B.Sc. (Physics)- III Year
Semester – V
Paper – V :: (A) Modern Physics
(DSE – Elective I)

UNIT - 1 : SPECTROSCOPY (12)

Atomic Spectra: Introduction - Drawbacks of Bohr's atomic model - Sommerfeld's elliptical orbits - relativistic correction (no derivation). Stern & Gerlach experiment, Vector atom model and quantum numbers associated with it. L-S and j-j coupling schemes. Spectral terms, selection rules, intensity rules - spectra of alkali atoms, doublet fine structure, Zeeman Effect, Paschen-Back Effect and Stark Effect (basic idea).

Molecular Spectroscopy: Types of molecular spectra, pure rotational energies and spectrum of diatomic molecule. Determination of inter nuclear distance. Vibrational energies and spectrum of diatomic molecule. Raman effect, classical theory of Raman effect. Experimental arrangement for Raman effect and its applications.

UNIT – II : Quantum Mechanics (14)

Inadequacy of classical Physics: Spectral radiation - Planck's law (only discussion). Photoelectric effect - Einstien's photoelectric equation. Compton's effect - experimental verification.

Matter waves & Uncertainty principle: de Broglie's hypothesis - wavelength of matter waves, properties of matter waves. Phase and group velocities. Davisson and Germer experiment. Double slit experiment. Standing de Brogile waves of electron in Bohr orbits. Heisenberg's uncertainty principle for position and momentum (x and p_x), Energy and time (E and t). Gamma ray microscope. Diffraction by a single slit. Position of electron in a Bohr orbit. Complementary principle of Bohr.

Schrodinger Wave Equation

Schrodinger time independent and time dependent wave equations. Wave function properties - Significance. Basic postulates of quantum mechanics. Operators, eigen functions and eigen values, expectation values.

Unit - III : Nuclear Physics (10)

Nuclear Structure: Basic properties of nucleus - size, charge, mass, spin, magnetic dipole moment and electric quadrupole moment. Binding energy of nucleus, deuteron binding energy, p-p, n-n, and n-p scattering (concepts), nuclear forces. Nuclear models- liquid drop model, shell model.

Alpha and Beta Decays: Range of alpha particles, Geiger - Nuttal law. Gammow's theory of alpha decay. Geiger - Nuttal law from Gammow's theory. Beta spectrum - neutrino hypothesis,

Particle Detectors: GM counter, proportional counter, scintillation counter.

UNIT: IV: Solid State Physics & Crystolography (12)

Crystal Structure : Crystalline nature of matter. Cystal lattice, Unit Cell, Elements of symmetry. Crystal systems, Bravais lattices. Miller indices. Simple crystal structures (S.C., BCC, FCC, CsCl, NaCl, diamond and Zinc Blende)

X-ray Diffraction: Diffraction of X -rays by crystals, Bragg's law, Experimental techniques - Laue's method and powder method.

Bonding in Crystals: Types of bonding in crystals - characteristics of crystals with different bondings. Lattice energy of ionic crystals - determination of Madelung constant for NaCl crystal. Calculation of Born Coefficient and repulsive exponent. Born-Haber cycle.

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Suggested books

1. Modern Physics by G. Aruldhas & P. Rajagopal.Eastern Economy Edition.
2. Concepts of Modern Physics by Arthur Beiser.Tata McGraw-Hill Edition.
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath.S. Chand & Co.
4. Nuclear Physics by D.C. Tayal, Himalaya Publishing House.
5. Molecular Structure and Spectroscopy by G. Aruldhas.Prentice Hall of India, New Delhi.
6. Spectroscopy -Atomic and Molecular by Gurdeep R Chatwal and Shyam Anand -Himalaya Publishing House.
7. Third Year Physics - Telugu Academy.
8. Elements of Solid State Physics by J.P. Srivastava. (for chapter on nanomaterials)-Prentice-hall of India Pvt. Ltd.

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B.Sc. (Physics Practical) – III year
Semester – V
Paper: V:: A. Modern Physics Practicals
(DSE)

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine the Planck's constant using LEDs of at least 4 different colors.
4. To determine the ionization potential of mercury.
5. To determine the absorption lines in the rotational spectrum of Iodine vapour.
6. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
7. To setup the Millikan oil drop apparatus and determine the charge of an electron.
8. To show the tunneling effect in tunnel diode using I-V characteristics.
9. To determine the wavelength of laser source using diffraction of single slit.
10. To determine the wavelength of laser source using diffraction of double slits.
11. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
12. To determine the value of e/m for electron by long solenoid method.
13. Photo Cell – Determination of Planck's constant.
14. To verify the inverse square law of radiation using a photo-electric cell.
15. To find the value of photo electric work function of a material of the cathode using a photo-electric cell.
16. Measurement of magnetic field – Hall probe method.
17. To determine the dead time of a given G.M. tube using double source.
18. Hydrogen spectrum – Determination of Rydberg's constant
19. Energy gap of intrinsic semi-conductor
20. G. M. Counter – Absorption coefficients of a material.
21. To draw the plateau curve for a Geiger Muller counter.
22. To find the half-life period of a given radioactive substance using a G.M. Counter.

Reference Books:

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

Note: Minimum of eight experiments should be performed.

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B.Sc. (Physics)- III Year
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Paper – V :: B Computational Physics
(DSE – Elective II)

Unit I Programming in C (14 hours)
Flow charts, Algorithms, Integer and floating point arithmetic, Precision, Variable types, Arithmetic statements, Input and output statements, Control statements, Executable and non-executable statements, Arrays, Repetitive and logical structures, Subroutines and functions, Operation with files, Operating systems, Creation of executable programs.

UNIT II (14 hours)
Numerical Methods of Analysis:
Solution of algebraic and transcendental equations: Iterative, bisection and Newton-Raphson methods, Solution of simultaneous linear equations: Matrix inversion method, **Interpolation:** Newton and Lagrange formulas, Numerical differentiation, Numerical Integration, Trapezoidal, Simpson and Gaussian quadrature methods, Least-square curve fitting, Straight line and polynomial fits,

UNIT III (14 hours)
Numerical solution of ordinary differential equations: Euler and Runge-Kutta methods. Simulation

Generation of uniformly distributed random integers, Statistical tests of randomness, Monte-Carlo evaluation of integrals and error analysis, Non-uniform probability distributions, Importance of sampling, Rejection method,

Unit IV (14 hours)
Metropolis algorithm, Molecular diffusion and Brownian motion as random walk problems and their MonteCarlo simulation.

Finite element and finite difference methods, boundary value and initial value problems, density functional methods.

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested Books:
1. Computational Methods in Physics and Engineering: Wong.
2. Computer Oriented Numerical Methods: Rajaraman.
3. Computer Programming in FORTRAN 77: Rajaraman.
4. Applied Numerical Analysis: Gerald.
5. A Guide to Monte Carlo Simulations in Statistical Physics: Land

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B.Sc. (Physics)- III Year
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Paper – V :: B Computational Physics Practicals
(DSE – Elective II)

1. Jacobi Method of Matrix Diagonalization
2. Solution of transcendental or polynomial equations by the Newton Raphson method
3. Linear curve fitting and calculation of linear correlation coefficient
4. Matrix summation, subtraction and multiplication
5. Matrix inversion and solution of simultaneous equation
6. Lagrange interpolation based on given input data
7. Numerical integration using the Simpson's method
8. Numerical integration using the Gaussian quadrature method
9. Solution of first order differential equations using the Runge-Kutta method
10. Numerical first order differentiation of a given function
11. Fast Fourier Transform
12. Monte Carlo integration
13. Use of a package for data generation and graph plotting.
14. Test of randomness for random numbers generators

Note: Minimum of eight experiments should be performed. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

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