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Your Roll No.....

Sr. No. of Question Paper : 2347 IC  
Unique Paper Code : 42224412  
Name of the Paper : Wave and Optics  
Name of the Course : B.Sc. (Prog)  
Semester : IV  
Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt Five questions in all.
3. Question Number 1 is compulsory.

1. Attempt any five parts from the following :  
(5×3=15)

(a) Two narrow parallel slits of  $0.5 \times 10^{-8}$  m apart are illuminated by a monochromatic light of wavelength  $5890\text{\AA}$ . Calculate the width of the fringes which are obtained on a screen distant 0.5 m from the slit.

(b) Why are Newton's rings circular?

P.T.O.

- (c) Why there is need of extended source in the interference by division of amplitude.
- (d) Find the radius of first half period element on a zone plate behaving like a convex lens of focal length 50 cm. The wavelength of light is  $5000\text{\AA}$ .
- (e) What is the condition for absent spectra in a diffraction grating?
- (f) What are sound waves? How can they be produced?
2. (a) What do you understand by Lissajous figure? A Particle is subjected to two perpendicular SHM's simultaneously
- $$x = A_1 \cos(2\omega t + \alpha) \quad y = A_2 \cos(\omega t)$$
- obtain Lissajous figure analytically and graphically if  $\alpha = \pi/2$  and  $\pi$ .
- (b) Define simple harmonic motion (SHM). Show that the differential equation of motion for SHM is linear and homogenous. Hence, prove that the principle of superposition hold for SHM. (9,6)
3. (a) What are beats? What is the necessary conditions to obtain them?

(b) Two vibrations along the same line are described by  $x(1) = 0.05 \cos 8\pi t$ ,  $x(2) = 0.03 \cos 10\pi t$ , where  $x$  is in meters,  $t$  in seconds. Obtain the equation describing the resultant motion. Hence find the beat period. (5,10)

4. (a) Explain the formation of standing waves on a stretched String. Sketch first three harmonics.

(b) What are progressive waves? How they differ from standing waves. Derive an expression for displacement in the progressive wave in terms of wavelength and velocity. Prove

$$y(x, t+T) = y(x, t) \quad (5,10)$$

5. (a) In Fresnel's Biprism experiment with a source of light of wavelength  $5890 \text{ \AA}$ , a thin mica sheet of refractive index 1.6 is placed normally in the path of one of the interfering beams and the central bright fringe is shifted to a position of third bright fringe from the centre. Calculate the thickness of the mica sheet.

(b) Derive the conditions of constructive and destructive interference for Young's double slit experiment. (10,5)

P.T.O.

6. (a) Explain the determination of difference in wavelengths of two waves using Michelson's Interferometer. How Michelson's Interferometer can be used to measure the refractive index of a thin transparent sheet.
- (b) In an experiment for determining the refractive index of a gas using Michelson's interferometer a shift of 148 fringes is observed, when all the gas is removed from the tube. If wavelength of light used is  $589.3 \text{ nm}$  and length of the tube is  $20 \text{ cm}$ , calculate the refractive index of the gas. (10,5)
7. (a) Each slit of a double slit has a width of  $0.15 \text{ mm}$  and the distance between their centers is  $0.75 \text{ mm}$ . Find the missing orders in the diffraction pattern.
- (b) Derive an expression for intensity distribution for Fraunhofer diffraction due to double slit. (5,10)
8. (a) What is zone plate? Show that a zone plate has multiple foci. Compare the zone Plate with a convex lens.
- (b) What is polarization of light? Explain elliptical and circular polarization. (10,5)