

**Syllabus for B.Sc. IV Semester
Optional Physics**

PHY 401: Paper 4: Physical Optics, Fibre Optics and Computational Physics

Total hours of teaching: 50 hrs

1. Interference of Light

10 hrs

Wave theory of light: Interference, interference by division of wave front, young's double slit experiment, Fresnel's bi-prism (both theory and experiment). Interference by division of amplitude, thin film of uniform thickness and wedge shape, Newton's rings by reflection; theory and experiment, Michelson's interferometer and experimental determination of wavelength of sodium light and its doublet separation.

2. Diffraction of light

10 hrs

Diffraction, Concepts of Fresnel and Fraunhofer diffractions. Rectilinear propagation of light. Theory of Zone plate, comparison between zone plate and convergent lens. Fresnel's diffraction at a straight edge and wire. Fraunhofer diffraction at a single slit – derivation expression for intensity, with theory of double slit method. Transmission grating (both theory and experiment)- determination of wavelength of light. Dispersion and resolution of grating.

3. Polarization of light

10 hrs

Polarization, methods for obtaining polarized light. Double refraction in uniaxial crystals, Huygens' theory, positive and negative crystals and principal refractive indices. Huygens' construction of O and E rays in uniaxial crystals for plane wave front. Quarter and half wave plates. Production and detection of plane, circularly and elliptically polarized light. Babinet compensator (qualitative). Optical activity; specific rotation, Fresnel's theory and Laurent's half shade polarimeter.

4. Optical Instruments

6 hrs

Cardinal points; Equivalent focal length of two thin convex lenses separated by a distance (derivation), tracing of cardinal points. Aberrations; Spherical and chromatic aberrations in lenses. Achromatic combination of lenses; in contact and separated by a distance. Huygens' and Ramsden's eye pieces

5. Optical fibres

4 hrs

Review of the idea total internal reflection. Optical fibres: structure, dispersion & propagation of light through optical fibres, angle of acceptance, expression for numerical aperture and refractive index, applications of optical fibres.

6. Special theory of relativity

10 hrs

Michelson–Morley experiment and explanation of its negative result. Postulates of special theory of relativity. Lorentz transformations, length contraction, time dilation– illustrations with twin-paradox and μ -meson, relativity of simultaneity, addition of velocities, variation of mass with velocity. Derivation of Einstein's mass–energy relation. Minkowski's space.

Reference books

1. A Text Book of Optics by Brijilal and Subramanyam
2. Optics by Ajay Ghatak
3. A Text Book of Optics by D.S. Mathur

PHYL4: Practical course for Semester IV

Instructions

1. Two experiments (3 hours duration each) per week should be performed.
2. One practical internal test of 3 hours duration for 15 marks be conducted at the end of practical course in the semester.
3. Minimum of 12 experiments from the list mentioned below should be performed in Semester IV. Of these, one experiment can be open ended type (Course teacher may develop a new innovative experiment and introduce into the course). Open ended experiment must also be considered for examination.

List of experiments

1. Interference at a wedge – Measurement of the thickness of paper separator.
2. Determination of wavelength of monochromatic light using biprism.
3. Newton's rings –Determination of radius of curvature and its verification by telescope method.
4. Diffraction at a wire – Diameter of wire.
5. Diffraction grating – Normal incidence method.
6. Diffraction of Cauchy's constants.
7. Conductivity of an electrolyte using Kohlrausch bridge
8. Brewster's law.
9. Resolving power of grating using spectrometer.
10. Resolving power of telescope.
11. Specific rotation of sugar solution using polarimeter.
12. Searle's Goniometer- Determination of equivalent focal length of combination of lenses for at least three separations and its verification.
13. Liquid lens –Determination of refractive index of liquid.
14. Measurement of numerical aperture of an optical fiber using LASER.
15. Measurement of fiber attenuation by cut back method using LASER.
16. Determination of mutual inductance of a pair of coils using BG.
17. Turn table –equivalent focal length and cardinal points.
18. Sextant – height of an inaccessible object such as hill, tree etc.
19. Determination of coefficient of damping, relaxation time and quality factor of a damped oscillator.
20. Construction of simple multimeter (Single versatile circuit)
21. Field along the axis of the circular coil