Waves and Optics

Course Code: PAS 8111

Course Credits: 2

Course Type: IDC Minor Course

Course Objectives: Understanding the concepts of electromagnetic waves which serve as a springboard for the various branches of modern physics. To explain Hamilton Jacobi theory and the principle of least action which provide the transition to wave mechanics while Poisson brackets and canonical transformations are invaluable in formulating the basic structure of quantum mechanics.

Course Outcomes: After reading these course students will be able to waves, lights etc. Students will be able to see the difference between interference and diffraction. Students will be able to understand plane waves etc.

Unit1: Superposition of Collinear Harmonic oscillations: (3 Lectures)
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.

Unit2: Superposition of two perpendicular Harmonic Oscillations (2 Lectures)
GraphicalandAnalyticalMethods.LissajousFigureswithequalanunequalfrequencyand their uses.

Unit3: Wave Motion :(4 Lectures)
Plane and Spherical Waves, Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave. Energy Transport, Intensity of Wave. Water Waves: Ripple and Gravity Waves.

Unit 4: Velocity of Waves :(3 Lectures)
VelocityofTransverseVibrationsofStretchedStrings.VelocityofLongitudinalWavesina Fluid in a Pipe, Newton's Formula for Velocity of Sound, Laplace's Correction.

Unit5: Superposition of Two Harmonic Waves :(6 Lectures)
Standing (Stationary) 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, Plucked and Struck Strings, Melde's Experiment, Longitudinal Standing Waves and Normal Modes, Open and Closed Pipes, Superposition of N Harmonic Waves, Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle, Temporal and Spatial Coherence.

Unit6: Interference:(2 Lectures)
Division of amplitude and wave front, Young's double slit experiment, Lloyd's Mirror and Fresnel's Biprism, Phase change on reflection: Stokes' treatment, Interference in Thin Films: parallel Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength,(3) Wavelength Difference, (4) Refractive Index, and (5)Visibility of Fringes, Fabry-Perot interferometer. Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) source holograms.

Reference Books:

1.Waves:BerkeleyPhysicsCourse,vol.3,
FrancisCrawford,2007,TataMcGraw-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.