M.Sc. DEGREE EXAMINATION – DECEMBER, 2019.

Second Year

Physics

QUANTUM MECHANICS

Time : 3 hours Maximum marks : 75

SECTION A — (5 × 3 = 15 marks)

Answer any FIVE questions.

All questions carry equal marks.

1. Explain Hilbert space.

2. Discuss briefly the validity condition of WKB approximation.

3. Explain time dependent perturbation theory.

4. Write short notes on spin angular momentum.

5. Explain the concept of negative energy states.

6. Write short notes on Born approximation.

7. Explain Sp^3 Hybridization.

8. What are number operators? Why are they called so?

SECTION B — (5 × 12 = 60 marks)

Answer ALL questions, choosing either (a) or (b).

9.   (a)   What is a unitary transformation? List the properties of unitary transformation. Show that $[x, p_x] = i\hbar$.

Or

(b)   Obtain the expressions for x, p and Hamiltonian matrices of one dimensional linear harmonic oscillator.

10.   (a)   Why the hydrogen atom in the ground state does not show a first order Stark effect? Obtain the expression for second order energy correction for hydrogen atom in ground state.

Or

(b)   What is adiabatic approximation? Derive an expression for probability for finding the system in the state $u_k(t)$.

11.   (a)   Derive the matrices for J_+, J_-, J_x and J_y.

Or

(b)   Derive the radial equation for an electron in a central potential.

12. (a) What are partial waves? Explain the asymptotic behavior of partial waves.

Or

(b) Outline the Heitler-London wave functions for hydrogen molecule.

13. (a) Obtain Einstein's A and B coefficients.

Or

(b) Derive the classical field equations in Hamiltonian form.

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