SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN
(AUTONOMOUS)
(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)
Chromepet, Chennai - 600 044.
M.Sc.Physics - END SEMESTER EXAMINATIONS - NOV' 2024
SEMESTER - I

22PPHCT1003 - Quantum Mechanics -I

Total Duration : 2 Hrs. 30 Mins. Total Marks : 60

Section B

Answer any **SIX** questions $(6 \times 5 = 30$ Marks)

1. Enlist the Postulates of quantum mechanics and interpretation of the wave function.
2. Derive the energy eigen value and eigen functions for a square well potential with rigid walls.
3. Outline Dirac's bra and ket notation. A conservation law implies the existence of a symmetry transformation for the system.
4. Obtain the matrix of Clebsch–Gordan coefficients for $j_1 = 1$ and $j_2 = 1$.
5. Briefly explain validity conditions of WKB approximation.
6. Discuss about the Schrodinger picture.
7. Explain briefly time independent perturbation theory in degenerate case.
8. Elaborate on the spin and Pauli matrices and their properties.

Section C

I - Answer any **TWO** questions $(2 \times 10 = 20$ Marks)

9. (i) Explain simple harmonic oscillator.
   (ii) Write about the reduction of two body problem.
10. Describe the (i) Interaction picture,
    (ii) Symmetries and conservation laws.
11. If the angular momentum operators obey the rule $[J_x,\ J_y] = -i\hbar J_z$ and similar commutation relations for the other components. Evaluate the commutators $[J^2,\ J_x]$ and $[J^2,\ J_+]$. What would be the roles of J_+ and J_- in the new situation?
12. Derive the ground state energy of the helium atom using variational principle and compare with the experimental result.

II - Compulsory question $(1 \times 10 = 10$ Marks)

13. State and prove the Ehrenfest's theorem.

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