Reg. No ..... Name **25U549**

B. Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2025

SEMESTER 5 : PHYSICS

COURSE : **19U5CRPHY06 : CLASSICAL AND QUANTUM MECHANICS**

(For Regular 2023 Admission and Supplementary 2022/ 2021/ 2020/ 2019 Admissions)

Time : Three Hours Max. Marks: 60

PART A

Answer any 8 (2 marks each)

1. If ϕ represent the wave function of a state. Write the expression of its probabilty current density.
2. Mention the advantages of Lagrangian approach over Newtonian approach.
3. Determine the degrees of freedom in the following cases i) a particle moving on a space curve ii) 4 particles moving freely in space.
4. State Bohr's Correspondence principle.
5. Briefly explain the principle of virtual work.
6. Define the expectation value of an operator. Give the expression for the same.
7. Differentiate, commuting and anti commuting operators.
8. What do you mean by stationary states.
9. Compton effect confirms the localisation of momentum of electron. Justify.
10. Prove that the probabilty density of a particle in a superpostion state depends on time.

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. State any three properties of orthogonal functions.
12. Find the probability that a particle trapped in a box L wide can be found between 0.8 L and 0.9 L for the ground state.
13. An electron and a proton have same amount of kinetic energy. Which of the two possess greater wavelength. Why?
14. Derive the Hamilton's equations of motion.
15. The uncertainity in the velocity of a particle is equal to its velocity. Show that uncertainity in its position is equal to 2π times its de - Broglie wavelength.
16. Deduce the relation between group and phase velocity. Explain.
17. Obtain the energy eigen values and eigen functions of a particle trapped in the potential V(x) = 0, for 0≤ x ≤ a, V (x) = α otherwise.
18. Discuss the terms (1) Probability current density (2) Orthogonality of wave function.

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. The normalized wave function of a particle is ψ(x) = A exp { iαx -ibt }, where, A, α & b are constants. Evaluate the expectation value of its position and momentum.
20. Discuss Davisson Germer experiment as a verification of the de' Broglie hypothesis.

21. Obtain the Schrodinger equation for a one dimensional simple harmonic oscillator. Give expressions for the energy eigen values.

22. Explain generalized coordinates. Find the Lagrange's equation of motion for a particle moving under the influence of a central force.

(10 x 2 = 20)