5th SEMESTER

DISCIPLINE SPECIFIC ELECTIVES (DSEs)

PHY516D: PHYSICS – MODERN PHYSICS - I

CREDITS: THEORY: 4, PRACTICAL: 2

Unit-I

Black body radiation; Planck's radiation law; Photoelectric effect; Compton Effect. Pair Production. De-Broglie's matter wave; The concept of wave packets and group velocities; Heisenberg's uncertainty relation for p and x; Its extension to energy and time; Applications of uncertainty principle .

Unit II

Schrödinger's wave equation (Time independent form); linearity and superposition; Expectation values; operators; Particle in a box; Finite potential well; Potential Barrier, Tunnel effect. Quantum numbers (n, l, m) for an electron in hydrogen atom; Space quantization; Electron probability density .

Unit III

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, L-S coupling; j-j coupling; Normal and anomalous Zeeman Effect; Lande g-factor. Quantization of rotational energies; Rotational energy levels; Pure rotational spectra; Vibrational energy levels, pure vibrational spectra; Rotation-Vibration spectra of diatomic molecules.

Unit IV

Nuclear composition; Nuclear properties (size, spin, magnetic moment), Stable Nuclei (Nuclear decay, Binding energy), Liquid drop model, Meson theory of nuclear forces. Gammow Theory of Alpha decay (no derivation), Pauli theory of beta-decay , gamma decay, Nuclear Reactions and Cross Section. Interaction and particles; Classification; Leptons and hadrons, Elementary particle quantum numbers; Baryon, lepton and strangeness numbers; Quarks; colour, flavour, Quark confinement.

Text Book:

Concepts of Modern Physics by Arthur Beiser, (Tata McGraw Hill).

References:

1. Introductory Nuclear Physics, Kenneth S. Krane, 3rd Ed. , Wiley.
2. Mani and Mehta, Modern Physics (TatMcgraw-Hill)

Physics. DH2EOSES16.

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MODERN PHYSICS -I LAB

Credits: 02, 60 Lectures

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine value of Planck's constant using LEDs of at least 4 different colours/photocell.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by magnetic focusing/helical/Thomson methods
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.
11. Study of spectra of hydrogen, helium and mercury.
12.. Absorption spectrum of iodine vapour.
13. Study of Zeeman effect.
14. Analysis of a given band spectrum.
15. Study of Raman effect using laser as excitation source.
16. Study of absorption of alpha and beta rays.
17. Study of statistics in radioactive measurement.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4 th Edition, reprinted 1985, Heinemann Educational Publishers
3.A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11 th Edition, 2011, Kitab Mahal, New Delhi.