SECTION B — (5 × 4 = 20 marks)

Answer ALL questions.

11. (a) Give any four properties of bra and ket vectors.

Or

(b) Explain Hillbert's space.

12. (a) Give the theory of time independent perturbation theory for non-degenerate case. Briefly explain the principle.

Or

(b) Discuss variation method to obtain the most suitable trial wave function for the system.

13. (a) Apply time dependent perturbation theory for the case of inelastic collision.

Or

(b) Explain sudden approximation. Bring out the differences between adiabatic and sudden approximations.

14. (a) Show that $[J^2, J_z] = 0$.

Or

(b) Show that $[J_z, J_\pm] = \pm \hbar J_\pm$ where $J_\pm = J_x \pm iJ_y$.

15. (a) Derive Klein Gordan equation.

Or

(b) State the properties of gamma matrices. (any four).

SECTION C — (5 × 8 = 40 marks)

Answer ALL the questions.

16. (a) Discuss the problem of harmonic oscillator by matrix mechanics method.

Or

(b) For the periodic potential, using Kronig–Penny model, obtain the necessary solutions.

17. (a) Discuss first order time independent perturbation theory for degenerate stationary state. Obtain corrected eigen function and eigen value.

Or

(b) Describe stark effect in Hydrogen. Derive expression for the energy separation ΔE between lines, in the spectrum.

18. (a) Derive expression for the transition probability between states for harmonic perturbation.

Or

(b) Discuss the problem of scattering of a particle by a potential.