

# Physics II

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## Syllabus

### I. Electric Charge, Field, and Force

- A. Elementary charge and the conservation of charge
- B. Electric conductors, insulators, and semiconductors
- C. Electrification by friction, conduction, and induction
- D. Electric field and electric field lines
- E. Coulomb's law and the electric force
- F. Electric dipoles
- G. Conductors in electrostatic equilibrium

### II. Electric Flux and Gauss's Law

- A. Electric flux and Gauss's law
- B. Electric fields of symmetrical charge distributions

### III. Electric Potential Energy and Electric Potential

- A. Electric potential energy
- B. Electric potential
- C. Equipotential surfaces
- D. Potential gradient

### IV. Capacitance and Dielectrics

- A. Capacitors and capacitance
- B. Capacitors in series and parallel
- C. Energy stored in a capacitor
- D. Dielectrics
- E. Gauss's law in dielectrics

## V. Current, Resistance, and Electromotive Force

- A. Current
- B. Resistivity and resistance
- C. Electromotive force
- D. Energy and power in circuits

## VI. Direct Current Circuits

- A. Terminal voltage
- B. Resistors in series and parallel
- C. Measuring voltages and currents in a circuit
- D. Kirchhoff's junction and loop rules
- E. Resistor-capacitor ( $RC$ ) circuits
- F. Power distribution systems and electrical safety

## VII. Magnetic Field and Force

- A. Magnetism, magnetic field, and magnetic field lines
- B. Magnetic flux and magnetic force
- C. Point charges moving in electric and magnetic fields
- D. Loop in a magnetic field
- E. Direct current (DC) motor
- F. Hall effect
- G. Magnetic materials

## VIII. Sources of Magnetic Fields

- A. Moving charges and current elements
- B. Straight wire carrying a current
- C. Magnetic force between two parallel wires carrying a current
- D. Loop carrying a current
- E. Ampere's law

## IX. Electromagnetic Induction

- A. Faraday and Lenz's law
- B. Electric generators
- C. Motional electromotive force
- D. Back emf of a motor
- E. Induced electric fields
- F. Eddy currents and displacement currents
- G. Maxwell's equations
- H. Superconductivity

## X. Inductance

- A. Mutual inductance
- B. Self-inductance and inductors
- C. Energy stored in an inductor
- D. Resistor-inductor ( $RL$ ) circuit
- E. Inductor-capacitor ( $LC$ ) circuit
- F. Resistor-inductor-capacitor ( $RLC$ ) circuit

## XI. Alternating Current Circuits

- A. Alternating current (AC) and voltages
- B. Average values of current and voltage
- C. Resistors, inductors, and capacitors in an AC circuit
- D. Phasor diagrams
- E. Resistance and reactance
- F. Impedance and resonance in an  $RLC$  circuit
- G. Power in an AC circuit
- H. Transformers

## XII. Electromagnetic Waves

- A. Maxwell's equations and electromagnetic (EM) waves
- B. Antennas
- C. EM spectrum and the speed of light  $c$
- D. Sinusoidal EM waves
- E. Energy and momentum of EM waves
- F. Standing EM waves
- G. Doppler effect

## XIII. Nature and Propagation of Light

- A. Nature of light
- B. Wavefronts, rays, and Huygens's principle
- C. Reflection and refraction of light
- D. Total internal reflection
- E. Dispersion
- F. Polarization
- G. Scattering of light

## XIV. Geometric Optics

- A. Reflection and refraction at a plane surface
- B. Reflection and refraction at spherical surfaces
- C. Refraction at thin lenses
- D. Lenses in combination
- E. Cameras
- F. The human eye
- G. Angular magnification and the simple magnifier
- H. Compound microscopes and telescopes
- I. Aberrations of lenses and mirrors

## XV. Interference of Light

- A. Coherent light sources
- B. Interference of light
- C. Michelson interferometer
- D. Double-slit interference
- E. Intensity in interference patterns
- F. Interference in thin films

## XVI. Diffraction of Light

- A. Diffraction and Huygens's principle
- B. Fresnel and Fraunhofer diffraction
- C. Single-slit diffraction
- D. Intensity in single-slit interference patterns
- E. Multiple slits
- F. Diffraction gratings
- G. X-Ray diffraction
- H. Circular aperture and resolving power
- I. Holography