SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2017

(CUCBCSS—UG)

Core Course—Physics/Applied Physics

PHY 2B 02 / APY 2B 02—PROPERTIES OF MATTER, WAVES AND ACOUSTICS

Time : Three Hours   Maximum : 80 Marks

Section A

Answer all questions.

1 mark each.

1. The Young's modulus of a wire of length L and radius 'r' is Y Nm^{-2}. If the length is reduced to L/2 and radius r/2, its Young's modulus will be ————.

2. The value of Poisson's ratio cannot be :

    (a) 0.01.

    (b) 0.1.

    (c) 0.4.

    (d) 0.6.

3. When the amplitude of a particle executing simple harmonic motion increases, the time period ————.

4. The maximum possible acceleration for a simple harmonic oscillator is ————.

    (a) $\omega^2 a$.

    (b) $\omega\sqrt{a^2 - x^2}$.

    (c) ωa.

    (d) ωa^2.

5. Write an expression for the quality factor ?

6. In a simple harmonic motion, when the displacement is one half the amplitude, what fraction of the total energy is kinetic ?

    (a) 0.

    (b) $\frac{1}{4}$.

    (c) $\frac{1}{2}$.

    (d) $\frac{3}{4}$.

7. Write the relation between wave velocity and group velocity of a wave ?

8. What is the frequency of second overtone, if the fundamental frequency of vibration for a transverse wave is 'n' ?

9. Which of the following expressions is that of a progressive wave ?

   (a) $a\sin(\omega t - kx)$.   (b) $a\sin \omega t$.

   (c) $a\cos kx$.   (d) $a\sin \omega t \cos kx$.

10. The loudness of sound is related to ——————— of the sound wave.

$(10 \times 1 = 10 \text{ marks})$

Section B

Answer all questions.
Write in two or three sentences.
2 marks each.

11. Derive a relation for workdone per unit volume in shearing strain.

12. Define the three modulii of elasticity.

13. Discuss the vibrational states of a diatomic molecule.

14. Give the theory of forced harmonic oscillator.

15. What do you mean by energy density of a plane progressive wave ?

16. Give the general equation of a wave motion. What is its significance ?

17. State sabine's reverberation formula.

$(7 \times 2 = 14 \text{ marks})$

Section C

Write any five questions.
Write in one paragraph.
4 marks each.

18. (a) Define flexural rigidity.

    (b) Find the workdone in a twisting cylinder.

19. Find an expression for the bending moment of a horizontal beam clamped at one end and loaded at the other ?

20. Derive the expression for KE and PE of a simple harmonic oscillator.

21. Derive the expression for average power dissipation for a damped harmonic oscillator.

22. Obtain the expression for period of a simple pendulum.

23. Prove that variation of pressure in the case of a longitudinal progressive wave travelling through

a gas is given by $P = -E \dfrac{dy}{dx}$.

24. Write a brief note on acoustics of buildings.

$(5 \times 4 = 20 \text{ marks})$

Section D

Solve any **four** *problems.*
4 marks each.

25. Find the stress to be applied to a steel wire to stretch it by 0.25% of its original length. Young's modulus for steel is 90 GPa.

26. Find the amount of workdone in twisting a steel wire of radius 10^{-3} m and length 0.25 m through an angle of 45°. The rigidity modulus of the material of the wire is $8 \times 10^{10} \text{N/m}^2$.

27. A particle executing simple harmonic motion has an acceleration 0.03 m/s² when its displacement is 0.09 m. Find the time period of oscillation ?

28. A particle in simple harmonic motion has velocity values 6 m/s and 5 m/s when its distance from the equilibrium positions are 2 cm and 3 cm respectively. Find the amplitude and frequency of oscillation ?

29. If the potential energy of a harmonic oscillator in its resting position is 5 joules and the total energy is 9 joules, when the amplitude is 1 m, what is the force constant ? If it's mass is 2 kg, what is the period ?

30. If in air, a plane wave of frequency 256 Hz and amplitude $\dfrac{1}{1000}$ mm is produced, calculate the

radiated energy per unit volume and the energy current. Density of air $= 1.29 \text{ kg/m}^3$ and velocity of sound in air is 332 m/s.

31. Calculate the change in intensity level when the intensity of sound increases 100 times its original intensity.

$(4 \times 4 = 16 \text{ marks})$

Turn over

Section E

32. With relevant theory, explain how the Young's modulus of the material of a cantilever can be determined?

33. Deduce the differential equation for a damped harmonic oscillator and discuss in the cases of critical damping and under damping.

34. State fourier's theorem. Give the conditions for the applicability of fourier's theorem. Apply it to a sawtooth wave.

35. Discuss the production, properties and applications of ultra sonics. How are they detected?

$(2 \times 10 = 20$ marks$)$