TM142430E **Reg. No: …….**

Name: …….

M. Sc. DEGREE (C.S.S.) EXAMINATION, APRIL 2017
Supplementary – 2014 Admission
SEMESTER II - PHYSICS
PHY2QM – QUANTUM MECHANICS - I

Time: Three Hours **Maximum Marks: 30**

PART A

I. Answer any six questions. Each question carries a weight of 1

1. Explain Hermitian operator with examples.
2. Obtain the operator for position in momentum representation.
3. Explain bra and ket vectors.
4. Distinguish between unitary and projection operators.
5. Briefly explain time evolution operator.
6. Give any four properties of Pauli spin matrices.
7. Show that the Clebch Gordan coefficients vanishes unless the sum of eigen values of J_{1z} and J_{2z} is equal to the eigen value of J_z.
8. How does the stationary state perturbation theory accommodate an operator having degenerate eigen values?
9. Explain why WKB approximations can only be applied to one dimensional problems.
10. What are the energy levels which become non degenerate as first order corrections are included to explain stark effect?

(6x1=6)

PART B

II. Answer any four questions. Each question carries a weight of 2

11. Show that linear momentum is the generator of translation.
12. Show that unitary equivalent observables have simultaneous eigen kets.
13. Derive the Ehrenfest's theorem in Heisenberg picture.
14. State and prove the fundamental commutation relation of angular momentum.
15. Find the 3×3 matrix representation of J_y for j= 1.
16. Apply stationary state perturbation theory to find the energy of anharmonic oscillator.

(4x2=8)

PART C

III. Answer all questions. Each question carries a weight of 4

17. a) Discuss the uncertainty principle and show that minimum uncertainty is Gaussian.

OR

b) Describe the linear vector space. Discuss various kinds of operation with example.

18. a) Discuss the Schrodinger picture of quantum mechanics. What are the changes to be expected if operators and state kets are time dependent?

OR

b) Obtain the eigen kets and eigen values of a linear harmonic oscillator.

19. a) Discuss the final theory of Addition of angular momentum. Illustrate with a an example.

OR

b) What are ladder operators? Use them to find the relation between eigen values of J^2 and J_z. Find the allowed eigen values of J_z.

20. a) Outline the principle of W K B approximation and apply the same to find the transmission coefficient for a potential barrier.

OR

b) Describe the Variational principle and get the ground state energy and wave function for hydrogen molecule ion.

(4x4=16)