Syllabus for Junior Lab Assistant-Electronics

Unit–I: Basic Circuit Elements and Sources

Voltage and current sources; ideal voltage source and ideal current source with their V–I characteristics; controlled (dependent) sources. Passive circuit elements—resistor, inductor and capacitor (R, L and C); V–I characteristics and ratings of R, L and C elements. Source transformation: conversion of voltage sources into current sources and current sources into voltage sources. Series, parallel and series–parallel combinations of resistances and determination of equivalent resistance. Colour coding of resistors.

Unit–II: Circuit Laws and Network Analysis

Ohm's law. Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL) with simple applications. Concept of node and loop; nodal and mesh analysis. Star–Delta and Delta–Star transformations. Introduction to network theorems: Superposition, Thevenin's, Norton's, Reciprocity and Maximum Power Transfer theorems. Basic concept of one-port and two-port networks.

Unit–III: Semiconductor Fundamentals and Diodes

Introduction to semiconductors and classification of materials; commonly used semiconductor materials. Energy band concept in semiconductors; charge carriers (electrons and holes) and effect of temperature on conductivity. Intrinsic and extrinsic semiconductors; N-type and P-type semiconductors. Formation and working of P–N junction diode; V–I characteristics under forward and reverse biasing; concept of knee voltage and breakdown voltage; basic diode equation. Zener diode: working, characteristics and application as a voltage regulator; introduction to regulator ICs. Special purpose diodes such as LED and photodiode—basic working principles, characteristics and applications.

Unit–IV: Rectifier and Wave-Shaping Circuits

Rectifier circuits: definition and types; half-wave rectifier and full-wave rectifier (centre-tapped and bridge); basic working principle and output waveforms. Concept of rectifier efficiency and ripple factor for half-wave and full-wave rectifiers. Diode numbering system, polarity identification, and basic ratings including maximum forward current, peak inverse voltage (PIV) and power dissipation. Wave-shaping circuits: clippers—unbiased and biased (positive and negative), and clampers—positive and negative; basic working and applications.

Unit–V: Transistors and Biasing

Introduction to transistors as semiconductor devices. Bipolar Junction Transistor (BJT): construction and working of PNP and NPN transistors. Transistor configurations—common base (CB), common emitter (CE) and common collector (CC); input and output characteristics. Regions of operation (cut-off, active and saturation). Transistor as a switch. Current gains in

CB and CE configurations. DC load line and operating point (Q-point). Introduction to transistor biasing. Voltage divider bias, Stabilization of Q point.

Introduction to other transistors: Field Effect Transistor (FET) and Metal Oxide Semiconductor Field Effect Transistor (MOSFET)—basic structure and working (qualitative).

Unit - VI: Amplifiers and Oscillators

Transistor as an amplifier: basic principle of amplification. Single-stage and multistage amplifiers; need for cascading. RC-coupled amplifier: basic circuit and working. Concept of positive and negative feedback.

Oscillators: basic concept and need; essentials of oscillation and Barkhausen criterion. Sinusoidal oscillators—Hartley, Colpitts, RC phase shift and Wien bridge oscillators: basic working principle and frequency of oscillation. Crystal oscillator: basic idea and applications.

Unit VII: Linear Integrated Circuits

Introduction to operational amplifiers (op-amps); basic idea and ideal characteristics of an op-amp. Block diagram of IC 741 and basic working principle. Concept of open-loop and closed-loop operation of an op-amp. Basic op-amp applications: inverting and non-inverting amplifiers; summing amplifier and subtractor; integrator and differentiator.
Schmitt trigger. 555 Timer: basic introduction; monostable and astable modes of operation.
Introduction to active filters: basic idea of low-pass and high-pass filters.

Unit–VIII: Digital Electronics

Number systems, base conversions. Representation of signed and unsigned numbers. Binary arithmetic: addition and subtraction using 2's complement method. Introduction to BCD code. Logic gates: numbering, truth tables and logic symbols. Boolean algebra: basic postulates and fundamental theorems.

Combinational logic circuits: standard representation of logic functions (SOP and POS forms). Karnaugh map minimization. Half adder and full adder; half subtractor and full subtractor. Multiplexers, demultiplexers, encoders and decoders—basic operation and applications. Sequential logic circuits: flip-flops, Counters, Registers and memories: registers and shift registers—Memory devices: ROM, PROM, EPROM and EEPROM. RAM: static and dynamic. Introduction to Logic Families.

Unit–IX: Communication Electronics

Introduction to communication systems and their basic elements; Modulation techniques: Amplitude Modulation (AM)—basic principle, modulation index, generation and detection using envelope detector. Frequency Modulation (FM)—basic concept, advantages over AM, generation and detection. Introduction to digital communication; need for digital transmission; basic idea of Pulse Code Modulation (PCM). Introduction to Dipole Antenna, Optic Fibre Basics.

Unit–X: Electronic Instruments and Measurements

Introduction to measurement and basic concepts of errors. Definition and classification of transducers. Basic idea of resistive, inductive and capacitive transducers. Working principles and applications of piezoelectric, thermoelectric, photoelectric and Hall-effect sensors. Applications of transducers in the measurement of temperature, pressure, displacement and light. Measurement of voltage, current and resistance using analog instruments. Digital measuring instruments: Digital Voltmeter (DVM) and Digital Multimeter (DMM)—basic principle and applications. Cathode Ray Oscilloscope (CRO): basic block diagram, principle of operation and applications; measurement of voltage and frequency using CRO.