

**FACULTY OF SCIENCE**

**M. Sc. I – Semester (CBCS / Non-CBCS) Examination, December 2013**

**Subject : Physics and Applied Electronics**

**Paper – III : Quantum Mechanics - I**

**Time : 3 Hours**

**Max. Marks: 80**

**Note :** Answer all questions from Part–A and Part–B. Each question carries 4 marks in Part–A and 12 marks in Part – B.

**PART – A (8 x 4 = 32 Marks)**  
(Short Answer Type)

1. Define and explain the parity operator.
2. Distinguish between degenerate and non-degenerate states.
3. Explain the equation of motion in the 'Schrodinger picture.
4. What are raising and lowering operators? Explain.
5. State and explain the space unitary operator.
6. Show that time reversal operator is an anti-linear operator.
7. Show that  $[J^2, J_x] = 0$ .
8. Define spin angular momentum and write Pauli spin matrices.

**PART – B (4 x 12 = 48 Marks)**  
(Essay Answer Type)

- 9.(a) Explain the physical significance of commuting and non-commuting operators.  
(b) Show that the eigen values Hermitian operator are real.

**OR**

- (c) Obtain the uncertainty relation between any two non-commuting operators.  
(d) State and prove any two basic commutation relations.

- 10.(a) What are stationary states? Explain.  
(b) Deduce the eigen values of linear harmonic oscillator by operator method.

**OR**

- (c) Obtain a solution of radial part of the Schrodinger equation for the hydrogen atom.

- 11.(a) Prove that angular momentum operator is the generator of infinitesimal rotation about an axis.  
(b) State and explain unitary inversion operator.

**OR**

- (c) Discuss the effect of time reversal operator for the spin zero and non-zero spin particles.

- 12.(a) Prove that  $[L_x, L_y] = i\hbar L_z$ .  
(b) Obtain eigen values of  $L^2$ .

**OR**

- (c) What are Clebsch - Gordon coefficients? Explain.  
(d) Calculate the Clebsch-Gordon coefficients for  $j_1 = j_2 = \frac{1}{2}$ .