Reg. No…….. Name…… **19U505**

B. Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2019

SEMESTER **–5: PHYSICS (CORE COURSE)**

COURSE: **15U5CRPHY05: CLASSICAL AND QUANTUM MECHANICS**

(Common for Regular 2017 admission & Improvement 2016/Supplementary 2016/2015/2014 admission)

Time: Three Hours Max. Marks: 60

PART A (Very short answer questions)

*Answer **all** questions, each question carries **1** Mark*

1. Whenever the Lagrangian function does not contain a coordinate q_k explicitly, the generalized momentum p_k is a …….
2. What is meant by zero point energy?
3. State Heisenberg's uncertainty principle.
4. The wave associated with a particle in motion is called……..
5. If the generalized coordinate has the dimension of velocity, the corresponding generalized velocity has the dimensions of …….
6. The states for which the probability density is constant in time are called …… states.
7. Write a note on wave packet.
8. The number of degrees of freedom of a particle which is constrained to move along the circumference of a circle is …….
9. Write the quantum mechanical operator for momentum.
10. $[L_x, L_y] =$ (1 x 1 0 = 10)

PART B (Short answer)

*Answer **any Seven** questions, each question carries **2** Marks*

11. Explain the principle of least action.
12. What type of difficulties arise due to the constraints in the solution of mechanical problems and how these are removed?
13. Show that generalised momentum conjugate to a cyclic co-ordinate is conserved.
14. What is photoelectric effect?
15. Explain the physical interpretation of wave function.
16. How classical physics failed to account for the spectral distribution of energy density in a black body?
17. What is meant by degeneracy?
18. Distinguish between group velocity and phase velocity.
19. What is an operator? Give the expression for the energy operator. (2 x 7 = 14)

PART C (Problem/Derivations)

*Answer **any Four** question, each question carries **4** Marks*

20. Set up Lagrangian and Lagrange's equation for simple pendulum.
21. Apply the principle of least action to prove that the system for which the kinetic energy is conserved moves along the path for which the time of transit is extremum.
22. The uncertainty in the velocity of the particle is equal to its velocity. If $\Delta p.\Delta x \cong h$, show that the uncertainty in its location is its de brogile wavelength.
23. If a photon has wavelength equal to the Compton wavelength of the particle, show that the photon's energy is equal to the rest energy of the particle.
24. Arrive the value of L^2 and L_z in spherical polar coordinates.
25. The wave function of a particle confined in a box of length 'a' is $\psi(x) = \sqrt{\frac{2}{a}}\sin\frac{\pi x}{a}, \quad 0 \le x \le a$ Calculate the probability of finding the particle in the region $0 \le x \le \frac{a}{2}$.

(4 x 4 = 16)

PART D (Long answer questions)

*Answer **any Two** question, each question carries **10** Marks*

26. Derive Lagrange's equation for a conservative system as an extension of D' Alembert's principle.
27. Derive Hamilton's canonical equations of motion. Obtain Hamilton's equation of motion for linear harmonic oscillator.
28. Solve the problem of particle in a one dimensional box using Schrodinger equation.
29. Explain the Davisson-Germer experiment and write down the conclusions.

(10 x 2 = 20)

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