PARVATHANENI BRAHMAYYA
SIDDHARTHA COLLEGE OF ARTS & SCIENCE
Autonomous
Siddhartha Nagar, Vijayawada–520010
Re-accredited at 'A+' by the NAAC

Course Code				23PHMAL231			
Title of the Course				**WAVE OPTICS**			
Offered to: (Programme/s)				**B. Sc Hons Physics,**			
L	**4**	**T**	**0**	**P**	**0**	**C**	**3**
Year of Introduction:	**2024-25**			**Semester:**			**3**
Course Category:	**MAJOR**			**Course Relates to:**	**GLOBAL**		
Year of Revision:	**NA**			**Percentage:**	**NA**		
Type of the Course:				EMPLOYABILITY			
Crosscutting Issues of the Course :				ENVIRONMENT AND SUSTAINABILITY			
Pre-requisites, if any				BASIC KNOWLEDGE			

Course Description:

This course explores wave optics, covering the principles of interference, diffraction, polarization, and aberrations. Topics include Fresnel's Bi-Prism, Newton's rings, diffraction gratings, and methods to produce and analyze polarized light. It also delves into laser technology and holography, emphasizing practical applications in wavelength determination, optical devices, and advanced imaging techniques.

Course Aims and Objectives:

S. NO	COURSE OBJECTIVES
1	To help students understand the nature of light, its propagation and interaction with matter which is essential to constantly emerging newest technologies.
2	To create interest among the students about modern communication systems by studying wave optics
3	Students will be able to understand applications of interference, diffraction, and lasers in real-life situations.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	understand the phenomenon of interference of light and its formation in Fresnel's biprism, Newton's rings and Michelson interferometer	K2	1	1
CO2	distinguish between Fresnel's diffraction and Fraunhofer diffraction and observe the diffraction patterns in the case of a single slit and the diffraction grating	K1	1	1
CO3	explain the various production methods of plane, circularly and polarized light and their detection and the concept of optical activity.	K4	2	1
CO4	Gain knowledge of various types of optical fibers	K1	1	1
CO5	Comprehend the basic principle of laser, the working of solid and gas lasers and their applications in different fields	K2	2	2

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2							2	
CO2	2							3	
CO3		3						3	
CO4	2							2	
CO5		3							3

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively

Course Structure:

Unit	Learning Units	Lecture Hours
I	**Interference of light** **A) Division of Wavefront:** Introduction, Conditions for the interference of light, Interference of light by division of wavefront and amplitude, Fresnel's Bi-Prism-Determination of Wavelength of Light, Phase change on reflection- Stokes' treatment. **B) Division of Amplitude**: Cosine law - colours in thin films, Newton's rings in reflected light - Determination of wavelength of monochromatic light, Michelson interferometer and determination of wavelength.	12
II	**Diffraction of light** **A) Fraunhofer Class**: Distinction between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit, N-slits (No	12

	derivation), Determination of wavelength of light using a diffraction grating, Resolving power of grating, **B) Fresnel's Class**: Fresnel's half-period zones, Zone plate, comparison of zone plate with a convex lens.	
III	**Polarisation of light** **A) Polarized light**: Methods of production of plane-polarized light - Polarisation by reflection (Brewster's law), Malus law, Double refraction, Nicol prism, Nicol prism as polarizer and analyzer **B) Types and production of polarized Light**: Quarter wave plate, Half wave plate, Optical activity, Idea of Plane, circular & Elliptical polarized light (Concept only), Laurent's half shade polarimeter : determination of the specific rotation.	12
IV	**Aberrations:** **A)** Monochromatic aberrations - Spherical aberration, Methods of minimizing spherical aberration, Coma, Astigmatism, - minimization methods, **B)** Chromatic aberration - the achromatic doublet; Achromatism for two lenses (i) in contact and (ii) separated by a distance.	12
V	**Lasers and Holography** **A) Lasers** Introduction, Spontaneous emission, stimulated emission, Population Inversion, Laser principle, Einstein coefficients, Ruby, He-Ne laser - Applications of lasers. **B) Holography** Basic principle and construction of holography, Applications of holography	12

Student Activities

UNIT-I 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-II 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-III 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-IV: 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-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

Text BOOKS:

1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. Unified Physics Vol. II Optics, Jai Prakash Nath & Co.Ltd., Meerut., Meerut

REFERENCE BOOKS:

1. A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand &Co.
2. Optics-Murugesan, S. Chand & Co.
3. Optics, F.A. Jenkins and H.G. White, McGraw-Hill
4. Optics, Ajoy Ghatak, Tata McGraw-Hill.
5. Introduction of Lasers – Avadhanulu, S. Chand &Co.
6. Principles of Optics- BK Mathur, Gopala Printing Press,1995

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SEMESTER -END QUESTION PAPER STRUCTURE

Course Code & Title of the Course:	**23PHMAL231(WAVE OPTICS)**
Offered to:	**B. Sc H Physics, B. Sc H Chemistry**
Category:	**SEMESTER: 3**
Max. Marks	**70**
Max.Time	**3 Hrs**

Section A: Short Answer Questions (20 Marks)

Answer All questions. Each question carries 4 Marks.

1 (a) What are the conditions for interference of light? (CO1, K2)

OR

(b) Distinguish between Fraunhofer and Fresnel diffraction. (CO2, K2)

2 (a) In Newton's ring experiment, the diameter of the 10th dark ring is 0.433 cm. Find the wavelength of the incident light, if the radius of curvature of the lens is 80 cm. (CO1, K3)

OR

(b) A diffraction grating has 15 cm of the surface ruled with 6000 lines per cm. Evaluate the resolving power of grating in the first order. (CO2, K3)

3 (a) State the Brewster and Malus law. (CO3, K2)

OR

(b) Explain spherical aberrations. (CO4, K2)

4 (a) A half-wave plate is constructed for a wavelength of $6000A^0$. Find the value of the wavelength of light for which this plate works as a quarter wave plate. (CO3, K3)

OR

(b) Two convex lenses having a combined focal length of 10 cm and separated by a distance of 2 cm are designed to eliminate spherical aberration. Calculate the focal length of individual lens (CO4, K3)

5 (a) Write the applications of LASERS. (CO5, K3)

OR

(b) Write the applications of holography. (CO5, K3)

Section B

Answer All questions. Each question carries 10 Marks.

6. a) Describe the experimental arrangement for observation Fresnel Bi prism experiment. (CO2, K2)

(OR)

b) Describe Newton's ring method for measuring the wavelength of monochromatic light with the necessary theory. (CO1, K2)

7. a) What is diffraction? Explain the Fraunhofer diffraction due to a single slit with intensity distribution. (CO2, K3)

(OR)

b) Describe the construction and working of the zone plate. Derive the equation for its focal length. (CO2, K3)

8 a) Describe the construction and working of Nicol's prism. Explain how it can be used as polarizer and analyser. (CO3, K1)

(OR)

b) What is specific rotation? Describe how specific rotation of sugar solution can be determined experimentally. (CO3, K2)

9 a) Explain about COMA and ASTIGAMATISM. (CO4, K1)

(OR)

b) Define chromatic aberration, Derive the condition for Achromatism for when two lenses are in contact. (CO1, K2)

10 a) What is LASER? Explain the construction and working of the Ruby laser with a neat diagram. (CO5, K2)

(OR)

b) Explain the basic principle and construction of holography. (CO5, K2)

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