

Course Syllabus: Core V, Semester III

Course Title: **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.
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Unit-wise Syllabus

Unit I: Geometrical and Wave Optics

- **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

- **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 Transport, Intensity of Wave
- **Superposition:**
 - 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

- **Fundamentals of 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)
- **Applications and Interferometers:**
 - Newton's Rings: Measurement of wavelength and refractive index
 - Michelson's Interferometer:
 1. Idea of form of fringes (No theory required)
 2. Determination of Wavelength
 3. Wavelength Difference
 4. Refractive Index
 5. Visibility of fringes
 - Fabry-Perot interferometer

Unit IV: Diffraction

- **Fraunhofer 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, a slit and a wire