

Mid-West University
Examinations Management Office

Final Examinations 2081

Bachelor level/ B. Sc. /3rd Semester

Time: 3 hours

Full Marks: 60

Pass Marks: 30

Subject: Oscillations, Waves and Acoustics (PHY431/331)

Candidates are required to give answer in their own words as far as practicable. The figures in the margin indicate full marks.

Group A

Long answer questions (attempt all)

[4x6 = 24]

1. Discuss the working of a compound pendulum and prove that the centers of suspension and oscillations are interchangeable. Find the conditions for maximum and minimum time-periods of this pendulum.
2. What are Lissajous figures? Explain with necessary theory, the superposition of two rectangular simple harmonic vibrations of equal frequencies but different amplitudes. Describe what happens if one of the vibrations changes in phase from 0° to 180° relative to the other.

OR

Define ultrasonic waves. Give two methods of their generation and explain their detection, properties and uses.

3. In a gaseous medium of density 1.25 kgm^{-3} , waves of angular frequency 10^4 rad/sec propagate with velocity $\frac{1}{3} \times 10^3 \text{ m/sec}$. If the intensity of the wave be $10^{-12} \text{ watt m}^{-2}$, find (i) bulk modulus of the medium, (ii) amplitude of waves and (iii) amplitude of the pressure variation.
4. What is Doppler's effect? Deduce the formula for the apparent pitch of a note when (i) both the source and the observer are moving along same direction, and (ii) both the source and the observer are moving in opposite directions.

Group B

Short answer questions (attempt all)

[6x4 = 24]

5. A simple harmonic oscillator of period 5 sec has 5 joules potential energy when its displacement is 2 cm (energy in rest position may be taken as zero). Calculate (i) force constant, (ii) average kinetic energy if the amplitude is 4 cm, (iii) kinetic and potential energies when the displacement is 1 cm, and (iv) oscillation frequency if mass is reduced to $1/100^{\text{th}}$ of its initial value.
6. A string of mass 2.0 gm/m carries progressive waves of amplitude 1.5 cm, frequency 60 sec^{-1} and speed 200 m/s . Calculate the energy per meter length of the wire, and the rate of energy propagation in the wire.
7. The intensity of sound of ordinary conversation is $1.154 \times 10^{-9} \text{ watts/cm}^2$. What is its intensity level?
8. A metallic rod 2 meters long is firmly clamped in the middle and one end is stroked by a resin cloth. What is the pitch of the note which you will hear? Young's modulus is equal to $20 \times 10^{11} \text{ dynes/cm}^2$ and density = 10 gm/cm^3 .

9. Calculate the velocity and the wavelength of the longitudinal waves of frequency 400 vibrations/sec in a rod of material of density 5 gm/cm^3 and young modulus $8.0 \times 10^{11} \text{ dynes/cm}^2$.
10. Discuss the possible modes of vibration of a string of finite length fixed at both ends.

OR

A closed brass pipe emits a note of frequency 512 Hz at 0°C . If the coefficient of linear expansion of brass is 1.87×10^{-5} per $^\circ\text{C}$, determine the pitch of the note at 20°C .

Group C

Very short answer questions (*any six*)

[6x2 = 12]

11. What is potential well? At what positions of a small oscillator does it gain maximum kinetic and Potential energies in the potential well?
12. Define principal features of musical sound.
13. Distinguish between echo and reverberation.
14. Establish the relation between particle velocity of medium and phase velocity of wave.
15. How does the velocity of sound depend on density, temperature and wind?
16. Express the time period, wave number and amplitude of a particle in S. H. M.
17. What is resonance? How does it help to measure velocity of sound?
18. Say torsional pendulum and express its time period.

The End