

2016

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)

Answer Question No. 1 and any five from the rest

1. (a) Define a stationary wave. 1
- (b) If two waves are represented by $x_1 = a \sin(\omega t + \pi/5)$ and $x_2 = a \cos(\omega t - \pi/3)$, then what is the phase difference between the two waves? 1
- (c) What is the ratio between the intensities of the first and fifth harmonics produced in a spring plucked at the midpoint? 1

(2)

- (d) Give an example of application of Fourier series analysis. 1
- (e) What is reverberation in sound wave? 1
2. Show that the direction of the acceleration and force are opposite to the direction of motion of the vibrating particle in simple harmonic motion. Calculate the total energy of a vibrating particles in simple harmonic motion. 3+4
3. (a) Two tuning forks A and B are of nearly equal frequencies. Frequency of A is 256. When the two tuning forks are used to obtain Lissajous figures, the complete cycle of changes takes place in 10 seconds. When the tuning fork B is loaded with a little wax, the time taken is 20 seconds. Calculate the frequency of B before loading. 4
- (b) Find whether the discharge of a condenser through the following inductive circuit is oscillatory :
- $C = 0.1 \mu\text{F}$, $L = 10 \text{ mH}$, $R = 200 \Omega$
- If it is oscillatory, find the frequency of oscillation. 3

4. (a) State the differences between transverse wave and longitudinal wave. 2
- (b) Determine the distribution of velocity and change in pressure in a plane progressive wave. Plot the displacement, velocity and the change in pressure to compare them. 3+2
5. (a) Obtain the positions of the nodes and antinodes of a standing wave formed in a closed-end organ pipe. 5
- (b) Give an example each of free, damped and forced oscillations. 2
6. (a) Calculate the velocity of sound in a gas in which two waves of wavelengths 1 meter and 1.01 metre produce 10 beats in 3 seconds. 3
- (b) What is the role of reverberation in constructing a good auditorium? Calculate the reverberation time of an auditorium of volume 5500 m^3 and absorbing surface area of 750 m^2 . [Given the average absorption coefficient is 0.5.] 2+2
7. Analyze, with the help of Fourier theorem, a periodic wave given by $f(t) = 1$ for $0 \leq t \leq T/2$ and $f(t) = 0$ for $T/2 \leq t \leq T$. Also plot the first three terms of the Fourier series. 5+2

8. (a) Deduce the expression for the energy of a string vibrating transversely. 5
- (b) Calculate the change in intensity level when the intensity of sound increases 200 times of its original intensity. 2
9. (a) Find the expression of velocity of a longitudinal wave in a thin solid bar. 5
- (b) Distinguish between phase velocity and group velocity. 2

SECTION—II

(Ray Optics)

(Marks : 20)

Answer any four questions

10. Using Fermat's principle, derive the formula $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ for a spherical mirror. 5
11. Using matrix method, find the matrix for combination of two lenses of focal lengths f_1 and f_2 and separated by a distance d in air. 5
12. Obtain the lens formula for a thick lens of thickness t . 5

13. Derive the relation between lateral magnification and longitudinal magnification of a lens system. 5
14. Show that spherical refracting surface is aplanatic with respect to certain position of the object. 5
15. (a) What do you mean by aberration in an optical system? 1
- (b) Distinguish between coma and astigmatism. 2
- (c) What is achromatic doublet? 2
