Course: Core paper IV- HPHCR2042T, HPHCR2042P

Semester	II
Paper Number	HPHCR2042T, HPHCR2042P
Paper Title	Waves & Optics
No. of Credits	06 (Theory – 4, Lab – 2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 periods/week Pr: 3 periods/week
Name of Faculty member(s)	
Course description/objective	The course introduces students to properties of waves, wave equation, superposition of waves and also discusses phenomena in optics. Interference, Diffraction & Polarisation are covered.
Syllabus	As enclosed
Texts	As enclosed
Reading/Reference Lists	As enclosed
Evaluation	Total – 100 (Theory – 60, Practical – 40) Theory – CIA – 10 Semester Examination – 50 Group A (25 marks) Group B (25 marks) One 10 marks qs out of two qs One 10 mark qs out of two qs Three 5 mark qs out of five qs Three 5 mark qs out of five qs

Syllabus :

HPHCR2042T - WAVES AND OPTICS (Credits: Theory-04, Practicals-02)

Module – A [26 lectures]

Superposition of Collinear Harmonic oscillations : 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. [5 Lectures]

Superposition of two perpendicular Harmonic Oscillations : Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. [2 lectures]

Wave Motion : 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 [6 lectures]

Velocity of Waves : Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. [6 lectures]

Superposition of Two Harmonic Waves : 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. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Superposition of N Harmonic Waves. [7 lectures]

Module – B [26 lectures]

Wave Optics : Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. [2 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. [8 lectures]

Interferometer : Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. [2 lectures]

Diffraction : Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) [1 lectures]

Fraunhofer diffraction: Diffraction grating by a single slit, double slit, multiple slits, circular aperture, resolving power, Resolving Power of a telescope. Resolving power of grating, Rayleigh's criterion. Finesse. [8 lectures]

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. [3 lectures]

Holography: Principle of Holography. Recording and Reconstruction Method. [2 lectures]

Reference Books

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Optics, E. Hecht, Pearson
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
4. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
5. Principles of Optics, B.K. Mathur
6. Vibrations & Waves, A.P. French
7. Advanced Acoustics, D.P. Roy Chaudhuri

HPHCR2042P - Waves and Optics Lab (CreditS – 2) (39 periods)

1. To investigate the motion of coupled oscillators.
2. To study Lissajous Figures using CRO.
3. Familiarization with Schuster`s focusing 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 wavelength of sodium light using Newton's Rings.
7. To determine an unknown wavelength using Fresnel's biprism
8. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
9. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
3. Advanced Practical Physics, B. Ghosh, K.G.Majumdar, Sreedhar Publishers