TB 374350 **Reg. No: .....**
Name: .....

B.Sc. DEGREE (C.B.C.S.S) EXAMINATION, OCTOBER 2016
SEMESTER V- PHYSICS
PHY5CQM- CLASSICAL AND QUANTUM MECHANICS

Time: Three Hours **Maximum: 60 Marks**

Part A

Answer all questions. Each question carries 1 mark

1. Determine the degrees of freedom for a system of N particles having k constraints.
2. Write down the principle of least action.
3. What are the generalised coordinates for a particle moving on the surface of a sphere.
4. What is the uncertainty relation for the angular momentum component L_z of a particle.
5. What are the conditions on wave function?
6. Write down the energy eigenvalue of a rigid rotator.
7. What is meant by stationary state?
8. What are anti-commuting operators?

(8x1=8)

Part B

Answer any six questions. Each question carries 2 marks

9. State the principle of virtual work.
10. What are constraints. Give example.
11. Obtain the Hamiltonian for a simple pendulum.
12. Show that the angular momentum of a particle moving under a central force is conserved.
13. What is meant by degenerate states?
14. State Bohr's correspondence principle.
15. Plot graphically the relation between stopping potential and frequency of photon in photoelectric effect.
16. What is the expression for the expectation value of energy operator?
17. Show that the Planck's radiation law reduces to Rayleigh-Jeans formula in the low frequency limit.

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18. Write down the time dependent Schrödinger equation for a free particle in three dimensions.

(6x2=12)

Part C

Answer any four questions. Each question carries 4 marks

19. Obtain the equation of motion of a one dimensional harmonic oscillator from Lagrange's equation.
20. Determine the phase and group velocities of the de Broglie waves of an electron moving with a speed of 0.95c.
21. Determine the eigenvalue for the Hamiltonian $H = -\frac{d^2}{dx^2} + x^2$ for the eigenfunction $xe^{-x^2/2}$
22. A metal of work function 3eV is illuminated by a light of wavelength $3000A^0$. Calculate the threshold frequency, the maximum energy of photoelectrons and the stopping potential.
23. What is D'Alembert's principle?
24. Prove $[x, p_x^2] = 2\hbar^2 \frac{\partial}{\partial x}$.

(4x4=16)

Part D

Answer any two questions. Each question carries 12 marks

25. State Hamilton's principle for a conservative system. Derive Lagrange's equation from Hamilton's principle.
26. What is Compton Effect? Obtain the expression for the wavelength of scattered photon.
27. Obtain the Schrödinger equation for a particle confined to a closed region within which the potential energy is zero and infinite everywhere else. Solve the equation for the energy of the particle and hence obtain the normalised wave function.
28. Starting from the angular momentum commutation relations obtain the eigenvalues of L^2 and L_z.

(2x12=24)