17. (a) Deduce expression for the eigen energy value for a one dimensional anharmonic oscillator.

Or

(b) Obtain one dimensional solution for the slowly varying potential problem using WKB method.

18. (a) Derive expression for the transition probability of first order per unit time.

Or

(b) Derive expression for differential cross section for the inelastic scattering.

19. (a) Show that the total angular momentum operator $\hat{J}^2$ commutes with $\hat{J}_x$ and $\hat{J}_z$.

Or

(b) Find the eigen values of $\hat{J}^2$.

20. (a) Derive Klein Gordan equation. State the inadequacies of the theory.

Or

(b) Calculate spin orbit energy from Dirac's equations.

SECTION D — (2 × 10 = 20 marks)

21. (a) Explain matrix mechanics method of one dimensional linear harmonic oscillator and its solution.

Or

(b) Discuss how variation method is useful in evaluating energy values of a hydrogen atom.

22. (a) Calculate CG coefficients for

$j_1 = ½; j_2 = ½, m_1 = \pm ½;$ and $m_2 = \pm ½$.

Or

(b) Obtain the plane wave solutions for a Dirac's relativistic free particle.

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