

**Paper III: Wave
Optics (For Maths
Combinations)III
SEMESTER**

Work load:60 hrs per semester

4 hrs/week

UNIT-I (8 hrs)

1. 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 (14hrs)

2. Interference

Principle of superposition – coherence-temporal coherence and spatial coherence-conditions for interference of light. Fresnel's biprism-determination of wavelength of light –change of phase on reflection. Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (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. Michelson interferometer, Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

UNIT-III (14hrs)

3. Diffraction

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

UNIT-IV(10 hrs)

4.Polarisation:

Polarized light: methods of polarization polarization by reflection, refraction, double refraction, scattering of light-Brewster's law-Mauls law-Nicol prism polarizer and analyzer- Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by Laurent's half shade polarimeter-Babinet's compensator - idea of elliptical and circular polarization

UNIT-V (14hrs)

5. Lasers and Holography

Lasers: introduction, spontaneous emission, stimulated emission. Population Inversion,

Laser principle-Einstein coefficients -Types of lasers-He-Ne laser, Ruby laser- Applications of lasers. Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

6. Fiber Optics

Introduction- different types of fibers, rays and modes in an optical fiber, fiber material, principles of fiber communication (qualitative treatment only), advantages of fiber optic communication.

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, AjoyGhatak,Tata Mc Graw-Hill.
6. Introduction of Lasers – Avadhanulu, S.Chand& Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical Paper III: Wave Optics

Work load:30 hrs

2 hrs/week

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 deviationmethod.
6. Determination of wavelength of light using diffraction grating-normal incidence method.
7. Resolving power of a telescope.
8. Refractive index of a liquid-hallow prism
9. Determination of thickness of a thin wire by wedge method
10. Determination of refractive index of liquid-Boy's method.

Scheme of Valuation

Practicals

50 marks

Formula & Explanation	6
Tabular form +graph +circuit diagram	6
Observations	12
Calculation, graph, precautions & Result	6
Viva-Voce	10
Record	10

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

- Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
- Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.
- Assignment - Few problems may be given to the students from the different units and asked them to solve.
- Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
- Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

QUESTION BANK

Unit – 1

Essay Questions(10M)

1. Explain chromatic aberration. Explain methods to rectify chromatic aberration.
2. What is the achromatic doublet? How the chromatic aberration eliminated when a) two lenses in contact and b) two lenses separated by some distance.
3. Explain spherical aberration. How the spherical aberration eliminated when two lenses separated by some distance.

Short Answers(5M)

1. Explain the defect coma
2. What is the astigmatism?
3. Derive formula for achromatism for two lenses in contact.

4. Explain spherical aberration

Unit – 2

Essay Questions(10M)

4. Give the procedure for determining the wavelength of the given monochromatic source of light using Fresnel's biprism.

5. Give the procedure for determining the thickness of the given thin transparent material using Fresnel's biprism.

6. How do you determine the wavelength of the monochromatic light using Newton's rings?

7. How do you determine the wavelength of the monochromatic light using Michelson interferometer?

Short Answers (5M)

1. State and explain the superposition principle.

2. Give the conditions for interference of light.

3. Show that the phase change by π when the light ray reflected from the surface of denser medium.

4. Derive the cosine Law.

5. Explain the colours in thin films.

6. Explain the non reflecting films.

Unit – 3

Essay Questions(10M)

1. Distinguish between Fresnel and Fraunhofer diffraction. Explain Fraunhofer diffraction due to single slit.

2. What is the diffraction? Explain the diffraction due to double slit.

3. What are Fresnel's half period zones? Give the construction and working of zone plate.

Short Answers (5M)

1. Explain zone plate.

2. What is the resolving power of grating?
3. Give the differences between zone plate and convex lens.

Unit – 4

Essay Questions(10M)

1. Give the construction and working of Nicol prism. Mention its uses.
2. Define specific rotator power? How it is determined by using Laurent's half shade polarimeter?

Short Answers (5M)

1. State and explain Brewster's Law.
2. State and explain Malus Law.
3. What is the double refraction?
4. Write a short note on Quarter wave plate.
5. Write a short note on Quarter wave plate.

Unit – 5

Essay Questions (10M)

1. What is population inversion? Describe the construction and working of He – Ne Laser.
2. Describe the construction and working of Ruby Laser. What are the applications of Lasers?

Short Answers (5M)

1. Give the difference between the stimulated and spontaneous emissions.
2. Write a short note on fiber optics.
3. What is fiber optics? Write the applications of fiber optics.
4. What is holography? Write its applications.