Core V **Semester III**

Waves and Optics

Course Outcomes

- Basic understanding of propagation of light, its application and wave nature.
- To Understand the concepts of wave motion.
- To Understand the concepts of interference and its application.
- To Understand the concepts of diffraction and its application.
- To Apply the acquired knowledge of optics in Experiment

Unit I

Geometrical optics: Fermat's principle, reflection and refraction at plane interface, Matrix formulation of geometrical Optics, Cardinal points and Cardinal planes of an optical system, Idea of dispersion, Application to thick Lens and thin Lens, Ramsden and Huygens eyepiece. Wave Optics : Electromagnetic nature of light. Definition and properties of wave front Huygens Principle. Temporal and Spatial Coherence.

Unit II

Wave Motion: Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Traveling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave, Energy Trans- port, Intensity of Wave. Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods, Lissajous Figures (1:1 and 1:2) and their uses, Superposition of Harmonic waves.

Unit III

Interference: Division of amplitude and wave front, Young's double slit experiment, Lloyds Mirror and Fresnels Bi-prism, 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. Interferometer : Michelson's 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.

Unit IV

Fraunhoffer diffraction: Single slit, Circular aperture, Resolving Power of a telescope, Double slit, Multiple slits, Diffraction grating, Resolving power of grating. 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, Fresnel's Integral, Fresnel diffraction pattern of a straight edge, as lit and a wire.

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Text Books:

- ✓ *A text book of Optics N. Subhramanyam and BrijLal (S.Chand Publishing)*
- ✓ *Optics - Ajoy Ghatak (McGraw Hill)*

Reference Books

- ✓ *Optics-E. Hecht(Pearson)*
- ✓ *Fundamentals of Optics-F. A. Jenkins and H. E. White(McGraw-Hill)*
- ✓ *Geometrical and Physical Optics R.S. Longhurst (Orient Blackswan)*
- ✓ *The Physics of Vibrations and Waves- H. J .Pain(John Wiley)*
- ✓ Optics P. K. Chakraborty.
- ✓ Principles of Optics-Max Born and Emil Wolf (Pergamon Press)
- ✓ The Physics of Waves and Oscillations-N. K. Bajaj (Mc Graw Hill)

LAB: Credit-1

(Minimum 5 experiments are to be done)

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify 2-T law.
2. To plot the I-D curve and to determine the refractive index of a prism
3. To determine refractive index of the Material of a prism using sodium source.
4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine wavelength of (1) Na source and (2) spectral lines of Hgsource using plane diffraction grating.
7. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books:

- ✓ Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- ✓ A Text Book of Practical Physics, I. Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal
- ✓ Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- ✓ A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani