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**63 (FY) SEM-3/MAJ/PHYMAJ2024**

**2024**

**PHYSICS**

Paper : PHYMAJ2024

**(Waves and Optics)**

Full Marks : 50

Pass Marks : 20

Time : Two hours

**The figures in the margin indicate full marks for the questions.**

1. Answer the following questions :  $1 \times 5 = 5$

(a) Lissajous figure at  $45^\circ$  means

(i) circle

(ii) ellipse

(iii) straight line

(iv) parabola

Contd.

(b) In a standing wave the distance between a node and its nearest antinode is

(i)  $\frac{\lambda}{2}$

(ii)  $\frac{\lambda}{4}$

(iii)  $\lambda$

(iv)  $3\frac{\lambda}{4}$

(c) If monochromatic light in Young's double-slit experiment is replaced by white light, then

(i) no fringes are observed

(ii) all bright fringes are white

(iii) all bright fringes are coloured but the central fringe is white

(iv) all bright fringes are coloured including central fringe

(d) In Fraunhofer diffraction of a single slit with monochromatic light of wavelength  $\lambda$ , the width of the slit is 'a' and the screen is at a distance  $D$  from the slit. If the slit width is decreased, the width of the central maximum

(i) will increase

(ii) will decrease

(iii) remains unchanged

(iv) may increase or decrease depending on the relative values of  $D$  and  $\lambda$ .

(e) A spherical wave front arises from

(i) a point source

(ii) a slit

(iii) an extended source

(iv) a double slit

2. Answer **any five** of the following questions :

2×5=10

- (a) Calculate the velocity of sound in a gas in which two waves of wavelengths 5 m and 5.5 m produces 6 beats per second.
- (b) Fundamental frequency of a stretched string of length 50 cm and mass 10 gm is 300 HZ. What is the tension applied?
- (c) Write about plane wave briefly.
- (d) What are the conditions for sustained interference of light?
- (e) Mention two differences between Fresnel and Fraunhofer diffractions.
- (f) Write the conditions under which circular fringes are formed in Michelson interferometer.
- (g) Define wave front. Write any two properties of wave front.

3. Answer **any five** of the following questions :

5×5=25

- (a) Obtain the differential equation for the motion of transverse wave along a string.

(b) What do you mean by beats? Show that the number of beats produced per second is equal to the difference in the frequencies of the two surrounding bodies.

(c) A simple harmonic motion is represented by

$$Y = \left(10 \sin\left(10t - \frac{\pi}{6}\right)\right),$$

Here  $Y$  is measured in metres,  $t$  in seconds and the phase angle in radians. Calculate

- (i) Frequency
  - (ii) Time period
  - (iii) Maximum displacement
  - (iv) Maximum velocity
  - (v) Maximum acceleration
- (d) Explain a method to determine the wavelength of sodium light using Newton's rings.

- (e) What is half-period zone? Find the area of second half-period zone. What will be the area of third half-period zone?
- (f) What is diffraction grating? Give the theory of plane diffraction grating.
- (g) Write briefly about Fabry-Perot interferometer.
- (h) Derive an expression for the velocity of sound in a gaseous medium. On what factors, the velocity of sound in such medium depends.

4. Answer **any one** of the following questions :

10×1=10

- (a) Describe and explain diffraction due to a straight edge.

An object is placed at 20 cm from a zone plate and the brighter image is situated at 20 cm from zone plate. The wavelength of light wave is 4000 Å. Find the numbers of Fresnel's zones in a radius of 1 cm of the plate. 7+3=10

- (b) Write short notes on *any two* of the following : 5+5=10

- (i) Fizeau fringes  
(ii) Haidinger fringes  
(iii) Lissajous figures  
(iv) Fourier theorem