## SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2018

### (CUCBCSS–UG)

#### 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.*
*Each question carries 1 mark.*

1. The apparatus used to find the rigidity modulus of the material of a wire is ————.

2. Poisson's ratio for steel if its Young's modulus is $2 \times 10^{11}$ N/m.$^2$ and rigidity modulus is $8 \times 10^{10}$ N/m.$^2$ is :

    (a) 0.25.                                    (b) 0.15.

    (c) 0.35.                                    (d) 0.1.

3. For an undamped oscillator, the quality factor is ————.

4. At what displacement, the energy of a harmonic oscillator becomes half kinetic and half potential.

5. Give one example for a damped harmonic oscillator.

6. Which of the following is not an example for linear sample harmonics motion ?

    (a) Vibration of atoms and molecules.

    (b) Vibration of a tuning fork.

    (c) Oscillations of a simple pendulum.

    (d) Oscillations of a freely suspended magnet in a uniform magnetic field.

7. The velocity of transverse waves in a stretched string is given by ————.

8. ———— is transmitted by a wave.

    (a) Amplitude.                               (b) Velocity.

    (c) Energy.                                  (d) Momentum.

9. Give the expression for intensity of a sound wave when expressed in terms of pressure amplitude $P_0$, velocity $v$ and density of air $\rho$.

10. The phenomenon of polarization is not observed in sound because, sound is ———— wave.

                                                         (10 × 1 = 10 marks)

## Section B

*Answer all questions in two or three sentences.*
*Each question carries 2 marks.*

11. Define ultimate strength or the tensile strength of the wire.

12. What is meant by twisting couple ?

13. What are damped and forced oscillations ?

14. Obtain the differential equation representing the oscillations of a driven harmonic oscillator.

15. What is a plane progressive harmonic wave ?

16. State Fourier theorem.

17. State and define unit of sound intensity.

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

## Section C

*Answer any five questions in one paragraph.*
*Each question carries 4 marks.*

18. Derive the expression for the period of oscillation of a torsion pendulum.

19. (a) Derive an expression for the bending moment.

    (b) Why the girders are I-section form ?

20. What is anharmonic oscillator ? Derive an expression for the time period of oscillation of an anharmonic oscillator.

21. Assuming the results of forced oscillations, discuss the sharpness of resonance.

22. Discuss the cases of critical damping and under damping.

23. Discuss the modes of transverse vibrations of a string.

24. What are the requirements of a good auditorium ?

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

## Section D

*Solve any four problems.*
*Each question carries 4 marks.*

25. A metal disc of diameter 0.1 m. and mass 1.2 kg. is fixed symmetrically to the lower end of a torsion wire of length 1 m. and diameter $1.44 \times 10^{-3}$ m., the upper end of which is fixed. The time period of torsional oscillation is 1.98 seconds. Calculate the rigidity modulus of the material of the wire.

26. A metal bar 0.01 m. square in section and 0.6 m. long is firmly clamped horizontally at one end and a weight of 1.4 kg. is applied at the free end. Calculate the depression produced. Young's modulus of the material = $9.9 \times 10^{10}$ $Nm^{-2}$.

27. Calculate the displacement of a body executing simple harmonic motion in terms of its amplitude at which the KE = $3 \times$ PE.

28. A body having a mass of 4 g. executes simple harmonic motion. The force acting on the body, when displacement is 8 cm., is 24 gm. wt. Find the period.

29. A particle of mass 10 g. lies in a potential field $V = 50 x^2 + 100$ ergs/gm. Deduce the frequency of oscillation.

30. The frequency of the fourth harmonic in a stretched string of length 20 cm. is 600 per sec. What is the velocity of the wave in the string ?

31. If the intensity of sound wave is increased by a factor of 20, by how many decibels is the sound level increased.

$(4 \times 4 = 16$ marks)

## Section E

*Answer any **two** questions.*
*Each question carries 10 marks.*

32. Obtain an expression for couple per unit twist of a wire. Explain how the rigidity modulus of a wire can be determined using a torsion pendulum.

33. Deduce the equation for the simple harmonic motion of a particle. Show that the resultant of two simple harmonic motions having the same period but different phase and amplitude are acting in the same direction on a particle is simple harmonic. What are the uses of Lissajous figures ?

34. Derive an expression for a plane progressive harmonic wave. Derive the expression for energy density and energy current for such a wave.

35. What are ultrasonic waves ? Explain the production of ultrasonic wave by piezoelectric crystal method. What are the applications of ultrasonic waves ?

$(2 \times 10 = 20$ marks)