(DPHY 03)

M.Sc. (PHYSICS) (Previous) DEGREE EXAMINATION :: MAY 2006

Paper - III : QUANTUM MECHANICS

Time: Three hours Maximum : 100 Marks

Answer Any FIVE Questions
All questions carry equal marks.

1. (a) With examples define linear operator. What are eigen functions and eigen values of an operator.
   (b) Define Hermitian operator. Show that the eigen functions of a Hermitian operator belonging to different eigen values are orthogonal.
2. (a) When the Hermitian operators A and B commute? Show that it is always possible to select a common complete set of eigen functions Lithum.
   (b) Solve the schrodinger equation moving in the potential defined as

$$v(x) = \begin{cases} v_0 & x < -a \\ 0 & -a < x < a \\ v_0 & x > a \end{cases}$$

3. (a) State and explain the expansion postulate.
   (b) Discuss the time independent perturbation theory for degenerate systems. Apply it to the ground state of Helium atom.
4. (a) Considering the effective atomic number as a variable parameter calculate the ground state energy of Helium atom.
   (b) Explain the principle you have used.
5. (a) Show that the components of angular momentum do not commute with are another and the operators $\hat{L}^2$ and $\hat{L}_3$. commute.

   (b) Find the common eigen functions and eigen values for $\hat{L}^2$ and $\hat{L}_3$.
6. (a) Define angular momentum. Give general theory and angular momentum.

   (b) Calculate Clesbsch - Gordan coeefficients for $j = \frac{1}{2}, j = \frac{1}{2}$.
7. (a) Derive Dirac relativistic equation for a free particle.
   (b) Obtain Dirac matrices in standard representation.
8. Answer any TWO of the following:
   (a) General uncertainty relation
   (b) Connection formulae and their explanation.
   (c) Pauli's spin matrices
   (d) Negative energy states.