23108097

QP CODE: 23108097

Reg No : .....

Name : .....

B.Sc DEGREE (CBCS) SPECIAL SUPPLEMENTARY EXAMINATIONS, APRIL 2023

Fifth Semester

CORE COURSE - PH5CRT06 - CLASSICAL AND QUANTUM MECHANICS

Common for B.Sc Physics Model I, B.Sc Physics Model II Applied Electronics, B.Sc Physics Model II Computer Applications & B.Sc Physics Model III Electronic Equipment Maintenance

2020 Admission Only

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Time: 3 Hours Max. Marks : 60

Part A

*Answer any **ten** questions.*

*Each question carries **1** mark.*

1. How many degrees of freedom are there for a system moving freely in a plane surface?
2. Write the lagrangian for a one dimensional harmonic oscillator which consists of a spring with spring constant k, with a mass m and which makes a displacement x.
3. Write down one difference between Hamiltonian formulism and Newtonian formulism.
4. Write down the transformation equation for a linear harmonic oscillator in tranforming from Lagrangian to Hamiltonian.
5. Distinguish between phase velocity and group velocity.
6. Find the eigen functions of the operator d/dx if its eigen value is 5.
7. Hermitian operators are often used in quantum mechanics. Why?
8. Write down the operators corresponding to energy and momentum.
9. State and explain Max Born's probability interpretation of wavefunction.
10. Brief the essential requirements on a wave function.
11. Write down the equations of Ehrenfest theorem.

12. When do you say two functions are orthonormal?

(10×1=10)

Part B

*Answer any **six** questions.*

*Each question carries **5** marks.*

13. Discuss the concept of generalized coordinates with illustrations.

14. Use the principle of virtual work done to obtain the equation of motion of a simple harmonic oscillator.

15. Define the Hamiltonian. When is it equal to the total energy of the system? When is it conserved?

16. What are the differences between Rayleigh-Jeans formulation and Planck's formulation of black body radiation?

17. A 100 MeV photon collides with a proton at rest. What is the maximum possible energy loss for the photon?

18. A stopping potential of 0.82 V is required to stop the emission of photoelectrons from the surface of a metal by light of wavelength $4000A^{o}$. For light of wavelength $3000A^{o}$, the stopping potential is 1.85V. Find the value of the Planck’s constant.

19. An electron is confined to move in cubical box of side 0.1 nm. Calculate the minimum uncertainty in its velocity.

20. Discuss the admissibility conditions on wave function.

21. A particle constrained to move along x-axis in the domain $0 \leq X \leq L$ has a wave function $\Psi(x) = \text{Sin}(n\pi x/L)$, where n is an integer. Normalize the wave function and evaluate the expectation value of its momentum.

(6×5=30)

Part C

*Answer any **two** questions.*

*Each question carries **10** marks.*

22. Obtain Lagrangian L from Hamiltonian H and show that it satisfies Lagrange’s equations of motion.

23. Explain de Broglie hypothesis. Discuss the Davisson-Germer experiment of electron diffraction.

24. Explain one experiment which shows the particle behaviour of light.

25. Setup the Schrödinger equation for a particle moving in a potential.

(2×10=20)