

Reg. No

Name

24U524

B.Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2024

SEMESTER 5 : PHYSICS

COURSE : 19U5CRPHY06 : CLASSICAL AND QUANTUM MECHANICS

For Regular 2022 Admission and Supplementary 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 probability current density.
2. Briefly explain the principle of virtual work.
3. Define ultra violet catastrophe.
4. Differentiate, anti commuting and non commuting operators.
5. What do you mean by stationary states.
6. What is the physical significance of a wave packet.
7. Determine the number of degrees of freedom in the following cases i) three particles connected by three rigid massless rods ii) a particle moving freely in space.
8. Define commutator relation of two operators.
9. Contrast phase velocity and group velocity of a wave packet.
10. 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 a plane.

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. Prove that any two eigen functions of a Hermitian operator that belongs to different eigen values are orthogonal.
12. An electron is confined to a one dimensional box of width 100nm. Calculate the minimum uncertainty in its momentum.
13. Calculate the group and phase velocity of a proton, whose de- Broglie wavelength is 1 nm.
14. The threshold wavelength of photo electric emission in tungsten is 230 nm. What wavelength of light must be used in order for electrons with maximum energy of 1.5 eV to be ejected.
15. Outline the various admissibility conditions of a wave function of a system.
16. An electron in a one dimensional infinite potential well goes from $n=2$ to ground state, the frequency of emitted photon is 2.13×10^{14} Hz. Find the width of the box.
17. What are generalised coordinates? What are the advantages of using generalised coordinates?
18. State and explain D'Alembert's principle.

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. What is Hamilton's principle? Derive Lagrange's equation from Hamilton's principle for a system in which the Lagrangian is not an explicit function of time.
20. Outline different postulates of quantum mechanics.
21. Derive the Schrodinger equation and energy eigen values for a particle trapped in a infinite potential well of length L.
22. Deduce Planck's radiation law for black body radiation spectrum.

(10 x 2 = 20)