13. (a) Explain harmonic perturbation.

Or

(b) Briefly outline the method of sudden approximation.

14. (a) Show that $[L_x, L_y] = i\hbar L_z$.

Or

(b) Show that $[J_x, J^2] = 0$.

15. (a) From K.G. relativistic equation, show that $P(x,t)$ does not represent probability density.

Or

(b) State any two properties of Gamma matrices.

SECTION C — ($5 \times 8 = 40$ marks)

Answer ALL questions.

16. (a) Describe with necessary theory, the harmonic oscillator problem on the basis of matrix mechanics. Evaluate eigen energy.

Or

(b) Obtain equation of motion in Dirac's picture. Bring out its important features.

17. (a) Discuss Helium atom problem on the basis of perturbation theory.

Or

(b) Obtain the solution for a particle in a slowly varying potential field by WKB method.

18. (a) Evaluate the perturbation parameter 'b' by considering first order time dependent perturbation theory.

Or

(b) Explain adiabatic approximation. Calculate transition probability coefficient 'a_n' for the same.

19. (a) If ψ_m is an eigen function of $\hat{L}_z$ with eigen value $m\hbar$ then the function $(\hat{L}_x + i\hat{L}_y)^\gamma \ \psi_m$ is also an eigen function of L_z with eigen value $(m \pm \gamma)\hbar$ where $\gamma = 0,1,2 \cdots$.

Or

(b) Show that the commutation rules are valid for the sum of two or any number of angular momenta. Discuss coupled representation.

20. (a) Explain probability density using Dirac's relativistic equation.

Or

(b) Explain hole theory.