Sr. No 321103

December 2023

B.Sc. (Physics)- I SEMESTER

Waves and Oscillations (BPH23-103T)

Time: 3 Hours **Max. Marks:75**

Instructions:
1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART -A

Q1 (a) Why compound pendulum is superior to simple pendulum? (1.5)

(b) Define normal coordinates and normal modes. Do normal modes exchange energy with each other? (1.5)

(c) Calculate the displacement to amplitude ratio for a SHM when K.E is 90% of total energy. (1.5)

(d) A spring when compressed by 10 cm developed a restoring force of 10 N. A body of mass 4 Kg is attached to it. Calculate the compression of the spring due to the weight of the body and calculate the period of oscillation. (1.5)

(e) What are Lissajous figures? State its few characteristics. (1.5)

(f) Define a coupled oscillator. (1.5)

(g) What do you mean by driven harmonic oscillator? (1.5)

(h) Stationary waves are set up by the superposition of two waves given by: (1.5)

$Y_1 = 0.05 \text{ Sin } (5\pi t - x)$ and

$Y_2 = 0.05 \text{ Sin } (5\pi t + x)$

Where x and y are in meters and t in seconds. Find the amplitude situated at a distance x = 1m.

(i) Define longitudinal and transverse waves. Give examples. (1.5)

(j) Write one dimensional differential equation for wave motion. (1.5)

PART -B

Q2 (a) Obtain the expression of acceleration due to gravity for kater's pendulum. (8)

(b) Define centre of suspension and oscillation of a compound pendulum. Show that they are interchangeable. (7)

Q3 (a) State the principle of superposition and prove that it holds for linear differential equations. (5)

(b) What are beats? Give an analytical description of the phenomenon of beats. (10)

Q4 Establish the differential equation of motion for a damped harmonic oscillator (15)

and obtain an expression for displacement. Discuss the cases of heavy damping, critical damping and light damping.

Q5 (a) Define simple harmonic motion. Obtain the differential equation of motion and solution for simple harmonic motion. Write the expressions of kinetic energy, potential energy and total energy. Also show the labeled graphical representation of energies. (10)

(b) A particle vibrates with SHM of amplitude 0.06 m and time period 31.4 seconds. Calculate its maximum velocity. (5)

Q6 (a) Obtain an expression for the time period of a diatomic molecule. (12)

(b) Sodium chloride molecule vibrates with natural frequency 1.14×10^{13} Hz. Calculate the interatomic force constant for the molecule. Given: mass of sodium atom = 23 a.m.u and Cl atom = 35 a.m.u. (3)

Q7 Write short notes on the following: (15)

(a) Characteristics of in-phase and out-of-phase modes of vibration

(b) Sharpness of resonance

(c) Standing waves on a stretched string (both ends fixed)

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