

ELECTRONICS

SYLLABUS FOR ENTRANCE EXAMS (UG)

For the Year 2025

ELECTRONICS

Unit 1: Electrostatics

- Electric charges and their conservation. Coulomb's law - force between two-point charges, forces between multiple charges; superposition principle and continuous charge distribution.
- Electric field, electric field due to a point charge, electric field lines; electric dipole, electric field due to a dipole; torque on a dipole in a uniform electric field.
- Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside).
- Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipoles in an electrostatic field.
- Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

Unit 2: Current Electricity

- Electric current, flow of electric charges in a metallic conductor, drift velocity and mobility, and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel.
- Kirchhoff's laws, Wheatstone bridge.

Unit 3: Magnetic Effects of Current and Magnetism

- Concept of magnetic field, Oersted's experiment. Biot-Savart law and its application to current carrying circular loop.
- Ampere's law and its applications to infinitely long straight wire, straight solenoid. Force on a moving charge in uniform magnetic and electric fields.
- Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current carrying conductors definition of ampere. Torque experienced by a current loop in a magnetic field; moving coil galvanometer - its current sensitivity and conversion to ammeter and voltmeter.
- Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic field intensity due to a magnetic dipole(bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines. Para-, dia- and ferro-magnetic substances, with examples.

Unit 4: Electromagnetic Induction and Alternating Currents

- Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents. Self and mutual inductance.
- Alternating currents, peak and rms value of alternating current/voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits, wattless current.
- AC generator and transformer

Unit 5: Electromagnetic Waves

- Need for displacement current.
- Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves.
- Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays) including elementary facts about their uses.

Unit 6: Optics

- Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens- maker's formula. Magnification, power of a lens, combination of thin lenses in contact combination of a lens and a mirror. Refraction and dispersion of light through a prism.
- Scattering of light - blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.
- Wave optics: Wavefront and Huygens' principle, reflection and refraction of plane wave at a plane surface using wavefronts.
- Proof of laws of reflection and refraction using Huygens' principle.
- Interference, Young's double hole experiment and expression for fringe width, coherent sources and sustained interference of light.
- Diffraction due to a single slit.
- Polarisation, plane polarised light.

Unit 7: Dual Nature of Matter and Radiation

- Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation - particle nature of light.

- Matter waves - wave nature of particles, de Broglie relation.

Unit 8: Atoms and Nuclei

- Alpha - particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones.
- Radioactivity - alpha, beta and gamma particles/rays and their properties. Mass-energy relation, fusion. mass defect; binding energy per nucleon and its variation with mass number; nuclear fission and

Unit 9: Electronic Devices

- Energy bands in solids (qualitative ideas only), conductors, insulators and semiconductors; semiconductor diode - I-V characteristics in forward and reverse bias, diode as a rectifier