D2BPH1801 (S4)　　　　　　　(PAGES 2)　　　　　　Reg. No...........................

Name: ....

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2023

(Supplementary – 2018 Admission)

PHYSICS

APHY2B02T: PROPERTIES OF MATTER, WAVES AND ACOUSTICS

Time: 3 Hours　　　　　　　　　　　　　　　　Maximum Marks: 80

SECTION A: Short answer: Answer *all* questions. Each carries *one* mark.

1. Define compressibility.

2. What is meant by simple harmonic motion? Give an example.

3. Write down the differential equation for a forced harmonic oscillator.

4. What is meant by Quality factor?

5. What are the limiting values of Poisson's ratio?

6. Write down the expression for energy density of a progressive wave.

7. A progressive wave in a stretched string is described by the equation $y = A\,Sin(kx - \omega t)$. Find the maximum particle velocity.

8. List any two factors affecting the acoustics of buildings.

(8 x 1 = 8 Marks)

SECTION B: Paragraph Answer any *six*: each carries *four* marks.

9. Derive the energy stored in a wire of length L and cross-sectional area A that has been stretched by a force F?

10. Derive an expression for the internal bending moment of a beam.

11. In S.H.M,when the displacement is one-half the amplitude, what fractions of the total energy are kinetic and potential? At what displacement, energy is half kinetic and half potential? Explain.

12. Discuss the variation of energy of a Simple harmonic Oscillator with displacement.

13. Set up the differential equation of a damped harmonic oscillator.

14. Explain the theory of oscillations in a Ballistic Galvanometer.

15. Discuss the modes of transverse vibrations of string.

16. Derive the relation between group velocity and phase velocity.

17. Describe in detail any method of production of ultrasonic waves.

(6 x 4 = 24 Marks)

(PTO)

SECTION C: Numerical Problems. Answer any *eight*. Each carries *four* marks.

18. Calculate the rigidity modulus for silver, given that Young's modulus and Bulk modulus for silver are $7.25 \times 10^{10} N/m^2$ and $11 \times 10^{10} N/m^2$ respectively.

19. What torque must be applied to a wire one metre long ,1mm in diameter in order to twist one end of it through $90°$, the other end remaining fixed? The rigidity modulus of the wire is $2.8 \times 10^{10} N/m^2$.

20. Calculate the depression at the free end of a rectangular cantilever of length 60cm loaded with 0.2kg; breadth=2cm;thickness=1cm; Young's modulus of the material of the beam is $10 \times 10^{10} N/m^2$.

21. A body having a mass 4gm executes S.H.M. The force acting on the body,when the displacement is 8cm, is 24gm wt. Find the period. If the maximum velocity is 500cm/s, find the amplitude and maximum acceleration($g = 9.8 \, m/s$).

22. If the potential energy of a harmonic oscillator in its restoring position is 5J and the total energy is 9J, when the amplitude is 1metre, what is the force constant? If its mass is 2kg, what is the period?

23. A pendulum is constructed from a light string of length 10m and a heavy mass 1kg (i) Calculate the period of the pendulum for small oscillations (ii) Calculate the approximate change in this value ,if the amplitude of oscillation is $60°$.

24. What is the frequency of electrical oscillations in an inductance of 10mH in series with a capacitance of $2\mu F$.If the maximum potential difference across the condenser is 5V, find the energy of the oscillating system.

25. If the suspension of a galvanometer coil exerts a restoring couple $5 \times 10^{-5} N - m/rad$, the period is 6.28 seconds and the amplitude decreases to $1/10^{th}$ of its original value in 92 seconds,find the value of I, γ and Q factor.

26. Find the frequency, period and wave number for a light of wavelength 6000Å.

27. A metal wire of mass 9.8gm is stretched with a tension of 10kg-wt between two rigid supports one metre apart. The wire passes at the middle point between the poles of a permanent magnet and it vibrates in resonance when carrying an alternating frequency f cycles/sec. Calculate f.

28. Prove that $y = (x - vt)^2$ is the solution of one-dimensional wave equation.

29. A piezoelectric X-cut quartz plate has a thickness of 1.5mm.If the velocity of propagation of longitudinal sound waves along the X direction is 5760m/s,calculate the fundamental frequency of the crystal.

(8 x 4 = 32 Marks)

SECTION D: Long answer questions. Answer any *two*. Each carries *eight* marks.

30. Describe with theory how a torsion pendulum can be used to determine the rigidity modulus of a wire.
31. Explain the theory of formation of Lissajous Figures.
32. State Fourier Theorem.Determine the values of Fourier co-efficients.
33. Define reverberation time. Derive Sabine's formula for reverberation time.

(2 x 8 = 16 Marks)