63 (FY)SEM–3/MAJ/PHYMAJ2024

2025

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 : 1×5=5

   (a) The velocity of sound in a gas in which two waves of wavelengths $5m$ and $5.5m$ produces 6 beats per second is

   (i) 330 *m/sec*

   (ii) 335 *m/sec*

   (iii) 336 *m/sec*

   (iv) 328 *m/sec*

(b) When a sound wave goes from one medium to another, the quantity that remains unchanged is

(i) frequency

(ii) amplitude

(iii) wavelength

(iv) velocity

(c) In a single slit diffraction, If I_0 is the intensity of central maximum, then the intensity of second secondary maximum is :

(i) $\approx \frac{I_0}{51}$

(ii) $\approx \frac{I_0}{61}$

(iii) $\approx \frac{I_0}{41}$

(iv) $\approx \frac{I_0}{31}$

(d) In Fabry Perot interferometer, the fringes are formed due to :

(i) division of wavefront

(ii) division of rays

(iii) division of amplitude

(iv) All of the above

(e) The shape of wavefront of a beam of parallel rays is

(i) spherical

(ii) plane

(iii) cylindrical

(iv) elliptical

2. Answer ***any five*** of the following questions : 2×5=10

(a) As in sound, can beats be observed by light source ? Explain.

(b) Explain the essential difference between interference and diffraction.

(c) What are the effects of humidity and temperature on the speed of sound in air ?

(d) Distinguish between wave velocity and group velocity.

(e) Explain briefly Huygen's principle of wave propagation.

(f) State Stoke's law in terms of phase change on reflection.

(g) Explain the meaning of Fresnel's half–period zones (elements).

(h) Define resolving power of a diffraction grating. On which factors does it depend ?

3. Answer ***any five*** of the following questions : 5×5=25

(a) State principle of superposition principle of waves. Two collinear simple harmonic motions acting simultaneously on a particle are represented as $y_1 = a\sin(\omega t + \phi_1)$ and $y_2 = b\sin(\omega t + \phi_2)$.

Show that the resultant motion of the particle is harmonic. Find the expression for amplitude and phase of the resultant motion in terms of a, b and ϕ. 1+2+2=5

(b) What are Lissajous figures ? Discuss the superposition of two simple harmonic motions of the same frequency but different amplitudes at right angles to each other. 1+4=5

(c) What are the basic essentials for the propagation of waves through a medium ? Find a relation between particle velocity and wave velocity. 2+3=5

(d) Write Newton's formula for velocity of sound in air and discuss Laplace's correction. At normal temperature and pressure the velocity of sound in air is 332 m/s. Find the velocity of sound in hydrogen at N.T.P. (Air is 16 times heavier than hydrogen) 1+2+2=5

(e) Give the theory and discuss in details how one can determine the wavelength of light used in Fresnel biprism method.

(f) Explain the principle and working of Michelson Interferometer.

(g) Describe the Fraunhofer diffraction at double slit.

(h) Discuss the theory and construction of a zone plate.

4. Answer ***any one*** of the following questions: 10×1=10

(a) Explain how Newton's rings are formed and show how from their study, the wavelength of monochromatic light can be determined. How the central ring can be made bright in Newton's rings experiment? In Newton's ring experiment, the radius of nth dark ring is 4 mm, and the radius of $(n+5)$th dark ring is 6 mm. If the radius of curvature of the lower surface of the lens is 10 $mt.$, find the wavelength of light used and the ring number n. 6+2+2=10

(b) Distinguish between stationary waves and progressive waves. Discuss analytically the formation of standing waves in a string of fixed length. Hence discuss the nodal point and antinodes. 2+6+2=10