(12/24)

15404

M.Sc. EXAMINATION

(For Batch 2021 & Onwards)

(First Semester)

PHYSICS

M.Sc/PHY/1/CC4

Quantum Mechanics-I

Time : Three Hours   *Maximum Marks : 70*

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. **1** is compulsory. All questions carry equal marks.

(Compulsory Question)

1. (a) What is the underlying physics behind the continuity condition of a wave function and its first derivative ?   2

(b) What type of the spectrum the Hamiltonian has for the case of bound and unbound states ? 2

(c) Find the operator representing the classical orbital angular momentum. 2

(d) What type of representation of quantum mechanics is being done by matrix mechanics and wave mechanics ? 2

(e) Why a common basis cannot be find for all the three components of angular momentum operator ? 2

Unit I

2. Discuss and derive time dependent and independent Schrödinger wave equation. 15

3. (a) What the Uncertainty principle illustrates ? Discuss it in reference to the joint measurements of position and momentum. 10

(b) Discuss the concept of degeneracy and orthogonality in quantum mechanics. 5

Unit II

4. Discuss the Heisenberg picture in detail and develop the equation of motion. 15

5. Illustrate the concept of quantization of a classical system. Also construct a suitable expression to estimate the various energy levels of harmonic oscillator. 15

Unit III

6. What are the commutation relations for angular momentum. Also show that the components of the angular momentum operator do not commute. 15

7. Solve the eigen value equation and obtain the eigen values and eigen functions for L^2. 15

Unit IV

8. Discuss the non-degenerate case of perturbation theory and also apply the first order correction to energy eigen function and eigen values. 15

9. Show that the experimental data pertaining to fine structure of the hydrogen atom (for $n = 2$ state) could not be reproduced without considering the relativistic and spin orbit interaction. 15