25131

M.Sc. DEGREE EXAMINATION, MARCH/APRIL 2019.

SECOND SEMESTER

Materials Science and Nanotechnology

Paper I — QUANTUM MECHANICS

Time : Three hours Maximum : 75 marks

(No additional sheet will be supplied)

PART A — (5 × 3 = 15 marks)

Answer any FIVE questions.

Each question carries 3 marks.

Each answer should not exceed 1 page.

1. Discuss quantum mechanical tunneling.

2. Explain Unitary transformation.

3. Obtain the commutation relations of L_X with L_+.

4. Discuss spin angular momentum.

5. Explain linear Stark effect in Hydrogen atom.

6. What is Fermi – Golden rule and write its significance?

7. Discuss the importance of Klein-Gorden.

8. Write the concept of negative energy states and spin of electron.

PART B — (4 × 15 = 60 marks)

Answer ALL questions.

Each question carries 15 marks.

Each answer should not exceed 6 pages.

9. (a) State and explain the postulates of quantum mechanics.

   (b) Solve Schrödinger's wave equation for a linear harmonic oscillator by operator method and obtain its eigen values.

Or

10. (a) Explain Dirac Bra and ket notation and discuss its importance.

    (b) Define Hermitian operators and show eigen values of Hermitian operator are real.

11. (a) Obtain eigen values and eigen function of L^2.

(b) Obtain the commutation relation of L_Y with L_Z.

Or

12. (a) Discuss addition of angular momentum.

(b) What are Clebsch Gordan coefficients? Obtain Clebsch Gordan coefficients for $J_1 = J_2 = 1/2$?

13. Discuss the time independent perturbation theory for a non-degenerate stationary system and apply it to an harmonic oscillator.

Or

14. Calculate the transmission probability of a particle through a potential barrier with the help of W.K.B method.

15. (a) Discuss probability current density basing on Klein–Gorden equation.

(b) What are the inadequacies of Klein – Gorden relativistic equation?

Or

16. (a) Obtain Dirac's relativistic equation for a free particle and explain the significance of Dirac's matrices.

(b) Discuss how the spin of electrons are explained by Dirac's equation.