Code No. 2080 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, January 2018

003

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 Explain what is meant by degenerate and non-degenerate eigen values of an operator by giving examples.

2 Prove that the eigen values of a hermitian operator are real. Show that the momentum operator is Hermitian.

3 For a linear harmonic oscillator evaluate $[H, a^z\ a^+]$.

4 What are stationary stages? Give their properties.

5 Define linear and anti linear operators, Give examples for each.

6 What is a unitary transformation? Show that the norm of a state vector is invariant under a unitary transformation.

7 What are the possible values of the resultant angular momentum $j = j_1 + j_2$ of a system with $J_1 = 3/2$ and $J_2 = 5/2$?

8 What are Clebsch – Gordon coefficients? Give any three properties.

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

9 (a) Derive the uncertainty relation between any two non commuting operators $\hat{Y}$ and $\hat{Z}$.

OR

(b) What are the properties of the wave function of a physical system? Given the wave function ψ (r, t) in position representation, deduce the wave function in the momentum representation.

10 (a) Obtain the eigen values and eigen functions of a linear harmonic oscillator using operation method.

OR

(b) Deduce the commutation relations between the components of the angular momentum operator L. Evaluate $[L_z, L_y, L_2^2]$

11 (a) Discuss in detail any two symmetries and conservation laws in quantum mechanics.

OR

(b) Show that the time reversal operator is anti linear. Construct the time reversal operator for spin 0 and spin ½ particles.

12 (a) Obtain the matrix of Clebsch-Gordon coefficients for the addition of $J_1=1/2$ and $J_2=1$.

OR

(b) Obtain the eigen values and eigen states of J^2 and J_2.

*****