

(FOR THE CANDIDATES ADMITTED

SUBJECT CODE **23 PPS 204**

DURING THE ACADEMIC YEAR 2023 ONLY)

REG.NO. **N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI****END-OF-SEMESTER EXAMINATIONS : MAY – 2024****M.Sc. – PHYSICS****MAXIMUM MARKS: 75****SEMESTER: II****TIME : 3 HOURS****QUANTUM MECHANICS -I****SECTION – A (10 X 1 = 10 MARKS)****ANSWER THE FOLLOWING QUESTIONS.****(K1)**

1. The totality of all n-dimensional vectors is called as.....
 - a) vector space
 - b) Hilbert space
 - c) 3-dimensional space
 - d) n-vector space
2. $m\omega^2 x^2 / 2$ is the expression associated with harmonic oscillator. It is expression of
 - a) energy
 - b) momentum
 - c) energy operator
 - d) equilibrium
3. $J^2 |jm\rangle = \dots\dots\dots$
 - a) $j(j+1) \hbar^2 |jm\rangle$
 - b) $j(j+1) \hbar^2 |jm\rangle$
 - c) $j(j+1) m\hbar |jm\rangle$
 - d) $(j+1) \hbar^2 |jm\rangle$
4. The WKB approximation also referred as.....
 - a) partial wave analysis
 - b) classical approximation
 - c) dipolemoment approximation
 - d) harmonic perturbation
5. The number of transition per unit time is called
 - a) density transition
 - b) emission processs
 - c) transition probability
 - d) spontaneous emission process

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES.**(K2)**

6. What is known as function space?
7. Write the Schrodinger equation for rigid rotator.
8. $[L_z, L_+]$ = _____
9. In which approximation method Rayleigh – Ritz method is used?
10. Define "scattering cross-section".

(CONTD 2)

SECTION – B**(5 X 5 = 25 MARKS)**

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.
(K3)

11. a) Define Hermitian operator. Prove that any two Eigen functions of a Hermitian operator that belong to different eigenvalues are orthogonal.

(OR)

- b) Give the theory of matrix representation of operator.
 12. a) Explain quantum mechanical tunneling.

(OR)

- b) Develop radial equation for hydrogen atom from the time independent Schrödinger equation of hydrogen atom
 13. a) What are Ladder operators? How are they used in commutation relations? Explain

(OR)

- b) State and explain Pauli's exclusion principle.
 14. a) Elaborate the basic principle of time independent Perturbation theory for a system.

(OR)

- b) State and prove Hellmann Feynman theorem.
 15. a) What is known as sudden approximation? Explain,

(OR)

- b) Give the theory of First order perturbation.

SECTION – C**(5 X 8 = 40 MARKS)**

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.
(K4 (Or) K5)

16. a) What is known as Hilbert space? List some of the important definitions regarding orthogonal functions.

(OR)

- b) What are the postulates of quantum mechanics? Explain
 17. a) Deduce the expression for eigen values and eigen functions of linear harmonic oscillator using operator approach .

(OR)

- b) Setup Schrödinger equation for hydrogen atom and obtain the solutions for angular and Radial part(ϕ , θ and R).

18. a) Explain the addition of two angular momenta in the study of atomic spectra and arrive the recursion relation for the computation of the Clebsch – Gordan coefficients.

(OR)

- b) Explain the parity operators and its important role in symmetry operations. Discuss about symmetry and anti-symmetry wave functions.
 19. a) Explain the effect of electric field on the $n=2$ state of hydrogen with the explanation for energy level diagram.

(OR)

- b) What is known as WKB approximation method? Determine the solutions for one dimensional Schrodinger wave equation through this method and discuss its validity.

20. a) Arrive Fermi Golden rule from the theory of transition to continuum states.

(OR)

- b) Deduce the expression for scattering amplitude and scattering cross section by scattering of a particle by a potential.