

**FACULTY OF SCIENCE**

**M.Sc. I - Semester (CBCS/Non-CBCS) Examination, December 2014**

**Subject : Physics / 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 Show that the momentum operator is Hermitian.
- 2 Show that eigen values of Hermitian operator are real.
- 3 Write a note on stationary states.
- 4 Distinguish between Schrodinger, Heisenberg and interaction pictures.
- 5 Write a note on Clebsch-Gordon coefficients.
- 6 What are the properties of Pauli spin matrices?
- 7 What are the space and time unitary operators?
- 8 Write a note on space inversion.

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

- 9 a) If a ket is simultaneously the eigen ket of two different operators then show that the two operators commute.  
b) What is projection operator? State its physical significance.  
**OR**  
c) Show that the state vector can be represented by a column matrix and the operator by a square matrix.
- 10 a) Define raising and lowering operators. Using these operators obtain the energy eigen values of one dimensional linear harmonic oscillator.  
**OR**  
b) Obtain the solution for the radial part of the Schrodinger equation for Hydrogen atom.
- 11 a) Calculate the Clebsch-Gordon coefficients for a system having  
 $j_1 = \frac{1}{2}$  and  $j_2 = \frac{1}{2}$ .  
**OR**  
b) State the eigen value equations for the operators  $J^2$  and  $J_z$ .
- 12 a) Show that translational symmetry in space and time gives the conservation of linear momentum and energy respectively.  
**OR**  
b) Explain how the generator for infinitesimal rotation is related to angular momentum.

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