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. *(a)* The equation of motion of a particle is $x = 2\sin\left(\dfrac{\pi t}{2} + \dfrac{\pi}{4}\right)$ 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/cm^2? Take the reference intensity as 10^{-16} watt/cm^2.   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**)

(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

★ ★ ★