

Exam. Code : 103202

Subject Code : 1305

B.A./B.Sc. 2nd Semester

PHYSICS

Paper—B

(Vibration and Waves)

Time Allowed—Three Hours] [Maximum Marks—35

Note :— The question paper has **five** sections. Attempt all questions in Section A and **ONE** question each from Sections B, C, D and E.

SECTION—A

1. (a) What is the necessary condition for a particle for executing SHM ?
- (b) Define relaxation time of an oscillator.
- (c) What is the phase relation between velocity and acceleration in SHM ?
- (d) When is the power delivered to the oscillator by driving force maximum ?
- (e) What is the value of shape for 'in phase' and 'out of phase' mode of oscillation ?
- (f) How a dispersive medium is distinguished from a non-dispersive medium ?
- (g) Find the resonant frequency of an LC circuit containing $C = 2\mu\text{F}$ and $L = 20\text{H}$. $1 \times 7 = 7$

SECTION—B

2. (a) Define SHM. Derive the equation of motion of simple harmonic oscillator. Find an expression for total energy of harmonic oscillator. Prove that it is conserved. 5
- (b) A force of 4500 dyne stretches a vertical spring by 3 cm. Find the mass which should be suspended from this spring, so that system has an angular frequency of 5 rad/s. 2
3. (a) What is a compound pendulum ? Obtain an expression for its time period T. Prove that centre of oscillation and centre of suspension are interchangeable. 5
- (b) Prove that the velocity of a particle executing SHM at a distance of $\frac{\sqrt{3}}{2}$ of its amplitude from the centre is half of its velocity at mean position. 2

SECTION—C

4. (a) What is meant by logarithmic decrement and Q-factor of a damped oscillator ? Deduce their values. Show that lower the damping, the higher will be the quality factor. 4

(b) Show that the ratio of energy lost per cycle to the energy stored in a damped oscillator is $\frac{2\pi}{Q}$, where Q is the quality factor. 3

5. (a) What causes damping in simple harmonic electrical oscillator? Derive an equation of damped simple harmonic electrical oscillator and find its solution. Discuss different cases. 5

(b) Why coils of moving coil galvanometer, ammeter and voltmeters are wound on the metallic frame? 2

SECTION—D

6. (a) Show that the average power supplied to a forced oscillator is equal to the average power dissipated. 4

(b) What do you mean by amplification factor? Show that the displacement at low frequency is amplified by a Q factor at displacement resonance. 3

7. (a) Two LC circuits are coupled by mutual inductances. Discuss the behaviour of a coupled system and find the frequency of oscillation of the system. 4

(b) Show that in the resonant LCR circuit, the maximum potential drop across a capacitor occurs

at a frequency $\omega = \omega_0 \left(1 - \frac{1}{2Q^2}\right)^{\frac{1}{2}}$. 3

SECTION—E

8. (a) What do you mean by the characteristic impedance of a string ? Show that it is given by the product of the mass per unit length of the string and the wave velocity. 5
- (b) Define reflection and transmission coefficient of energy. How are they related ? 2
9. (a) Define the terms wave velocity and group velocity. Find the relation between wave velocity and group velocity. Is group velocity always greater than wave velocity ? 5
- (b) What is the need of impedance matching ? Define coupling element. What are the conditions for perfect coupling element ? 2