

ELECTRICAL ENGINEERING

PAPER I

1. ELECTRO-MAGNETIC CIRCUITS

Electric and magnetic fields, terms related to magnetic circuit, Comparison between Electric and magnetic circuits and related simple problem, Conductors and magnetic materials.

2. ELECTRIC MATERIALS

Conductors, Semi-Conductors & Insulators, Super Conductivity, Insulating materials for electrical & their applications, Magnetic materials, Ferro, Para, diamagnetic materials, ceramics, properties and applications, Special Semi-conductors.

3. ELECTRICAL CIRCUITS (AC & DC CIRCUITS)

Circuits elements, Network Theorem:- Kirchhoff's Law, Thevenin's Theorem & Superposition Theorem, R-L-C Series & Parallel circuits, Series & Parallel Resonant circuits, 3-Phase circuits, Star Delta conversion and simple problems.

4. ELECTRIC MEASUREMENT & MEASURING INSTRUMENTS:

Units & standards:-

Indicating instruments-ammeter, voltmeter, wattmeter & energy meter. Measurement of power, Resistance (low, medium & high) & transducer.

Bridge measurements:

D.C. Bridge-Wheatstone Bridge & Kelvin Bridge

A.C. Bridge-Anderson Bridge, Maxwell Bridge & Wein's Bridge.

A.C. & D.C. Potentiometer & Localisation of cable fault (Loop Test), High voltage measurement.

5. PROTECTIVE DEVICES:

Types of Relay – Over current, Over voltage, Distance, Directional & Differential.

Types of Circuit Breakers – Oil C.B., Air C.B., Vacuum & Gas C.B.

Types of Lightning Arrester – Horn-gap Arrester, Thyrite Arrester, Valve type Arrester & Pellet type Oxide film Arrester.

Types of Insulators:-Pin insulator, Strain insulator & Suspension type insulator.

6. BATTERY

Primary & Secondary Cells, Construction & characteristics of Lead acid Cell, Chemical changes, Application & Maintenance of Lead acid cell & Charging systems (constant current & constant voltage)

7. ELECTRICAL MACHINES

D.C. Generator: - Construction and different types of generator, E.M.F. Equation, Armature reaction, Commutation, General characteristics and related problems.

D.C. Motor:- Significance of back e.m.f., Derivation of Torque equation, Characteristics of different types of D.C. motors (Series, Shunt & Compound motor), Speed control of D.C. motor (Series & Shunt), Losses & Efficiency and related problems.

8. DIGITAL FUNDAMENTALS

Number system and codes: Binary Number System, Octal Number System, Decimal Number System, Hexadecimal Number System, Conversion of number systems. ASCII Code, Excess-3 Code, Gray Code, EBCDIC Code.

Digital Logic: Basic Gates, Boolean Algebra, Combinational and Universal Gates, Positive and Negative logic.

Combinational Logic Circuits: Boolean Laws and theorems, De-Morgans Theorem, Sum of Products (SOP) and Product of sums (POS), Pairs, Quads, Octets, K-Map.

Data Processing Circuits: Multiplexers and De-Multiplexers, Encoder and Decoders, Parity generators and checkers, Programmable Logic Arrays, Programmable Array Logic.

Arithmetic Circuits: Binary addition and subtraction, Signed and un-signed magnitude numbers, 1's and 2's complement, 9's and 10's complement, Adder and subtractor circuits.

Flip Flops: RS, JK, Gate, Edge triggered flip-flops, JK Master-Slave flip-flop.

Registers: Types of Registers, Serial In-Serial Out, Serial In-Parallel Out, Ring Counters.

Counters: Asynchronous and Synchronous Counters, Decade counters, Modulus counters.

Memory: Basic terms and concepts, Magnetic and semiconductor memories, Memory addressing.

Paper-II

1. ELECTRICAL MACHINES

Transformer: Construction of different types of transformers, e.m.f. Equation, Equivalent circuit, Vector diagrams on No load & load condition, Short circuit & Open circuit test, Losses & Efficiency, Auto-transformer, Different connections of 3 phase Transformer like star-star, delta-delta, delta-star & star-delta & related problems.

Synchronous Motor: Principle of operation, Starting methods, effects of excitation on armature current & power factor, Construction of V-curve & inverted V-curve, Vector diagram and related problems.

3-phase induction motor: Description of its component, Relation between supply frequency, slip & rotor frequency, Torque equation, condition of

maximum torque, Power stages, Starting & Speed control and related problems.

1-phase motor:

Single phase induction motor: Different types, starting method, double field revolving theory.

Shaded pole motor, Universal motor, Repulsion motor & A.C. Series motor.

Alternator Or AC Generator: Construction, Pitch factor, Breadth factor, Equation of induced emf, leakage reactance, Synchronous reactance, Vector diagram, Voltage regulation & its determination by Synchronous impedance method and related problems.

2. POWER SYSTEM:

Power Generating Stations: Hydro, Thermal & Nuclear.

Tariff: Tariff & Economic consideration, operating factors, Power factor improvements & Related problems.

Transmission Lines: Transmission line (Short, Medium & Long), Voltage regulation & Transmission efficiency and related problems.

Distribution Lines: Types of distributors (radial & ring main), Inter connected system and related problems.

3. SUB-STATION:

Different types & Components of Sub-station, Bus-bar arrangement, Types & laying method of Underground Cables and Types of Earthing.

4. CONTROL SYSTEM:

Mathematical modelling of physical system, Block diagrams open and closed loop control system & their reduction.

5. ELECTRONIC DEVICES AND CIRCUITS

Fundamental of Electronics: Definition and field of application of electronics. Types of electronics components – active, passive, symbols, colour codes and uses.

Basic semiconductor Theory: Atomic structure, valency and energy levels, energy band diagrams of insulators, conductors and semiconductors, Definition and types of semiconductors, Doping, Intrinsic and extrinsic semiconductors, P and N type semiconductors.

PN Junction Theory: PN Junction Diode, formation of electrons and holes and the effect of temperature, forward and reverse bias, volt ampere characteristics, LED, Photodiode, Zener diode and their applications.

Rectifier and filters: Rectifier circuits – Half wave, full wave, center tapped and bridge rectifiers, Simple filter circuits-C, LC and CLC.

Junction Transistors: Junction transistors construction, types, symbols, principle of operation and field of applications, Biasing transistor in active, saturation and cut-off region, Fixed bias and potential divider, Types of configuration – CB, CE and CC, their input and output characteristics, Current amplification factors – alpha, beta and relationship between them.

Transistor Amplifiers: Basic CB, CE amplifiers – graphical analysis and load lines, RC coupled amplifier – frequency response, upper and lower cut-off and bandwidth, Multistage Amplifiers – Class A, B, AB and C tuned voltage amplifiers.

Feedback Amplifier and Oscillators: Principle of feedback and types of feedback, Barkhausen Criterion, RC phase shift, Wienbridge, Hartley, Colpitt and Crystal oscillators.

Special electronic devices: Construction symbols and characteristics of JFET, MOFET, UJT DIAC, TRIAC and SCR.

Operational Amplifiers (OPAMP-741C): Differential amplifier, Differentiator, Integrator, Characteristics of OPAMP.

IC 555 Timer Counter: Multivibrators – Astable, Monostable and Bi-stable.

6. MICROPROCESSOR AND ITS APPLICATIONS

Introduction: Evolution of microprocessor, evolution of microcomputer, Components of a computer (digital), Buses and memory addressing capacity of CPU.

Microprocessor Architecture of 8085: ALU, Timing and control unit, Registers, Address and data buses, Pin configuration, Opcode and operand, Instruction cycle and data flow, Timing diagram.

Instruction Set of 8085: Instruction and data formats, Addressing modes, Status flags, Instructions and types, Various languages, Stack and subroutines, Programs.

Peripheral Devices and their interfacing: Address space partitioning, Memory and input output interfacing, Data transfer schemes, Interrupts of 8085, Interfacing devices and input output devices, Programmable peripherals interface (8255), 8253, 8257, 8279.