Code No. 6077/CBCS

FACULTY OF SCIENCE

M.Sc. I – Semester(CBCS) Examination, December 2016

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 (8x4 = 32 Marks)
[Short Answer Type]

1 Distinguish between linear and anti-linear operators. Give examples of each.
2 What are the normalized eigen functions of the operator $p_x = -i\hbar\partial / \partial x$?
3 Explain the raising and lowering operators.
4 What are stationary states? Mention their properties.
5 Show that the time reversal operator is anti-linear.
6 show that the linear momentum operator is the generator of infinitesimal space translation.
7 What are Pauli matrices? Mention their properties.
8 What are the possible eigen states $|j, m>$ for the addition of $j_1 = 3/2$ and $j_2 = 1$ where $j = j_1 + j_2$?

PART – B (4x12 = 48 Marks)
[Essay Answer Type]

9 a) Explain the physical significance of the following in quantum mechanics:
   i) The Eigen value equation
   ii) Complete set of commuting operators
   iii) Hermitian operators

OR

b) Explain Dirac's bra and ket notation. Give the matrix representation of bras, kets and operators.

10 a) Deduce the eigen values and eigen functions of a linear harmonic oscillator using operator method.

OR

b) Derive the radial eigen functions of a hydrogen atom.

11 a) Construct the time reversal operator for spin zero and spin non-zero particles.

OR

b) What is a unitary transformation? Show that infinitesimal space and time translations are unitary.

12 a) Determine the eigen values and eigen vectors of the generalized angular momentum $\hat{J}$.

OR

b) Find the Clebsch-Gordon coefficients associated with the coupling of two spin half particles.

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