

3 (Sem-1) PHY M 2 (O)

2 0 1 9

PHYSICS

(Major)

Paper : 1.2

Full Marks : 60

Time : 3 hours

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

SECTION—I

(Waves and Oscillations)

(Marks : 40)

1. (a) What is the phase relationship between particles lying between two consecutive nodes? 1
- (b) A particle vibrates in simple harmonic motion. Where will it have maximum acceleration? 1
- (c) What two factors determine wave speed along a stretched string? 1
- (d) What is Sabine's formula for reverberation time? 1

(2)

2. (a) The equation of motion of a particle is $x = 2 \sin\left(\frac{\pi t}{2} + \frac{\pi}{4}\right)$ cm. Find the period and the maximum velocity of the particle. 2
- (b) Define the intensity and energy density at a point in a plane wave of sound. 2
- (c) What is the intensity level in decibels of a sound wave whose intensity is 10^{-10} watt/cm²? Take the reference intensity as 10^{-16} watt/cm². 2
3. Answer any two questions : 5×2=10
- (a) Establish the differential equation of a simple harmonic oscillator and solve it. 2+3=5
- (b) Solve the three-dimensional wave equations in rectangular Cartesian co-ordinates using method of separation of variables. 5
- (c) Deduce the expression for the energy of a string vibrating transversely. 5

(3)

- Answer any two questions : 10×2=20
4. Derive and solve the differential equation of a forced harmonic oscillator. Obtain resonance condition. 3+5+2=10
5. State Fourier's theorem regarding expansion of a periodic function. What are its limitations? How are Fourier coefficients evaluated? 2+2+6=10
6. What is stationary wave? Distinguish a stationary wave from a progressive wave. Explain mathematically how a stationary wave is formed due to superposition of two waves. Show that the distance between two consecutive nodes is $\frac{\lambda}{2}$. 2+2+4+2=10
7. Derive an expression for velocity of longitudinal waves produced in a thin solid bar. Find the fundamental frequency of a bar clamped at two points each one-fourth of its length away from the ends, the rod being excited longitudinally. 7+3=10

(4)

SECTION—II

(Ray Optics)

(Marks : 20)

Answer any *four* questions : 5×4=20

8. State Fermat's principle of extremum path and use it to deduce Snell's law of refraction. 1+4=5
9. What is the advantage of using matrix method in paraxial optics? What is system matrix? Obtain the matrix for a thin lens placed in air and made of refractive index 1.5 and radii of curvature 50 cm each. 1+1+3=5
10. Deduce the expression for lateral magnification of image produced by a convex lens. 5
11. What are aplanatic points? Find the aplanatic foci for a spherical refracting surface. 1+4=5
12. Obtain the conditions for achromatism with two thin lenses when they are in contact. 5
