COURSE 5: OPTICS

Theory   **Credits: 3**   **3 hrs./week**

COURSE OBJECTIVE:

The course on Optics aims to provide students with a fundamental understanding of the behaviour and properties of light and its interaction with matter.

LEARNING OUTCOMES:

On successful completion of this course, the student will be able to:

1. Explain about the different aberrations in lenses and discuss the methods of minimizing them

2. Understand the phenomenon of interference of light and its formation in (i) Lloyd's single mirror due to division of wave front and (ii) Thin films, Newton's rings and Michelson interferometer due to division of amplitude.

3. Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating and to describe the construction and working of zone plate and make the comparison of zone plate with convex lens

4. Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.

5. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields. To understand the basic principles of fiber optic communication and explore the field of Holography and Nonlinear optics and their applications.

SYLLABUS

UNIT-I Aberrations

Introduction – monochromatic aberrations, spherical aberration, methods of minimizing spherical aberration, coma, astigmatism and curvature of field, distortion. Chromatic aberration-the achromatic doublet. Achromatism for two lenses (i) in contact and (ii) separated by a distance.

UNIT-II Interference

Principle of superposition – coherence Conditions for interference of light. Fresnel's biprism determination of wavelength of light –change of phase on reflection. cosine law –colors of thin films-Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film). Determination of diameter of wire, Newton's rings in reflected light. Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

UNIT-III Diffraction

Introduction, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction – Diffraction due to single slit-Fraunhoffer, Fraunhofer diffraction pattern with N slits (diffraction grating). Resolving power of grating, Determination of wavelength of light in normal incidence using diffraction grating. Fresnel's zone plate-comparison of zone plate with convex lens-difference between interference and diffraction.

UNIT-IV Polarisation

Polarized light: methods of polarization by reflection, refraction, double refraction, Brewster's law-Mauls law-Nicol prism polarizer and analyser, Quarter wave plate, half wave plate-optical activity, determination of specific rotation by Laurent's half shade Polari meter. Idea of elliptical and circular polarization

UNIT-V Lasers and Holography

Lasers: introduction, spontaneous emission, stimulated emission. Population Inversion, Laser principle -Types of lasers-He-Ne laser, Ruby laser- Applications of lasers. ***Holography***: Basic principle of holography- Applications of holography.

REFERENCE BOOKS:

1. BSc Physics, Vol .2, Telugu Academy, Hyderabad

2. A Text Book of Optics-N Subramanyam, L Brijlal, S. Chand& Co.

3. Unified Physics Vol. II Optics & Thermodynamics – Jai Prakash Nath & Co. Ltd., Meerut

4. Optics, F.A. Jenkins and H.G. White, Mc Graw-Hill

5. Optics, Ajay Ghatak, Tata Mc Graw-Hill.

6. Introduction of Lasers – Avadhanulu, S. Chand & Co.

7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical   **Credits: 1**   **2hrs/week**

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for studying light and its interactions with matter.

LEARNING OUTCOMES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying light and its interactions with matter.

2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.

3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.

4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.

5. Understanding of physical principles: Students should develop an understanding of the physical principles governing optics, including reflection, refraction, diffraction, interference, and polarization.

Minimum of 6 experiments to be done and recorded

1. Determination of radius of curvature of a given convex lens-Newton's rings.
2. Resolving power of grating.
3. Study of optical rotation –polarimeter.
4. Dispersive power of a prism.
5. Determination of wavelength of light using diffraction grating-minimum deviation method.
6. Determination of wavelength of light using diffraction grating-normal incidence method.
7. Determination of wavelength of laser light using diffraction grating.
8. Resolving power of a telescope.
9. Refractive index of a liquid-hallow prism
10. Determination of thickness of a thin wire by wedge method
11. Determination of refractive index of liquid-Boy's method.

Scheme of valuation for Practical

1.   Formula, Units and Modal Graph = 5 M
2.   Tabular Column   = 5 M
3.   Observations   = 15 M
4.   Calculations   = 10 M
5.   Viva   = 5 M
6.   Record   = 10 M

                        Total =   50 Marks

STUDENT ACTIVITIES

Suggested student activities

UNIT-I Aberrations:

Ask students to observe and sketch the different images produced by the lens at different distances.
Build a simple optical system with two lenses in contact and ask students to calculate the focal length
and magnification of the system. Then, introduce a thin glass plate between the lenses to simulate the
effects of chromatic aberration and ask students to observe and discuss the changes in the image
produced.

UNIT-II Interference:

Ask students to measure the diameter of the central bright spot and the diameter of the nth ring for
different values of n, and then calculate the wavelength of light.

UNIT-III Diffraction:

Build a simple diffraction grating using a piece of cardboard and some sewing needles. Ask
students to measure the distance between the needles, count the number of lines per unit length, and
then calculate the grating spacing and the wavelength of light.

UNIT-IV Polarisation:

Ask students to measure the angle of rotation of the polarized light before and after passing through
the sample, and then calculate the specific rotation of the sample.

UNIT-V Lasers and Holography:

Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic
plate. Ask students to record a hologram of a simple object and then reconstruct the image using a
laser beam.

MODEL QUESTION PAPER

SECOND YEAR -SEMESTER-III- COURSE 5: OPTICS

Time: 3 Hrs.   **Max Marks: 75**

PART - A

Answer any five questions. Each one carries 5 marks   5 x 5 = 25 Marks

1.

2

3.

4.

5.

6.

7.

8.

PART – B

Answer any Five Questions. Each one carries 10 marks   5x 10 = 50 Marks

9.   a)   From unit-1

         (OR)

         b)   From unit-1

10.   a)   From unit-2

         (OR)

         b)   From unit-2

11.   a)   From unit-3

         (OR)

         b)   From unit-3

12.   a)   From unit-4

         (OR)

         b)   From unit-4

13.   a)   From unit-5

         (OR)

         b)   From unit-5

BLUE PRINT FOR THE QUESTION PAPER SETTING

S. No.	Type of Question	To be given in the Question Paper			To be answered		
		No. of Questions	Marks allotted to each question	Total Marks	No. of Questions	Marks allotted to each question	Total Marks
1	Section – A (Short Questions)	8	5	40	5	5	25
2	Section - B (Essay Questions)	10	10	100	5	10	50
		Total Marks		140	**Total Marks**		**75**