

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)

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. $[L_z, L_+] = \underline{\hspace{2cm}}$
9. In which approximation method Rayleigh – Ritz method is used?
10. Define “scattering cross-section”.

(CONT'D 2)

SECTION – B (5 X 5 = 25 MARKS)**ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)**

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

(OR)

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

(OR)

b) Develop radial equation for hydrogen atom fom 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 Clebsh – 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.