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# BACHELOR'S DEGREE (C.B.C.S.) EXAMINATION, FEBRUARY 2024 2021 ADMISSIONS SUPPLEMENTARY (SAY) SEMESTER V - CORE COURSE (PHYSICS) PH5B06B18 - Classical and Quantum Mechanics

Time: 3 Hours

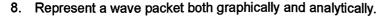
Maximum Marks: 60

#### Part A

#### I. Answer any Ten questions. Each question carries 1 marks

(10x1=10)

- 1. Give two examples for nonholonomic constraint.
- 2. What are generalized coordinates?
- 3. Compare the features of Hamiltonian and Lagrangian dynamics.
- 4. Mention the physical significance of Hamiltonian function.
- 5. Briefly describe photoelectric effect.
- 6. Outline the Rutherford planetary model of atom.
- 7. State the de- Broglie hypothesis.





- 10. Outline the various admissibility conditions on the wave function of a system.
- 11. Define a linear operator.
- 12. Graphically represent the first two eigenfunctions of a one-dimensional harmonic oscillator



#### Part B

#### II. Answer any Six questions. Each question carries 5 marks

(6x5=30)

- 13. Show that for equilibrium of a system, the virtual work of applied forces is zero.
- 14. Derive the equation of motion of Atwood's machine using Lagrangian dynamics.
- 15. Show that the shortest distance between two points in a plane is a straight line.
- 16. Explain Bohr's postulates with regard to hydrogen.
- 17. Obtain the expression for the de Broglie wavelength for a relativistic particle of mass m moving with the velocity of light.
- 18. Obtain the relation between particle velocity and the group velocity for a non relativistic particle.
- 19. Evaluate the probability current density of a spherical wave given by  $\Psi(r) = \frac{A}{r} \exp(ikr)$
- 20. If two functions  $\Psi_1$  and  $\Psi_2$  are the eigen functions belonging to the same energy eigen value  $E_1$ , show that their linear combination is also an eigen state having the same energy  $E_1$ .
- 21. For an electron in a one dimensional potential well of width 1 Å, calculate (i) the separation between the two lowest energy levels (ii) the frequency and wavelength of the photon corresponds to a transition between these two levels.

### Part C

## III. Answer any Two questions. Each question carries 10 marks

(2x10=20)

- 22. Derive Lagrange's equations using Hamilton's principle.
- 23. Give the Physical significance of Compton effect. Obtain an expression for Compton wavelength of a scattered photon.
- 24. Develop time dependent Schrodinger equation for a particle moving in a field.
- 25. Solve the Schrodinger equation for a particle in a one dimensional box and find out its energy eigen values.

