U.G. 2nd Semester

Paper: PHY201C (Core)
Electricity & magnetism

Credits: 5 = 3+1+1 (48 Lectures)

Theory: 48 Lectures

Electric field and Electric Potential:

Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. **(6 Lectures)**

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. **(6 Lectures)**

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. **(8 Lectures)**

Dielectric Properties of Matter: (6 Lectures)

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.

Magnetic Field: (8 Lectures)

Magnetic force on a moving charge and on current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Magnetic Properties of Matter: (4 Lectures)

Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

Electromagnetic Induction: (5 Lectures)

Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

Electrical Circuits: **(5 Lectures)**

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education

3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edition., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
5. Electricity and Magnetism, J. H. Fewkes & J. Yarwood, Vol. I, 1991, Oxford Univ. Press.
6. Elecromagnetics, B B Laud, 1996, New Age International (P) Limited.

List of Experiments: Credit=1 (16 Classes of 2 hours each)

1. Determination of B and M using magnetometers
2. Hysteresis loop tracer experiment
3. Magnetic field measurement experiment
4. Study of dielectric constant and Curie temperature of ferroelectric ceramics.
5. To study the variation of potential drops with frequency across inductor, capacitor and resistor of a series LCR circuit for an ac signal and hence find the resonant frequency. Compare it with theoretical value.
6. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
7. To determine the value of self-induction of a coil with the help of Anderson's bridge.
8. Measurement of charge sensitivity, current sensitivity and CDR of Ballistic Galvanometer

(*At least 5 experiments from the above list*)

Reference Books for Practicals

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash &Ramakrishna, 11th Ed., 2011,Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning.

Paper: PHY202C (Core)
Waves & Optics

Credits: 5=3+1+1 (48 Lectures)

Theory: 48 Lectures

Superposition of Collinear Harmonic oscillations: Simple harmonic motion. Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **(8 Lectures)**

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses. **(4 Lectures)**

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. **(6 Lectures)**

Superposition of Two Harmonic Waves: Standing Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves. **(8 Lectures)**

Geometrical Optics: Conjugate foci relation for refraction of paraxial rays at a Spherically Refracting Surface. Translation matrix and refraction Matrix, use of matrix method in refraction at a spherical surface and refraction through thin lens. **(4 Lectures)**

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. Michelson Interferometer:(1) Idea of formation of fringes (No theory required), (2) Determination of Wavelength and (3) Wavelength Difference. **(9 Lectures)**

Diffraction: Fresnel diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Comparison of a Zone Plate with a convex lens. Diffraction due to (1) a Straight Edge and Slit, (2) a Small Circular Aperture. Fraunhofer diffraction: Single slit. Rectangular and Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **(9 Lectures)**

Recommended Books:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications
8. A Text Book on Light, B. Ghosh & K. G. Mazumdar, Sreedhar Publishers, Kolkata

List of Experiments: (1 Credit, 16 Classes of 2 hours each)

(At least five experiments to be performed)

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda 2 - T$ law.
2. To measure unknown frequency from Lissajous figures using CRO .
3. To balance a spectrometer by Schuster`s method and determination of angle of prism.
4. To determine refractive index of the Material of a prism using sodium source.
5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
6. To determine the wavelength of sodium source using Michelson's interferometer.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
10. To determine wavelength of Na source using plane diffraction grating.
11. To determine dispersive power and resolving power of a plane diffraction grating.

(Few more Experiments may be added by the department later)

Reference Books

1. A Text Book of Practical Physics I, Prakash & Ramakrishna, Kitab Mahal

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, Vani Pub.

Paper: PHY203G (General Elective)
Mechanics & Properties of matter, Oscillation & Waves and Optics

Credits: 4 = 3+0+1 (48 Lectures)

Theory: 48 Lectures

Kinematics: laws of motion. Circular motion, Work. Kinetic and potential energy. Line integrals. Work-Energy Theorem. Conservative and non conservative forces. Friction, terminal velocity in air. Dynamics of a system of particles. Centre of mass. Conservation of linear momentum. Scattering in one and two dimensions. Rotational Dynamics: Angular momentum of a particle and a system of particles. Torque. Conservation of angular momentum. Rotation about a fixed axis of a rigid body. Moment of inertia. Calculation of moment of inertia of symmetrical bodies. Central force. Reduction of two-body problem to one-body problem. **(14 Lectures)**

Hook's law of elasticity, different kinds of elastic constants, work done in deforming a body, Relation among the elastic constants. Bending of beam (light beam) fixed at one end and loaded at the other end; torsion of a rod. Surface tension and surface energy, excess pressure inside soap bubble and liquid drop, rise of liquid in a capillary tube. Streamline and turbulent flow, critical velocity, viscosity of fluids, Poiseuille's and Bernoulli's equation. **(10 Lectures)**

Simple pendulum, damped and forced vibration, resonance. Compound pendulum. Transverse waves on a string. Standing waves on a string. Energy of a vibrating string. Linear superposition, interference, beats. Fourier series. Sound waves in air. **(10 Lectures)**

Interference of light, Fresnel biprism, colour of thin films, Newton's ring phenomenon. Fresnel and Fraunhofer classes of diffraction, diffraction at a straight edge and single slit, diffraction grating. Plane polarized light, polarization on reflection, Brewster's law, double refraction, Nicol prism. **(14 Lectures)**

Reference Books:

1. Kleppner D and Kolenkow R J, An Introduction to Mechanics (Special Indian Edition) (2007)
2. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000
3. Properties of Matter, D.S. Mathur
4. Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
5. Principles of Optics, B.K. Mathur, 1995, Gopal Printin
6. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
7. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
8. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

List of Experiments: GENERIC ELECTIVE II LAB

(1 Credit, 16 Periods of 2 hours)

(Mechanics & Properties of Matter, Oscillation & Waves and Optics)

(At least 05 experiments from the following list)

1. To determine the moment of inertia of a cylinder or a rectangular parallelepiped about two different axes of symmetry by torsional oscillation method.
2. To determine the value of g by bar pendulum.
3. To study the elongation of a wire by different pulling forces using Searle's apparatus and find the value of Young's modulus.
4. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
5. To determine velocity of sound in moist air by resonant air column method.
6. To find the frequency of a tuning fork using sonometer.
7. To determine the wavelength of sodium light by Newton's ring.
8. To adjust and focus the given spectrometer using Schuster's method and then determine the refractive index of the material of the prism.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.

2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal

3. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal, 1985, Vani Publication.