Semester – V

BRANCH	Subject	Subject Code
B.Sc. (Physics)	Quantum Mechanics, Solid State Physics and Devices	PHYDSE1-151

Course learning outcomes (CLO):-

On completion of the course, the students will be able to

1 Understand the necessity of quantum mechanics and its applications.

2. Explain the atomic structures and X-rays

3. Identify the molecular spectra such as electronic rotational and vibration.

4. Identify the various materials using the Raman spectroscopic technique

5. Use different types of diodes and transistors. Various electronic applications

6. Analyze the amplifiers and oscillators

Unit – I
Introduction to Quantum Mechanics

1. A brief biography of Chandrasekhar Venkata Raman and their major contribution to science.

2. Limitations of classical mechanics and origin of quantum mechanics, Black body radiation, Photoelectric effect. Compton effect. De-Broglie hypothesis, Davisson-Germer experiment, Wave packet, Phase velocity and Group velocity

3. Heisenberg uncertainty principle. Different forms of uncertainty principle, Schrödinger wave equation: Tiης
Dependent and time independent equation, Physical interpretation of wave function, Equation of Continuity.

4. Operator in quantum mechanics: Eigenfunctions and Eigenvalues, Hermitian operator, Position and Momentum operator, Total energy operator (Hamiltonian). Expectation value, Parity operator, Ehrenfest Theorem.

Unit – II

Application of quantum Mechanics and Atomic structure

1 Application of Schrödinger equation Free particle. Particle in one-dimensional box, Rectangular potential

barrier, Tunnel effect. One dimensional Harmonic Oscillator

2. Three dimensional Schrödinger equation. The radial and angular equation, Hydrogen atom, electron probability density

3. Bohr's atomic model, Atomic spectra of Hydrogen, Sommerfeld model, electron pin, Stern Gerlach experiment, Orbital and spin angular momentum. Concept of space quantization, Quantum numbers

Unit – III

Many - Electron atom

1. Pauli's exclusion principle, Electronic configuration, Symmetric and antisymmetric wave function (Bosons and Fermions).

2. Spin-Orbit interaction, Selection rules, Spectra of alkaline atom, Fine structure of Sodium D line. Spectral terms of two electron atoms, L-S and j-j coupling, Multiplicity of energy levels, Spectra of Helium atom. Zeeman effect: Types and Experimental arrangement.

3. Various types of molecular spectra, Electronic, Rotational and vibrational spectra of diatomic molecule, Raman effect. Experimental setup and explanation by quantum principle, Production of X-rays, Contimous and characteristics X-ray spectrum, Moseley's law=

Unit – IV
Solid State Plysies

1. Crystalline and amorphous solids, Space lattice, Basis, Lattice translational vector, Primitive cell, Bravais lattice, Seven crystal systems, Symmetry, Miller indices Foterplanar spacing.

2. Crystal structures Simple cubic, Face cemered cubic (NaCh, Body centred cubic (CCD), Hexagonal closed packed, Diamond structure, Coordination numbers and atomic packing fraction, Lave's and Bragg's to Reciprocal lattice

3. Dulong and Petit's theory of Specific heat instein's theory of specific heat. Debye's theory of specific host Lattice vidvations in crystal. Mono-atomic lattice vibration and dispersion relation, Brillouin Zone Concept of phonos, Leventz Drade theory. Ohm's Law of Wiedemann Frung tan. Hall effect

Unit – V

Semiconductor and Devices

1. Energy bands in solids, Intrinsic and extrinsic semiconductors, Fermi energy level, Mobility, Conductivity of semiconductors, Concentration of electrons and holes in semiconductors.

2. P-N Junction, depletion layer, Potential barrier, Shockley diode equation (without derivation), Zener diode and its application, Elementary knowledge of photodiode. Light Emitting diode and Solar cell, Bipolar Junction Transistors and its characteristic curves, Current pains (a, Band 7). Junction Field Effect Transistor.

3 Amplifiers and their classification, Single stage common emitter amplifier, Q-point, load line and

frequency response curve, Feedback amplifiers, Barkhausen criterion, Phase shift and Wien bridge oscillator

List of Experiments/Exercise (Practical's)

1. To determine the Rydberg's constant using hydrogen discharge tube.
2. To determine the Planck's constants using light emitting diode.
3. To determine the of specific charge e/m by Thomson's method.
4. To determine the of Plank's constant using Photo cell.
5. To determine the first excitation potential of gas (argon) by Franck Hertz experiment.
6. To observe the Zeeman splitting of green mercury line using Fabry- Parot Etalon for normal transverse and longitudinal configuration.
7. To measure the wavelength of a mercury source spectrum by constant deviation spectrograph and calibration of drum.
8. To determine the electronic charge with the help of Millikan's oil drop method.
9. To study the absorption spectra of iodine vapour
10. To draw the characteristic curves of a Photo cell and determine stopping potential
11. To study characteristic curve of a PN Junction diode.
12. To study characteristics curve of a Zener diode
13. To study characteristics curve of a light emitting diode (LED).
14. To determine the energy band gap ola semiconductor using PN diode in reverse hias.
15. To study characteristics curves of PNP NPN transistor in common emitter mode configuration and determination current gain
16. To study characteristics curves of Junction field effect transistor.
17. To study single stage RC amplifier
18. Te study Wien bridge oscillator
19. To study the characteristic curve of Photodiode
20. To study the characteristic curve of solar cell.