



K18P 0126

Reg. No. :

Name :

**Second Semester M.Sc. Degree (Regular/Supplementary/Improvement)
Examination, March 2018
(2014 Admn. Onwards)**

**PHYSICS
PHY2C06 : Quantum Mechanics – I**

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **both** questions (Either **a** or **b**).

1. a) What are Clebsch Gordon coefficients ? Explain the computation of Clebsch Gordon coefficients.

OR

b) Explain the Heisenberg picture. Obtain the equation of motion.

2. a) What is symmetry transformation ? Show that the law of conservation of angular momentum is a consequence of the rotational invariance of the system.

OR

b) Explain the principle of the time independent perturbation theory. Find out the ground state energy of the He atom using this model. **(2×12=24)**

SECTION – B

Answer **any four** (One mark for part **a**, 3 marks for part **b**, 5 marks for part **c**) :

3. a) Define Hilbert space.

b) Explain linear operators.

c) If operators **A** and **B** are Hermitian, show that $i[A, B]$ is Hermitian.

P.T.O.



4. a) Define eigen functions and eigen values of a system.
b) Explain what you mean by expectation value of an operator.
c) If the wave function of a system is an eigen function of the operator associated with the observable A , show that $\langle A^n \rangle = \langle A \rangle^n$.
5. a) What are ladder operators ?
b) What do you understand by spin up and spin down states ?
c) For Paulis matrices, prove that $[\sigma_x \sigma_y] = 2i\sigma_z$.
6. a) Why time reversal operator is not linear ?
b) Wave functions possess even or odd parity. Explain.
c) Prove that the parity of spherical harmonics $Y_{lm}(\theta, \phi)$ is $(-1)^l$.
7. a) What do you mean by WKB approximation ?
b) The WKB method is valid for a system in which the potential is slowly varying. Why ?
c) Write a note on the validity conditions of WKB approximation.
8. a) Define quadratic stark effect.
b) Define a general angular momentum operator.
c) Prove that the fundamental commutation relation $[x, p_x] = i\hbar$ remains unchanged under unitary transformation. (4×9=36)