BACHELORS WITH PHYSICS AS MAJOR
5th SEMESTER

PHY522J1 PHYSICS _ MODERN PHYSICS

CREDITS: THEORY – 3; PRACTICAL: 1

THEORY (3 CREDITS: 45 HOURS)

COURSE LEARNING OUTCOMES:

The learning outcomes of the course cover a wide range of topics in modern physics and its applications, providing students with a solid foundation in the subject.

1. *Understand the inadequacies of classical physics in explaining phenomena like Blackbody Radiation, the Photoelectric Effect, and the Compton Effect.*
2. *Analyze the Davisson-Germer Experiment and its role in confirming the wave nature of particles.*
3. *Explain Heisenberg's Uncertainty Principle and its significance in quantum mechanics.*
4. *Understand Schrödinger's wave equation in its time-independent form.*
5. *Explain the linearity and superposition principles in quantum mechanics.*
6. *Calculate expectation values and work with operators in quantum mechanics.*
7. *Understand the concept of tunneling and its effects in quantum mechanics.*
8. *Understand the concept of electron spin and its experimental verification through the Stern-Gerlach experiment.*
9. *Describe the concept of symmetric and anti-symmetric wave functions in the context of quantum mechanics.*
10. *Understand atomic structures, including electron shells and sub-shells.*
11. *Calculate the total angular momentum J and understand the normal and anomalous Zeeman Effect.*
12. *Quantized rotational energies and describe rotational energy levels.*
13. *Explain the Raman Effect from a classical theory perspective.*

UNIT-I (15 HOURS)

Inadequacies in Classical Physics. Blackbody Radiation: Quantum Theory of Light. Franck-Hertz experiment, Photoelectric Effect. Compton Effect. Wave Nature of Matter: De-Broglie Hypothesis. Wave-Particle Duality. Davisson-Germer Experiment. Wave description of Particles by Wave Packets. Group and Phase Velocities and relation between them. Two-Slit Experiment with Electrons (Probability). Heisenberg's Uncertainty Principle. Some important implications: γ-ray Microscope.

UNIT-II (15 HOURS)

Schrödinger's wave equation (Time independent form); linearity and superposition; Properties of Wave Function. Interpretation of Wave Function. Probability Current Density and Probability, Expectation values; operators; Particle in a box; Finite potential well; Potential Barrier, Tunnel effect.

UNIT-III (15 HOURS)

Electron spin; Stern-Gerlach experiment; Pauli's exclusion principle; Symmetric and anti-symmetric wave functions; Atomic structures (shells and sub-shells); Spin- orbit coupling; Total angular momentum J, Normal and anomalous Zeeman Effect; Lande g-factor. Quantization of rotational energies; Rotational energy levels; Pure rotational spectra; Vibrational energy levels, pure vibrational spectra, Raman Effect (Classical theory).

PRACTICALS (1 CREDIT: 30 HOURS)

1. Study of e/m by Helical Method.
2. Determination of e/m by Thomson Method.
3. Determination of Planck's constant.
4. Study of Zeeman Effect.
5. Determination of Bohr Magneton using normal Zeeman effect.
6. To setup Millikan Oil drop experiment for determination of charge.

TEXT BOOKS:

1. Concepts of Modern Physics by Arther Beiser , Shobhit Mahajan , S. Rai Choudhury , McGraw Hills.
2. Modern Physics, R Murugeshan and Kiruthiga Sivaprasath ,S. Chand & Co.
3. Modern Physics, Raymond A. Serway, Clement J. Moses and Curt A. Moyer, Pearson.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
5. B.Sc. Practical Physics by C.L. Arora
6. A Textbook of Advanced Practical Physics by S. Ghosh: New Central Book Agency.