

## Syllabus : Electrical Engineering

Topics
<p>1. Fundamentals Electrical Engineering: <b>Ohm's Law, Circuit connections (Series, Parallel, Star &amp; Delta) , Electro-magnetics (Faraday's Law, Lenz's Law, Magnetic circuit etc), Chemical effects of current (Types &amp; operation of Batteries)</b> <b>Alternating Current and Voltage, Sinusoidal, Triangular, Square (Periodic waveforms), Frequency, Time Period &amp; Phase Angle of A.C waveforms, R.M.S value, Average value and Phasor representation of alternating quantities. Inductors &amp; capacitors. Phase relationships &amp; concept of impedance. Introduction to rectangular and polar forms of A.C quantities. Power Measurements in Poly-phase Circuits</b></p>
<p>2. Electrical Circuit &amp; Networks: <b>Overview of Network Theorems, Kirchhoff's Voltage Law (KVL), Kirchhoff's Current Law (KCL), Thevenin's Theorem, Norton's Theorem Superposition Theorem, Maximum power Transfer Theorem, Reciprocity theorem</b></p>
<p>3. Electronic Devices &amp; Circuits: <b>Active and Passive components, Semiconductor Physics, PN Junction, Diode (Types), Bipolar Junction Transistor, Field Effect Transistor, Rectifier, Amplifiers - Design And Analysis - Single Stage and multi stage, Feed Back Amplifier, Oscillators, Large Signal Amplifiers, IC Design, IC Fabrication Processes, MOSFET (principle of operation)</b></p>
<p>4. Electrical Machines: <b><u>DC Generators &amp; Motors</u> - Construction &amp; Working principle, Types, Characteristics, E.m.f. equation, Armature reaction, Commutation, Torque equations</b> <b><u>Poly Phase Induction Motor</u> - Construction &amp; Working principle, Types (Squirrel cage rotor and Wound Rotor), Equivalent Circuit, Determination of equivalent circuit parameters, Performance of Induction Machine, Loss and Efficiency, Starting of induction motor, parallel operation, Application</b> <b><u>Alternator</u> - Construction &amp; Working principle, Types, Distribution Factor, Pitch Factor, Voltage Regulation (Methods)</b> <b><u>Synchronous motor</u> – Construction &amp; Working principle, Types (Cylindrical rotor and Salient pole), Starting methods, Effect of load on a synchronous motor, Effect of varying excitation on armature current and power factor, Hunting and damper winding, Efficiency, Applications</b> <b><u>Special Purpose Machines (Basics)</u>- Single Phase induction motor, Capacitor Start Motors, Commutator Motors, A.C. series motor, Universal Motor, Repulsion Motor</b></p>
<p>5. Electrical Measurements &amp; Measuring Instruments: <b>Measurement and Error, Bridges, Electromagnetic Instruments (D'Arsonval galvanometer, Ammeter, Voltmeter, Wattmeter, Energy meter etc.), Electronic Instruments (Multimeter, Frequency Meter, etc.), Meggar, Transducers (definition, classification of resistive, inductive, capacitive types), thermal,</b></p>

magnetic & photoelectric transducers, Potentiometer, Strain gauge, p-h meter, Data holding

6. Digital Electronics: Basics of Digital Electronic Circuits, Logic Gates, Boolean Algebra, Flip-flops, Combinational logic circuits, Sequential logic circuits, Logic Families, Memory devices, D/A and A/D converters

7. Electrical Power –

**Mechanical design of transmission lines** - Main components of overhead lines, Line supports, Conductor material, Types of line insulators (string efficiency), Sag and tension calculation for overhead lines including effects of ice and wind and for equal and unequal supports

**Substations components** - Substation (Transmission and Distribution), their types, Choice of their location, installation and size

Bus-bar, Feeder and Distributor, Ring system and Radial system, AC and DC distribution

**Generation of Electrical Power** –Load Curve, Load duration curve, Base load, Peak load, Load factor, Diversity factor, Maximum demand, Power Stations (Types, Equipments and layout)

**Performance of Transmission Lines** - Short , Medium and Long Transmission Lines, Evaluation of ABCD parameters, Equivalent  $\pi$  and T Circuits, Ferranti Effect

8. Electrical Engineering Materials – Conductors, Insulators, Semiconductors & Magnetic materials - Types , Characteristics and applications

9. Microprocessor: Architecture of 8085 Microprocessor, Programming of 8085 Microprocessor, Data Transfer, Interfacing I/O devices, Applications

10. Protection and Switchgear -

**Fundamentals** - Necessity & functions of protective system, Normal & abnormal conditions, Types of faults & their causes.

**Circuit interrupting devices**- Fuses (Low voltage, High voltage fuses, HRC fuses, construction, types, working, characteristics and applications), Isolators- vertical break, horizontal break & panto-graph type, Arc formation process, methods of arc extinction, related terms, Circuit breakers- Concept, Classification, Working principle,

**Circuit Breakers** - Construction, Specification of the following:

Bulk oil circuit breaker, Minimum oil circuit breakers (MOCB), Sulphur Hexa- Fluoride circuit breaker (SF<sub>6</sub>), Vacuum circuit breaker, Air circuit breakers (ACB)

**Protective Relaying** – Requirements, related terms, relay time, Time current Characteristics, Classification of relays.

**Operation of the following relays** -

Electromagnetic attraction, induction, static, Non-directional and Directional Over-current relay, Differential Relay, Buchholz Relay, Thermal relay.

Distance relaying- Principle and types

**Abnormalities, Faults & Protection schemes of the following:**

**Transformer, Alternator, Busbars, Feeders & Transmission line**

**Neutral Earthing – importance, types**

**Over voltage Protection – Lightning phenomena, Causes of over voltages, Protection schemes- Shielding & Non-shielding methods, Surge diverters & absorbers.**

**11. Electrical Wiring, Estimating and Costing – Tender, Design and Estimation of the following: Internal house wiring (Types), Industrial wiring, Service connections, Overhead lines and Underground cable laying**

**12. Installation and Maintenance –**

**Installation & Commissioning- Theodolite, foundations of static & rotating machines, installation of low and large capacity machines and transformers. Tests required before commissioning of equipments.**

**Earthing – Reasons, earthing systems, measurement.**

**Testing and Maintenance – Instruments used for measuring insulation, polarization index, drying of insulation, testing of insulating oil, preventive maintenance schedules for transformer, induction motor, lines, circuit breakers, underground cables**

**Trouble shooting – External and internal causes of faults, electrical, mechanical and magnetic instruments used for troubleshooting, common faults in domestic circuits.**

**13. Non-conventional Energy – Sources, Types (Solar, Wind, Ocean, Biomass, MHD, Geothermal) of non-conventional power generation schemes.**