DCPH – 501

V Semester B.Sc. Degree Examination, February/March 2024
(NEP Scheme) (Freshers)
PHYSICS
Paper – V : Classical Mechanics and Quantum Mechanics – I

Time : 2½ Hours Max. Marks : 60

***Instruction** : Answer **all** Parts.*

PART – A

Answer **any four** of the following. **Each** question carries **two** marks. **(4×2=8)**

1. State the principle of virtual work.
2. Define degrees of freedom.
3. Are mass and energy are equivalent relativistically ? Justify.
4. Photoelectric effect is an instantaneous process. Explain.
5. What is the significance of a wave function ?
6. Is the energy of a particle in a box quantised ? Explain.

PART – B

Solve **any four** of the following. **Each** problem carries **five** marks. **(4×5=20)**

7. If $F = (2xy + z^2)\,\hat{i} + x^2\,\hat{j} + 2xz\,\hat{k}$ newton, then show that it is conservative. Calculate the workdone by the force in moving the particle from (0,1,2) to (5,2,7)m.
8. Obtain the equation of motion of a simple pendulum by using Lagrangian method.
9. At what speed the mass of the particle will be double its value at rest. Velocity of light 3×10^8m/s.
10. Compare the de'Broglie wavelength of an electron and proton moving with a velocity of 2×10^6m/s. Mass of electron = 9.1×10^{-31}kg, mass of proton = 1.67×10^{-27}kg.

P.T.O.

11. The wave function of a particle confined to a box of side 'L' is given by $\psi_n(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi}{L}\right) x$ for $0 < x < L$ and $\psi_n(x) = 0$ else where. Calculate the probability of finding the particle in the range $0 < x < L/2$.

12. Calculate the zero point energy and the spacing of the energy levels for a linear harmonic oscillator with the period of oscillation 1 ms.

PART – C

Answer **any four** of the following. **Each** question carries **eight** marks. **(4×8=32)**

13. a) Show that linear momentum and angular momentum are conserved for a system of particles.

    b) State D′ Alembert's principle. **(6+2)**

14. Describe with necessary theory of Michelson-Morley experiment.

15. a) State the postulates of special theory of relativity.

    b) Define proper length and obtain an expression for length contraction. **(2+6)**

16. Explain the failure of classical mechanics to explain,

    i) Black body radiation and

    ii) Photoelectric effect. **(4+4)**

17. a) State Heisenberg's uncertainty principle.

    b) Describe γ-ray microscope experiment with necessary theory. **(2+6)**

18. a) Mention any two postulates of quantum mechanics.

    b) Derive Schrodinger's time dependent equation for a free particle. **(2+6)**