

SECOND SEMESTER M.A./M.Sc./M.Com. DEGREE EXAMINATION, JUNE 2020

(CBCSS)

Physics

PHY 2C 05—QUANTUM MECHANICS-I

(2019 Admissions)

Time : Three Hours

Maximum : 30 Weightage

Section A

*Answer all questions.**Each question carries 1 weightage.*

1. Given that P is a projection operator, show that $P' = 1 - P$ also is a projection operator.
2. Show that the set of eigen values of a matrix do not change under similarity transformation.
3. State and explain Ehrenfest's theorem.
4. What is meant by Heisenberg picture ?
5. Show that angular momentum components are generators of rotations.
6. Write a brief note on Clebsch-Gordan co-efficients.
7. What is the advantage of using spherical polar co-ordinates in the case of central potentials ?
8. Write a short note on Pauli's exclusion principle.

 $(8 \times 1 = 8 \text{ weightage})$

Section B

*Answer any two questions.**Each question carries 5 weightage.*

9. Discuss Stern-Gerlach experiments and its implications.
10. Solve the Simple Harmonic Oscillator problem in one dimension and find the formula for eigen values (no need to obtain the eigen functions explicitly.)
11. Find the eigen values for angular momentum operators J^2 and J_z .
12. Describe the concepts of symmetry and conservation laws with specific reference to displacement in space and time.

 $(2 \times 5 = 10 \text{ weightage})$

Turn over

Section C

Answer any four questions.

Each question carries 3 weightage.

13. Assuming the basic commutation relations between q and p prove the general uncertainty relation.
14. Given that $|0\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and $|1\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ write down the matrix representations for
- (a) $|0\rangle\langle 0|$,
 - (b) $\langle 0|1\rangle$,
 - (c) and show that the two kets form a basis.
15. Show that a Gaussian wave packet continues to be a Gaussian whether we choose the basis as position space or momentum basis.
16. State and prove the continuity equation.
17. Prove the commutation relation between angular momentum components given by ;
- $$[L_x, L_y] = i\hbar L_z$$
18. Discuss addition of angular momenta of two spin $-\frac{1}{2}$ particles.
19. Write a note on conservation of parity.

(4 × 3 = 12 weightage)