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2 SEM TDC PHYH (CBCS) C 4

2023

(May/June)

PHYSICS

(Core)

Paper : C-4

(**Waves and Optics**)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct option from the following : 1×5=5

(a) The resultant amplitude due to superposition of harmonic waves expressed by $y = a\sin(\omega t - kx)$ and $y = a\cos(kx - \omega t)$ will be

(i) 0

(ii) a

(iii) $\sqrt{2}a$

(iv) $2a$

(Turn Over)

(2)

(b) Two periodic waves of amplitudes a and b pass through a region at the same time in the same direction. If $a > b$, then the difference in the maximum and minimum possible amplitudes is

(i) $a + b$

(ii) $a - b$

(iii) $2a$

(iv) $2b$

(c) The relation between path difference x and phase difference ϕ is

(i) $\phi = 2\pi\lambda x$

(ii) $\phi = \frac{2\pi}{\lambda} x$

(iii) $\phi = \frac{2\pi}{x\lambda}$

(iv) None of the above

(d) In Young's double-slit experiment with slit separation d , a monochromatic light of wavelength λ is used. The angular separation of the fringes is

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

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

(iii) $\frac{2\lambda}{d}$

(iv) $\frac{\lambda}{2d}$

(Continued)

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(3)

(e) 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 central fringe is white

(iv) None of the above

2. Answer the following questions : 2×5=10

(a) Distinguish between wave velocity and group velocity.

(b) How many beats per second will be heard if two sources of frequencies 512 Hz and 516 Hz are sounded simultaneously? What will be the time interval between the sounds of successive maximum intensity? 1+1=2

(c) Describe the principle of holography in brief.

(d) What are Haidinger's and Fizeau's fringes?

(e) Describe the term 'Rayleigh's criterion' in connection with resolution of images.

(Turn Over)

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3. Answer any *five* of the following : $6 \times 5 = 30$

- (a) What are Lissajous figures? A point moving on a plane is subjected to simple harmonic motions perpendicular to each other given by $x = A \cos \omega t$ and $y = B \cos(\omega t + \phi)$. Show that the general motion of the point is in an elliptical path. Under what condition will it move in a circular path? $1+3+2=6$
- (b) Discuss the variation of speed of sound with pressure, temperature and humidity. The ratios of specific heats of H_2 and CO_2 are respectively 1.4 and 1.3. Compare the velocities of sound in hydrogen (H_2) and carbon dioxide (CO_2). $3+3=6$
- (c) Describe how refractive index of a liquid can be found by Newton's rings method. Newton's rings are formed with reflected light of wavelength 5095 \AA with a liquid inserted between the lower surface of the planoconvex lens and upper surface of the plane glass plate. The diameter of the 5th bright ring is 0.3 cm and the radius of curvature of the planoconvex lens is 1 m. Calculate the refractive index of the liquid. $3+3=6$

- (d) What is an interferometer? What is sharpness of fringes? What is the advantage of using a Fabry-Perot interferometer over a Michelson's interferometer? Write down the expression for resolving power of a Fabry-Perot interferometer. $1+2+2+1=6$
- (e) Derive an expression for intensity in single-slit Fraunhofer's diffraction. Show that the intensity of diffraction maxima decreases with order number. $3+3=6$
- (f) Describe Huygens construction of half-period zone on a plane wavefront. Show that the area of each half-period zone is approximately equal. $3+3=6$
4. Write short notes on (any *two*) : $4 \times 2 = 8$
- (a) Newton's formula for velocity of sound
- (b) Fresnel's biprism
- (c) Missing orders in double-slit Fraunhofer's diffraction
