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3 (Sem-2/CBGS) PHY HC 2

2024

PHYSICS

(Honours Core)

Paper : PHY-HC-2026

(Waves and Optics)

Full Marks : 60

Time : Three hours

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

1. Answer the following questions: $1 \times 7 = 7$

(a) Who invented holography?

(b) What is the type of wavefronts for parallel rays of light in a homogeneous medium?

Contd.

(c) A sine wave is travelling in a medium. What is the minimum distance between two particles, always have the same speed?

(d) What is the ratio between the intensities of the fundamental and third harmonic in a string plucked at the mid point of its length?

(e) What will be the change in fringe width if the separation between the two slits in Young's double slit experiment is halved and that between slits and screen is doubled?

(f) Why is Newton's ring circular in shape?

(g) What is the resolving power of an optical instrument?

2. Answer the following questions : $2 \times 4 = 8$

(a) Write down the expression of wave travelling in negative direction along X-axis and having an amplitude $0.02m$, frequency 440Hz and velocity 330ms^{-1} .

(b) From Stokes' law, establish the relation $tt' = 1 - r^2$.

(c) A string when stretched by a weight of 4kg gives a note of frequency 250Hz . What weight will produce an octave in this note?

(d) What are the fringes of equal inclination? Explain in brief.

3. Answer **any three** of the following questions: $5 \times 3 = 15$

(a) What is a zone plate? Show that zone plate acts like a convex lens.

(b) Deduce an expression for pressure in a plane progressive wave.

(c) Obtain the positions of nodes and antinodes of a standing wave formed in a closed end organ pipe.

(d) What is Fresnel's diffraction? A strong parallel beam of light is incident on a thin plate having a small circular aperture. A screen placed very close to the plate in the beginning is moved slowly away from it. When it is at a distance of 0.3 m , the centre appears to be dark for the first time. Calculate the radius of the hole. Given $\tau = 5890\text{ A}$.

(e) What is angular dispersion in grating?

Mention the difference between grating spectrum and prismatic spectrum.

$$2+3=5$$

Ques 1

4. Answer any three of the following questions:

(a) Two simple harmonic motions act simultaneously on a particle at right angles to each other. Show that the path of the particle will be an ellipse when the two motions have the same period but different amplitude and initial phase. What happens when the phase difference between the motions is π ? What are the uses of Lissajous figures?

(b) What is standing wave? How can they be produced? Explain how nodes and antinodes are formed in standing wave. The third overtones of a closed pipe is found to be in unison with the first overtone of an open pipe. Find the ratio of the length of pipes?

(c) Discuss the distribution of intensity in the diffraction pattern due to a circular slit in Fresnel diffraction. What will happen when the incident wavefront is plane?

$$6+2+2=10$$

$$7+3=10$$

(d) Give the conditions necessary for observing interference of light. How are these satisfied in Fresnel bi-prism experiment? Explain clearly what will happen in interference pattern if white light is used in Fresnel bi-prism experiment.

Fringes are produced by a Fresnel bi-prism in the focal plane of an eyepiece which is 1 m from the centre of the slit. A lens is inserted between the bi-prism and eyepiece. gives two images of the slits are $4.05 \times 10^{-3}\text{ m}$ and in the other position $2.9 \times 10^{-3}\text{ m}$ apart. If the sodium light of wavelength $5893 \times 10^{-10}\text{ m}$ is used, find the distance between interference fringes.

$$2+2+3+3=10$$

(e) (i) Describe Lloyd's mirror experiment to determine the unknown wavelength of a monochromatic radiation.
(ii) Give the difference between bi-prism and Lloyd's mirror fringes.
(iii) State the condition for dark fringes formation in Lloyd's mirror experiment.

$$6+2+2=10$$

(f) Write short notes on *any two* of the following : $5 \times 2 = 10$

- (i) Zone plate
- (ii) Melde's Experiment
- (iii) Michelson's interferometer
- (iv) Hologram—its recording and reconstruction