PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2018
(First Semester)

Branch – PHYSICS

QUANTUM MECHANICS-I

Time: Three Hours   Maximum: 75 Marks

Answer **ALL** questions
ALL questions carry **EQUAL** marks   (5 x 15 = 75)

1 a i) State the distinction between the Schrödinger picture and the Heisenberg picture.

   ii) Obtain the equation of motion in Heisenberg picture.

OR

   b i) Define Hilbert's space. Explain the basis in Hilbert space.

   ii) What do you mean by unitary transformation? Give its physical significance. Discuss the important properties of unitary transformation.

2 a Explain the principle of WKB method. Obtain the asymtotic solution of one dimensional Schrödinger equation in WKB approximation.

OR

   b Briefly explain the variation method for solving quantum problems. How is it applied to estimate the ground state energy of Hydrogen molecule?

3 a Discuss the first order time dependent perturbation theory under constant perturbation and hence derive transition probability per unit time.

OR

   b Discuss the Adiabatic approximation in perturbation theory.

4 a What are Clebsch Gordon coefficients? Obtain their values when two angular momenta $j_1 = \frac{1}{2}$ and $j_2 = \frac{1}{2}$ are coupled.

OR

   b Obtain the eigen value spectrum of the angular momentum vector J^2 and J_z. Find the matrices representing the angular momentum components J_x, J_y, J_z and J^2 for $j = \frac{1}{2}$.

5 a What are the drawbacks of Schrödinger non relativistic equation? Derive Klein Gordon equation for a free particle and find its solution. Also derive an expression for charge and current density.

OR

   b Derive Dirac relativistic equation in an electromagnetic field and find its solution and deduce that a Dirac electron has a magnetic moment $\dfrac{ch}{2mc}.\sigma^z$.

Z-Z-Z   END