



ANDHRA UNIVERSITY TRANS-DISCIPLINARY RESEARCH HUB

QUANTUM MECHANICS

UNIT – I: Origin of Quantum Theory, Revision; Inadequacy of classical mechanics; Schrodinger equation, postulates of quantum mechanics, continuity equation; Ehrenfest theorem; Admissible wave functions; Stationary states. One-dimensional problems, wells and barriers; problem of Harmonic oscillator by Schrodinger equation.

UNIT – II: Uncertainty relation of x and p , states with minimum uncertainty product; operators – use of operators in quantum mechanics, Bracket notation, orthonormal functions, linear operators, hermitian operator and properties, equation of motion of an operator –Schrodinger representation, Dirac delta function- properties, the continuous spectrum.

UNIT – III: Angular momentum in QM; particle moving in a spherically symmetric potential, spherical harmonics, radial equation, Eigen values and Eigen functions of rigid rotator, Hydrogen atom, angular momentum operator, Commutation relations, eigen values and eigen functions of L^2 , L_z , L_+ and L_- operators.

UNIT – IV: Time-independent perturbation theory; Non-degenerate systems –application to ground state of helium atom and degenerate systems- Stark effect. Variational method: WKB approximation.

UNIT –V : Development of time dependent perturbation theory; the golden rule for constant transition states, Klein-Gordon equation- its success and limitations, Dirac equation for a free particles, Equation of continuity, spin of Dirac particle, negative energy states.

TEXT AND REFERANCE BOOKS:

1. Quantum Mechanics – R.D.Ratna Raju
2. Quantum Mechanics – Tharkappan
3. Quantum Mechanics – Ghatak and Loknathan
4. Quantum Mechanics – Gupta , Kumar , Sharma
5. Quantum Mechanics - G. Aruldas
6. Quantum Mechanics - L I Schiff, (McGraw-Hill)
7. Quantum Mechanics – B Craseman and J D Powell, (Addison Wesley)
8. Quantum Mechanics- Mathews and Venkateshan
9. Advanced Quantum Mechanics – B.S. Rajput.



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MODEL QUESTION PAPER

QUANTUM MECHANICS

Time: 3H

(R101715)

Marks : 100

Answer ALL questions. All questions carry equal marks (5 X20 =100)

1. a) Derive Schrodinger time dependent wave equation. Explain the significance of wave function. Solve the problem of Harmonic oscillator by Schrodinger equation.

Or

- b) Explain the postulates of quantum mechanics. State and explain Ehrenfest theorem,

2. a) What is an operator? Write the use of operators in quantum mechanics. Define Hermitian operator and write its properties. Show that the eigen functions of Hermitian operator belonging to different eigen values are orthogonal.

Or

- b) Explain Dirac Bracket notation and its properties. Define Dirac delta function and explain the properties of delta function.

3. a) Explain the importance of angular momentum from the rigid rotator concept. Obtain the eigen values and eigen functions of angular momentum in spherical coordinates.

Or

- b) Obtain the commutation relations of L^2 and L_+ operators. Discuss the eigen values and eigen functions for these two operators.

4. a) Discuss the time independent perturbation theory for non-degenerate systems. Solve the problem of ground state of helium atom.

Or

- b) Explain the linear stark effect in hydrogen atom. Describe WKB approximation in solving the wave equation when the potential function is slowly varying function of position.

5. a) Discuss Klein-Gordon Equation and mention its success and limitations.

Or

- Explain the time dependent perturbation theory in detail. Derive Fermi Golden rule and write its importance in obtaining the transition probabilities.