S.S.D. Girls' College, Bathinda
Multidisciplinary course Based on NEP-2020
B.Sc./B.Sc. (Honours)
Session: 2026-27,2027-28,2028-29
B.Sc. (Non-Medical) Part-3, Sem-V
Quantum Mechanics
Paper Code: BNM501
(Major Theory)

Max. Marks: 70 **Total Teaching Hrs.: 39 Hrs (3Hrs Per Week)**

End Semester exam:50 **Credits: 03**

Internal Evaluation: 20 marks **Pass Marks: 35%**

INSTRUCTIONS FOR PAPER SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions each from the respective sections of the syllabus out of which the student will be required to attempt two questions from each Section. Each question will carry 08 marks. Section C will be compulsory with 9 short-answer type questions of 02 marks each which will cover the entire Syllabus.

Instructions for Students

Students have to attempt four questions in all from Section A and B by selecting 2 questions from each Section. Section C will be compulsory. Use of scientific calculator is allowed.

SECTION–A

Failures of classical mechanics: The spectrum of blackbody radiation inadequacies of classi -cal mechanics to explain blackbody spectrum. Plank's hypothesis. Other evidences in support of Quantum model: Photoelectric effect, Bohr Model, Compton effect, Frank Hertz experiment.

Time dependent Schrodinger equation: Postulates of Quantum Mechanics, Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function, Interpretation of Wave Function, Probability and probability current densities in three dimensions. Eigen values and Eigen functions, Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum, Wave Function of a Free Particle.

Time-independent Schrodinger equation: Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states.

General discussion of bound states in an arbitrary potential: continuity of wave function, boundary condition and emergence of discrete energy levels; Application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator, ground state, zero-point energy & uncertainty principle.

SECTION–B

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wave functions.

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization, Electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stern-Gerlach Experiment.

Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect.

Many electron atoms: Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions.

Course Outcomes:

1. Solving Schrodinger equation for physical systems.
2. Define dynamical variables as linear operators, and compute expectation values, eigenvalues, and eigenstate problems
3. Calculate energy levels and wave functions for a particle in a 1D/3D box, step potentials, and linear harmonic oscillators.
4. To understand the mechanics of hydrogen like atoms.
5. To understand the effect of electric and magnetic field on atoms.

Text Books:

1. A Text book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, 2nd Ed., 2010, McGraw Hill.

2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.

3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.

4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning India.

5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

6. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer.

7. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.

S.S.D. GIRL's COLLEGE, BATHINDA
Multidisciplinary course Based on NEP-2020
B.Sc. / B.Sc. (Honours)
Session: 2026-27,2027-28,2028-29
B.Sc. (Non-Medical) Part-3,Sem V
Physics Laboratory
Paper Code: BNM501P
(Major Practical)

Max. Marks: 30 **Total Teaching hours: 2 hours/week**

End-Semester exam: 20 marks **Total time Allowed:03 hours**

Internal Evaluation: 10 marks **Pass Marks: 35 %**

Credits: 01

General Guidelines for End-Semester Practical Examination:

The student will be allotted one experiment out of the experiments mentioned in syllabus and asked to perform.

Instructions for Students

Students have to perform at least nine experiments from the List of the experiments:

List of the Experiments

1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.
2. Study of Zeeman Effect with external magnetic field; Hyperfine splitting.
3. To show the tunnelling effect in tunnel diode using I-V characteristics.
4. Quantum efficiency of CCDs.
5. Study of alkali or alkaline earth spectra using concave grating.
6. Study of Raman spectrum using laser as an excitation source.
7. Study of spectra of hydrogen and deuterium (Rydberg constant and ratio of masses of electron to proton).
8. To verify the inverse square law of light using a photo-voltaic cell.
9. To determine the value of Planck's constant (h) using the photoelectric effect.
10. To compare the luminous intensities (illuminating powers) of two light sources using a photo-voltaic cell.
11. To determine the ionization potential of mercury using the Franck-Hertz experiment.
12. To study the absorption spectrum of iodine vapors and observe the band structure in the visible region.
13. To demonstrate the existence of discrete atomic energy levels using the Franck-Hertz experiment.

Text Books

1. D.P. Khandelwal, "A Laboratory Manual for Undergraduate Classes" (Vani Publishing).
2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. B.Sc. Practical Physics, C.L. Arora, S. Chand & Company Ltd. 2020.