



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)

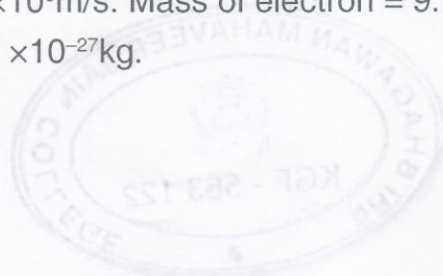
1. State the principle of virtual work.
2. Define degrees of freedom.
3. Are mass and energy are equivalent relativistically ? Justify.
4. Photoelectric effect is an instantaneous process. Explain
5. What is the significance of a wave function ?
6. Is the energy of a particle in a box quantised ? Explain.



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  $3 \times 10^8$ m/s.
10. Compare the de'Broglie wavelength of an electron and proton moving with a velocity of  $2 \times 10^6$ m/s. Mass of electron =  $9.1 \times 10^{-31}$ kg, mass of proton =  $1.67 \times 10^{-27}$ kg.



P.T.O.



11. The wave function of a particle confined to a box of side 'L' is given by

$$\psi_n(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi}{L}x\right) \text{ for } 0 < x < L \text{ and } \psi_n(x) = 0 \text{ else where. Calculate the probability of finding the particle in the range } 0 < x < L/2.$$

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  $\gamma$ -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)**

