

B. Sc. DEGREE END SEMESTER EXAMINATION : NOVEMBER 2023**SEMESTER 5 : PHYSICS****COURSE : 19U5CRPHY06 : CLASSICAL AND QUANTUM MECHANICS***(For Regular 2021 Admission and Supplementary 2020/2019 Admissions)*

Time : Three Hours

Max. Marks: 60

PART A**Answer any 8 (2 marks each)**

1. Define ultra violet catastrophe.
2. Determine the number of degrees of freedom in the following cases i) three particles connected by three rigid massless rods ii) 2 particles moving freely in space.
3. What is an operator? Give the expression for momentum operator.
4. State de- Broglie hypothesis.
5. State Planck's Radiation Law.
6. Determine the number of degrees of freedom in the following cases i) A particle moving on a space curve ii) 2 particles moving freely in space.
7. Draw the energy density versus frequency spectrum of a black body for any two temperatures.
8. What is meant by degeneracy of a quantum state.
9. What is the value of probability current density, when the wave function is real.
10. State D'Alembert's principle.

(2 x 8 = 16)**PART B****Answer any 6 (4 marks each)**

11. Find the Hamilton's equations of motion for a harmonic oscillator.
12. The wavefunction of a particle confined in a box of length 'a' is $\psi(x) = \sqrt{2/a} \sin(\pi x/a)$, $0 \leq x \leq a$. Calculate the probability of finding the particle in the region $0 \leq x \leq a/2$
13. Briefly explain i) generalized coordinates ii) degrees of freedom? Also determine the degrees of freedom of 4 particles moving freely in space.
14. The uncertainty in the velocity of a particle is equal to its velocity. Show that uncertainty in its position is equal to 2π times its de - Broglie wavelength.
15. Prove that any two eigen functions of a Hermitian operator that belongs to different eigen values are orthogonal.
16. Find the Hamilton's equations of motion for a simple pendulum.
17. Calculate the group and phase velocity of a proton, whose de- Broglie wavelength is 1 nm.
18. Find the energy of an X-ray photon which can impart a maximum energy of 50 KeV to an electron.

(4 x 6 = 24)**PART C****Answer any 2 (10 marks each)**

19. Outline different postulates of quantum mechanics.
20. Obtain the Schrodinger equation for a particle moving in a time independent potential.

21. Explain generalized coordinates. Find the Lagrange's equation of motion for a particle moving under the influence of a central force.
22. Discuss Compton effect. Derive expression for Compton shift.

(10 x 2 = 20)