit, Solving parallel circuit by 'J' notation method, Problem based on parallel circuit by 'J' notation.

UNIT III - LOCUS DIAGRAMS, RESONANCE AND MAGNETIC CIRCUITS

Locus diagram for series RL, RC circuits - Series circuits. **Problems based on locus diagram of RL, RC circuits -** Problem based on locus diagram of R-L series circuit, Problem based on locus diagram of R-C series circuit. **Parallel combination with variation of various parameters -** Parallel circuits, Problem combination with variation of various parameter. **Series resonance -** Resonance, Variation of Impedance, Admittance and Current with frequency, Plot of impedance and current as a function of frequency. **Q-Factor and Magnification factor -** Quality factor of coil and capacitor - Q-Factor of Parallel Circuit, Magnification factor (Q_0) in series resonance circuit, Bandwidth and selectivity**. Relation between resonance frequency and Half power frequency -** Geometrical relation between resonant frequency (f_0) and half power frequencies (f_1,f_2), Effect of resistance on bandwidth, Relationship between selectivity, bandwidth and quality factor (Q_O). **Parallel resonance -** Variation of reactance with frequency, Current in parallel resonant circuit, Parallel L, CR circuit. **R_LL-R_CC and LC parallel circuit -** Two branch parallel circuit (or) parallel R_LL-R_CC circuit, L-C parallel circuit, Magnification in parallel resonant circuit. **Problems on series and parallel resonance circuit -** Problem based on RLC series resonance circuit. **Comparison and uses between series and parallel resonance circuit -** Comparison between series and parallel resonant circuits. **Definitions of magnetism -** Magnetic Flux, Definitions concerning magnetic circuit. **Concept of magnetic circuits -** Magnetic circuits, Series magnetic circuits, Parallel magnetic circuit,Compare magnetic circuit with electric Circuit. **Magnetic circuits -** Problems based on magnetic circuit. **Introdcution to electromagnetism -** Introduction to magnets, Types of Magnets, Magnetic field. **Faraday's laws of electromagnetic induction -** Introduction, Faraday's law of electromagnetic induction, Problem based on Faraday's law. **Lenz's law and Fleming's law -** Direction of induced e.m.f. and current. **Principle of self and mutual induction -** Induced e.m.f, Dynamically induced E.M.F., Self inductance, Mutual inductance, Coefficient of coupling, Problem based on coefficient of coupling, Dot rule for coupled circuits.

UNIT IV - NETWORK TOPOLOGY

Introduction to network topology - Introduction to network topology, Oriented Graph and Unoriented Graph, Tree. **Incidence matrix -** Incidence matrix, Network analysis by incident matrix, Problem based on incidence matrix. **Tie set -** Tie-set, Tie set matrix, Equilibrium equations using tie-sets, Problem

based on Tie-set matrix. **Cut set matrix** - Cut-set, Problem based on cut-set matrix, Cut-set matrix, Equilibrium equations using cut-sets, Problem based on cut-set matrix. **Mesh analysis of independent and dependent sources -** Mesh analysis of circuits excited by both voltage and current sources, Problem based on mesh analysis with dependent and independent sources, Mesh analysis independent and dependent sources, Problem based on mesh analysis with dependent and independent sources. **Node analysis of independent and dependent sources -** Node analysis of circuits excited by both voltage and current sources, Problem based on node analysis with dependent and independent sources, Node analysis of circuits excited by independent and dependent sources. **Duality and dual networks -** Duality, Duality of network graph, Problem based on dual graph, Duality of network, Dual of node basis network, Problem based on dual of the network.

UNIT V - NETWORK THEOREMS (WITH A.C. & D.C.)

Thevenin's theorem for D.C. excitation - Thevenin's theorem, Problem based on Thevenin's theorem for d.c. excitation. **Thevenin's theorem in sinusoidal excitation -** Thevenin's theorem (A.C.), Problem based on Thevenin's theorem for sinusoidal excitation, Problem based on Thevenin's theorem for sinusoidal excitation, Problem based on Thevenin's theorem for sinusoidal excitation. **Norton's theorem for D.C. excitation -** Norton's theorem, Problem based on Norton theorem for d.c. excitation. **Norton's theorem for sinusoidal excitation -** Norton's theorem (A.C.), Problem based on Norton theorem for sinusoidal excitation. **Maximum power transfer theorem for D.C. excitation -** Maximum power transfer theorem, Problem based on maximum power transfer theorem for d.c. excitation. **Maximum power transfer theorem for sinusoidal excitation** - Maximum power transfer theorem (A.C), Problem based on maximum power transfer theorem for sinusoidal excitation, Exercise based on maximum power transfer theorem for sinusoidal excitation. **Millman theorem for D.C. excitation -** Millman's Theorem, Problem based on milliman theorem for d.c. excitation. **Millman theorem for sinusoidal excitation -** Problem based on milliman theorem for sinusoidal excitation. **Tellegan's theorem for D.C. excitation -** Tellegen's theorem, Problem based on Tellegan's theorem for d.c. excitation. **Tellegan's theorem for sinusoidal excitation -** Tellegan's theorem for sinusoidal excitation, Problem based on Tellegan's theorem for sinusoidal excitation. **Superposition theorem for D.C. excitation -** Super position theorem for D.C. source, Problem based on superposition theorem for d.c. excitation. **Superposition theorem for sinusoidal excitation -** Superposition Theorem for A.C. circuits, Problem based on superposition theorem for sinusoidal excitation. **Reciprocity theorem for D.C. excitation -** The reciprocity theorem, Problem based on Reciprocity theorem for d.c. excitation. **Reciprocity theorem for sinusoidal excitation -** Problem based on Reciprocity theorem for sinusoidal excitation. **Compensation theorem for D.C excitation -** Compensation theorem, Problem based on compensation theorem for d.c. excitation. **Compensation theorem for sinusoidal excitation -** Problem based on compensation theorem for sinusoidal excitation