SYLLABUS

Five year Integrated U.G. Programme in Physics

Semester I

Paper I (BP-101): Mechanics and properties of Matter

Unit I: Cartesian coordinate system, Frame of reference, Laws of motion, One dimensional motion of particle under the influence of (i) constant force F (ii) time dependent force $F(t) = F_o e^{-\lambda t}$, $F_o \sin(\omega t + \varphi)$ (iii) velocity dependent force $F(v) = -kv$, k is a constant and (iv) position dependent force $F(x) = -kx$, k is a constant. Rotational motion, Uniformly rotating frame, Centrifugal acceleration, Coriolis force and its applications (freely falling particle).

Unit II: System of particles, Centre of mass, Conservation of linear and angular momentum, Conservation of energy, Elastic and inelastic collisions, Rigid body motion, Moment of inertia and their products, Principle moments and axes, Euler's equations (qualitative), Theorem of parallel and perpendicular axis (statement) for calculation of moment of inertia, Derivation of moment of inertia for (i) rectangular lamina (ii) circular disc (iii) annular disc (iv) solid sphere (v) spherical shell and (vi) Flywheel.

Unit III: Elasticity, Stress and Strain, Hook's law, Types of elasticity, Young Modulus, Bulk Modulus, Modulus of rigidity, Relation between elastic constants, Poission's ratio, Torsion of cylinder, Twisting couple, Torsional pendulum, Bending of beam, Bending moment, Beam supported at both ends, Cantilever.

Unit IV: Kinematics of moving fluids, streamline and turbulent flow, Equation of continuity, Differential form of equation of continuity, Euler's equations of motion, Bernoulli's theorem, Viscous fluids, Poiseuille's law, Critical velocity, Reynold's number, Motion of Viscous fluid, Stoke's law, Terminal velocity, Determination of viscosity using Stoke's law and Coaxial cylinder method.

Reference books:

1. Mechanics By D. S. Mathur
2. Mechanics By J. C. Upadhyaya
3. Mechanics By R. B. Singh
4. Classical Mechanics By A. P. Arya
5. Elements of Properties of Matter by D.S.Mathur

Reference books:

1. Classical Dynamics of Particles and Systems By Thornton & Marion
2. Berkeley Physics Course, Vol. I, Mechanics
3. The Fynman Lecture Series, Vol. I

PAPER II ((BP-102): Electrostatics and Magnetostatics

Unit–I: Introductory remarks on vectors & scalars, addition, subtraction, multiplication (dot and cross products); concept of Scalar and Vector fields, Gradient of a scalar field and its geometrical interpretation, Divergence and Curl of a vector field, line, surface and volume integral. Flux of a vector field, Gauss's Divergence Theorem, Stokes Theorem.

Unit–II: Electric charge, Coulomb's Law and principle of superposition, Electric field, field of point charge, force on a charged particle in electric field. Electric dipole, electric field of dipole and electric dipole in electric field, potential energy of an electric dipole, continuous charge distributions, line, surface, volume charge densities;
Gauss's Law and its application for finding electric field, calculation of electric field for symmetric charge distributions (Infinitely long rod of uniform charge density, Infinite plane of charge, & Non – conducting solid sphere), Field at the surface of a conductor., Work done on a charge in a electrostatic field expressed as a line integral, conservative nature of the electrostatic field and Electric potential, Potential due to point charges and potential in system of charges, potential due to electric dipole

Unit–III: Dielectrics, polarization and polarization vector (P), displacement vector (D), electric susceptibility, dielectric constant, relation between E, D, & P. Gauss's law in presence of dielectric, energy in dielectric system and force on dielectric. Steady current, current density, Ohm's law, non steady current and continuity equation.

Unit–IV: Force on a moving charge, Lorentz Force Equation and definition of B, motion of a charged particle in a uniform magnetic field, applications: velocity selector and mass spectrometer, magnetic force on a current carrying wire, torque on a current loop, Biot and Savart's law, Magnetic field due to a finite straight wire, Force between two parallel wires, Ampere law, Field inside and outside a current carrying wire, Solenoid and Toroid.

Text Books:

1. Electricity & Magnetism by J.D.Dubey and R.K.Tiwari

2. Electricity and Magnetism by R. Murugeshan

3. Electricity and Magnetism by Purcell

References:

1. Electromagnetism by Pramanik

2. Introduction to Electrodynamics by Griffiths

3. Haliday and Resnik, 'Physics'-Vol. II

Paper III (BP-103)

Experiments list

1. To determine the value of Modulus of rigidity of material of a given wire using inertia table.

2. To determine the value of Modulus of rigidity of material of a given rod using Barton's apparatus (vertical pattern)

3. To determine the value of Modulus of rigidity of material of a given rod using Barton's apparatus (Horizontal pattern)

4. To study the cantilever and determine the young modulus of material of cantilever.

5. To determine Young's modulus, Bulk Modulus, Modulus of rigidity and Poisson's ratio of material wire by Searle's apparatus

6. To determine the moment of Inertia of Fly wheel about its axis of rotation.

7. To determine the moment of iInertia of Irregular body using inertia table.

8. To determine the coefficient of viscosity of a given liquid using Stoke's method.

9. To determine the coefficient of viscosity of a liquid by the coaxial cylinder method.

10. To determine the value of Earth's magnetic field and magnetic moment of a given magnet and compare the magnetic moments of two magnets

11. To determine the critical velocity and maximmum height of liquid for the streamline flow.

12. Poiseulli's method

13. Measurement and data analysis of experimental observations

    (i) Analysis of observations in the experiments (1.Acceptance and rejection of observations, accuracy and precession of observations, significant figure, plotting graphs and its advantages, System of units, precautions and scheme of presentation 2. Measurement of least count of various measuring instruments)

    (ii) Study of the errors in the experiments (1. Random error in time period of a simple pendulum, 2. Least count error in different experiments)

Books:

1. Practical Physics-D.Chattopadhyay and P.C. Rakshit

2. Practical Physics-Wilson

3. Practical Physics- Geeta Sanon

Semester II

Paper IV (BP-201): Kinematics and Oscillations

Unit I: Conservative and non-conservative forces, Motion under central force, Kepler's laws, Gravitation, gravity, Gravitational field and potential due to uniform spherical shell & due to uniform solid sphere, Conservation of mechanical energy, Gauss's and Poisson's equation for gravitational self energy.

Unit II: Simple Harmonic Oscillations, Displacement in Simple Harmonic Motion, Velocity and Acceleration in Simple Harmonic Motion, Differential equation of SHM, Energy of a Simple Harmonic Oscillator, simple pendulum, compound pendulum, bar pendulum, simple harmonic oscillations of a loaded spring.

Unit III: Free Oscillations, Damped Oscillations, Damping Coefficient, Logarithmic Decrement, Forced Oscillations, Transient and Steady States, Amplitude, Phase, Resonance, Sharpness of Resonance, Power Dissipation and Quality Factor and Electrical analogs, Linearity and superposition principle, Superposition of Two mutually Perpendicular Simple Harmonic Motions with Frequency Ratios 1:1 and 1:2 , Lissajous Figures and their Uses.

Unit IV: Motion of charged particles in electric & magnetic field: $\mathbf{E}$ as an accelerating field, electron gun, case of discharge tube, linear accelerator, cathode ray oscilloscope (CRO), Transverse $\mathbf{B}$ field: 180° deflection, mass spectrograph and velocity selector, mutually perpendicular $\mathbf{E}$ & $\mathbf{B}$ field, motion of charged particle in parallel $\mathbf{E}$ & $\mathbf{B}$ field, Cyclotron

References:

1. Mechanics by Mathur D.S.

2. Mechanics by Upadhyay J.C.

3. The Physics of Vibrations and Waves by Pain, H.J.

4. The Mathematics of Waves and Vibrations by Ghosh, R.K.

5. Oscillations and Waves by Singh, R.B.

6. Oscillations and Waves by Buckley, R.

PAPER V ((BP-202): Electromagnetic theory

Unit I: Magnetization, magnetic susceptibility and permeability, Magnetic materials, types of magnetism: paramagnetism, diamagnetism and ferromagnetism; Hysteresis, the B – H curve

Unit II:. Faraday's law of induction, Lenz law, Motional Electromotive force, Induced electric field, Eddy currents, Self inductance, self inductance of solenoid and self inductance of toroid, mutual inductance, mutual inductance of two concentric coplanar loops, Energy stored in magnetic fields.

Unit III: Concept of Maxwell's Displacement current, Guass's law of Magnetism, Maxwell's equations, Electromagnetic field energy density, Poynting's vector and pointing theorem,

Unit IV: Electromagnetic waves in free space, properties of electromagnetic waves, Electromagnetic waves in conducting medium, Skin depth, relative directions and phase of **E** and **H** in conducting medium. Boundary conditions on the field at interface of two media.

Texts:

1. Electricity and Magnetism, R. Murugeshan

2. Electromagnetic theory and Electrodynamics, Satyaprakash

3. Electromagnetism , Pramanik

References:

1. Berkeley Physics Course, Electricity and Magnetism, Ed. E.M. Purcell

2. Foundations of Electromagnetic theory, John R.Reitz, Frederic J. Milford, and Robert W. Christy (Narosa publications)

3. Introduction to Electrodynamics, Griffiths

Paper VI (BP-203)

List of Experiments

1. To determine the value of acceleration due to gravity by Kater's reversible pendulum.

2. To determine the value of electronic specific charge (e/m) by Thomson's method.

3. To determine the damping constant, relaxation time and quality factor of a simple pendulum as damped harmonic oscillator

4. To determine the damping constant, relaxation time and quality factor of a Ballistic galvanometer as damped harmonic oscillator

5. Spiral Spring (Force constant)

6. Verification of laws of series and parallel combination (LCR)

7. To determine Self Inductance of a Coil by Rayleigh's Method.

8. To determine the Mutual Inductance of Two Coils by Absolute method using a B.G.

9. Self inductance by Gouy's method

10. Frequency of A.C. mains using sonometer

Semester III

Paper VII (BP-301): Heat and Thermodynamics

Unit I: Introduction to thermodynamics, State of the system, system in contact with a heat reservoir, Approach to thermal equilibrium, intensive and extensive parameters, Zeroth law, internal energy as a state function, concept of path function and point function, Work done by and on the system, first law of thermodynamics, reversible and irreversible processes, Carnot's cycle and Carnot's engine, Carnot theorem,

Unit II: Concept of entropy, changes in entropy in reversible and irreversible processes, entropy and second law of thermodynamics, various statements of second law and their equivalence, principle of increase of entropy, entropy and disorder, entropy of universe, temperature – entropy diagram, calculation of entropy changes.

Unit III: Thermodynamic Relations: Thermodynamic variables and thermodynamic potentials, Maxwell general relations, Internal energy equations, TdS equations, Clausius Clapeyron relation, Specific heat capacities C_v and C_p, Joule – Kelvin effect and Joule – Kelvin effect for ideal gas and real gas obeying Vander Waal's equation, Concept of low temperatures, production of low temperatures, Joule-Thomson cooling (Porus plug experiment) and adiabatic demagnetization techniques.

Unit IV: Heat transport: Transference of heat – types of heat transport (Conduction, Convection and Radiation) Theory of thermal conductivity (types of conducting material), difference between thermal conductor and thermal insulator, heat conduction through a long conducting rod (one dimensional flow of thermal conductivity.

Text books

1. Heat, Thermodynamics and statistical physics, by Brijlal, N. Subrahmnaman and Hemne

2. Basic Thermodynamics, Guha

3. Heat & Thermodynamics by Sharma & Sarkar

References:

1. Heat, Thermodynamics and statistical physics Zemansky & Dittman

2. Fundamental of Physics by Halliday,Resnick and Walker

Paper VIII (BP-302): Basic Electronics

Unit I: Circuit analysis: Electrical Networks, Loop and Nodal analysis of d.c. and a.c. circuits (based on Kirchhoff Laws), Network theorems: Superposition, Thevenin, Norton, Reciprocity and Maximum power transfer theorem.

Unit II: Fundamentals of semiconductors, P-N Junctions and junction Diode, junction breakdown, Zener Diode, Rectification; Half-Wave and full wave, Bridge rectifiers, calculation of efficiency, Ripple factor and Regulation, Filters, Regulated Power Supply

Unit III: Basic ideas of bipolar devices, operation, different configuration and characteristics, Transistor h-parameters, Concept of d.c. and a.c. load lines, cut off saturation, Transistor as a switch, as a current source, transistor biasing circuits: base bias, collector and emitter feedback bias and voltage divider method, F.E.T.

Unit-IV: Transistor Amplifiers: classification of amplifier, CE, CC and CB Amplifier and their approximate analysis for gain, input and output impedance in terms of h-parameters, coupling of amplifiers, RC coupled amplifier, transformer coupled amplifier, frequency response curve. F.E.T. Amplifier

References:

1. Principles of Electronics by Mehta V.K.

2. Elements of Electronics by Bagde and Singh S.P.

3. Basic Electronics by Thareja B.L.

4. Basic Electronics, by Grob B., McGraw Hill, NY,1989 Edition

5. Electronics principles by Malvino

6. Semiconductor Electronics by Sharma A.K.

7. Physics of semiconductor by Shur.

Paper IX (BP-303)

Experiments list

1. Verify Thevenin's theorem (AC)

2. Verify maximum power transform theorem (AC)

3. Verify Norton's theorem (AC)

4. To study forward biased and reversed biased characteristics of p-n junction diode.

5. To study the characteristics of the Zener diode using bread board.

6. To determine the band gap of the semiconductor using bread board.

7. To find the coefficient of thermal conductivity by Searle's conductivity method.

8. To determine the coefficient of thermal conductivity of bad conductor by Lee's disc method

9. Callender and Barne's continuous flow method.

10. Linear expansion coefficient.

11. DC to AC source conversion.

12.(i) pnp transistor characteristics using bread board

(ii)npn transistor characteristics using bread board

Semester IV

Paper X (BP-401): Optics

Unit I: Light and it's characteristics: Wave nature of light, Transverse waves, Sine waves, Wave characteristics (phase angle, Phase velocity and Wave velocity, amplitude and intensity, Frequency and wavelength), Superposition of waves, Addition of simple harmonic motions along the same line, Vector addition of amplitudes, Superposition of two wave trains of same frequency, Superposition of many waves with random phases, Complex waves, Group velocity, Graphical relation between Wave and Group velocity, Addition of Simple harmonic motions at right angles.

Unit II: Interference: Interference of light waves, Classification in terms of division of amplitude and division of wave front, Interference fringes from a double source, Young's double slit experiment, Intensity distribution in the fringe system, Fresnel's biprism, Displacement of fringes, Interference with white light, Michelson's interferometer, Fringes of equal inclination and fringes of equal thickness, Phase change on reflection, Interference in thin parallel plane film and wedge-shaped film, Newton's ring.

Unit III: Diffraction: Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at Single slit, Fraunhofer diffraction by a circular aperture, Two slit Fraunhofer diffraction pattern, Position of maxima and minima, missing orders, N-slit Fraunhofer diffraction pattern, Principal maxima, minima and secondary maxima, Fresnel's diffraction by a circular aperture, Fresnel's diffraction by a circular obstacle, Zone plate, Fresnel's diffraction at straight edge.

Unit IV: Polarization: Polarization of light waves, Plane Polarized, Circularly and elliptically polarized light, Polarization by reflection. Law of Malus, Superposition of two disturbances, Double refraction, Optic axis, Principle sections and Principle planes, Polarization by double refraction, Nicol Prism, Quarter and half wave plates, Production and Analysis of Plane Polarized, Circularly and elliptically polarized light.

Text books:

1. Optics by Brijlal and Subramayam N.
2. Optics by Ajoy Ghatak
3. Fundamentals of Optics – Jenkins and White.
4. Optics by Eugene Hecht
5. Schaum's Outline of Optics

Paper XI (BP-402): Modern Physics

Unit I The Special Theory of Relativity: Galilean Transformation, Electromagnetism and Galilean Transformation, Michelson-Morley Experiment, Postulates of special theory of Relativity, Lorentz Transformation, Velocity Transformation, Length Contraction, time dilation, relativistic mass, space time diagrams.

Unit II Particle nature of radiation: Black body radiation, Planck's quantum hypothesis, Planck's radiation law, photoelectric effect, Einstein's concept and photon, Compton effect

Unit III: Lasers: Coherence time and coherence length, i.e. temporal and spatial coherence Spontaneous and stimulated emission, density of states, Einstein's A and B coefficients, Ratio of stimulated to spontaneous transitions in a system in thermal equilibrium. Energy density of radiation as a result of stimulated emission and absorption, condition for amplification. Population inversion, Methods of optical pumping,

Unit IV: Description of He-Ne, Ruby lasers, Carbon di oxide LASERS and Semiconductor LASER, Applications.

Text books:

1. Concepts of Modern Physics by Beiser A.
2. Perspectives of Modern Physics by Beiser A.
3. Modern Physics by Richtmayer, Kennard and Cooper
4. Modern Physics by Singh R.B.
5. Modern Physics by Lal H.B.
6. Modern Physics by Murugeshan R.
7. Optics by Ajoy, Ghatak
8. Lasers and Non-linear Optics B. B. Laud.

9. Lasers: Theory and Applications K. Thyagarajan, A. K. Ghatak.

Paper XII (BP-403)

Experiments list

1. To determine the wavelength of sodium light with help of Fresnel's Biprism.
2. To determine the wavelength of sodium light by Newton's ring method.
3. To determine the wavelength of sodium light by diffraction grating.
4. To determine the thickness of thin wire by measuring the width of the interference fringes produced by a wedge shaped film.
5. To demonstrate the diffraction pattern and determine the wavelength of different colours of mercury lamp using diffraction grating.
6. To determine the wavelength and number of lines per cm on a diffraction grating using semiconductor laser diode.
7. To study the Fraunhofer diffraction occurring at a single slit & a circular aperture and to determine the width of the single slit & diameter of circular aperture using semiconductor laser diode.
8. To determine the value of Planck's constant by using a photoelectric cell.
9. To study the polarization of light by reflection and hence to determine the polarizing angle for air-glass interface.
10. To determine the value of Stefan's constant.

Semester V

Paper XIII (BP-501): Optical Instruments and Techniques

Unit –I

Introduction, review of abberations, the compound microscope, microscope objective, dark field illumination, telescopes, the astronomical reflecting telescope, oculars or eye-piece, types of eye-piece: Ramsden and Huygens eye-piece, comparison of Ramsden and Huygens eye-piece.

Unit –II

Diffraction grating: construction, theory of diffraction grating, principal maxima and minima, grating equation, characteristics of grating, determination of wavelength of light with diffraction grating, difference between grating and prism.

Unit –III

Resolving power of optical instruments, Rayleigh's criteria for limit of resolution, resolving power of telescope, experimental determination of resolving power of telescope, resolving power of microscope, resolving power of plane transmission grating

Unit –IV

Spectrometer, measurements of refractive index and dispersive power of a prism, Polarimeters: Laurent half shade polarimeter, Biquartz polarimeter, Lippich's two prism polarizer, determination of specific rotation of sugar solution of using Laurent half shade polarimeter

References:

1. Optics- Brijlal and Subramayam N.
2. Geometrical and Physical Optics –Mathur B.K.
3. Optics –Sharma J.K. and Sarkar K. K.
4. Text of light – Vasudevo D. N.
5. Fundamentals of Optics – Jenkins and White.
6. Optics – Khandewal D. P.
7. Engineering Physics- S.K. Shrivastawa and R.A. Yadav
8. Optics by Ajoy Ghatak, the McGraw –Hill

Paper XIV (BP-502): Mathematical Physics

Unit I Vector relations in orthogonal curvilinear co-ordinates, expression for gradient, divergence, curl and laplacian operator in spherical polar and cylindrical co-ordinates

Unit II Differential equations of first and second order and first degree (homogeneous and inhomogeneous with constant coefficients) and their solutions, Bessel, Legendre (spherical harmonics), Hermite and Laguerre Polynomials

Unit III Matrices: Hermitian, orthogonal and unitary matrices, inverse of a matrix, similarity transformations, Eigenvalue problems and diagonalization of matrices (Examples: non-degenerate and degenerate cases).

Unit IV Fourier's theorem and its application in the analysis of square and saw tooth waves. Fourier series for odd and even functions, Laplace transform and its basic properties, Laplace transform of elementary functions

References:

1. Mathematical Methods for Physics by Arfken, G.

2. Advanced Engineering Mathematics by Joshi , A.W.

3. Mathematics for Physicists by Boas, L.M.

4. Higher Engineering Mathematics by Grewal, B.S.

5. Mathematical Physics by Rajput, B.S.

Paper XV (BP-503): Basic Quantum Mechanics

Unit I: Inadequacy of classical mechanics; Rayleigh-Jean's law and Wien's law for black body radiation and their difficulties, Planck's hypothesis for black body radiation, short review of the line spectra, the Rutherford and Bohr atom, Franck-Hertz experiment, Photoelectric effect,

Unit II: Wave-particle duality, Wave Packets and Uncertainty Relation, de-Broglie hypothesis, Davisson-Germer experiment, Wave packets, Group velocity and phase velocity, Uncertainty principle, Complimentarity.

Unit III: Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Stationary states, Superposition principle, Commutation relations, Commuting observables and compatibility.

Unit IV: Application of Schrödinger Wave Equation: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Angular momentum operators and their eigenfunctions.

References:

1. Introduction to Quantum Mechanics- M.C.Jain

2. Quantum Mechanics: V. Devanathan.

3. Quantum Mechanics: Ghatak and Loknathan

4. Quantum Mechanics: Agrawal and Hari Praksh

Paper XVI(BP-504): Solid State Physics I

Unit I: crystal structure: Amorphous and crystalline solids, Lattice translation vectors, basis and crystal structure, primitive unit cell, Fundamental types of lattices, Index system for crystal planes and directions; Miller indices, Examples of simple crystal structures (NaCl, ZnS, CsCl, Diamond), Diffraction of waves by crystals: Bragg's law, Reciprocal lattice,

Unit – II: Crystal Binding: Crystals of inert gases, Ionic crystals, Binding Energy of ionic Crystal: Madelung energy and Madelung constant, Covalent crystals, Metallic forces, Hydrogen Bonding, Vander Wall interactions.

Unit III: Elementary Lattice Dynamics: Thermal properties**:** Einstein and Debye theories of specific heat of solids, T^3 law **,** Vibrations of crystals with mono atomic and diatomic basis, Acoustical and optical phonons

Unit IV: Electrical properties of materials: Basic Idea of Free electron gas Theory, Elementary band theory, Bloch theorem, Kronig-Penney model, concept of hole, Band gaps, difference between conductors, semiconductors and insulators, intrinsic and extrinsic semiconductors, p and n type semiconductors, conductivity in semiconductors, mobility of carriers.

Text books:

1. Elementary Solid State Physics –M.A.Omar

2. Solid State Physics- S.O.Pillai

3. Numerical Problems in Solid State Physics- M.A.Wahab

4. Introduction to Solid State Physics – C. Kittel

Paper XVII (BP-505)

Experiments list

1. Resolving power of a telescope
2. Resolving power of microscope
3. Resolving power of a prism
4. To determine the resolving power of grating
5. Refractive index of material of a prism
6. Dispersive power of material of prism
7. Polarimeter
8. Cauchy's constants (dispersion of white light)
9. Velocity of ultrasonic wave in a liquid by studying the diffraction of light by an ultrasonic grating (Quartz crystal)

Paper XVIII (BP-506)

Experiments

1. Diagonalization of matrix and to find out its eigen values

2. Inversion of a matrix

3. Calculation of Fourier series coefficients

4. Fourier analysis of a square wave

5. Specific Heat of solids

6. Ratio of specific heats of solids

7. Frank-hertz experiment
8. To determine the value of Planck's constant by using LED.
9. Stefan's constant

10. Wien's displacement law

Semester VI

Paper XIX (BP-601): Atomic and Molecular Physics

Unit I Atomic spectra Sommerfield's elliptic orbits, relativistic corrections (qualitative), space quantization, magnetic moments of atoms, the Stern-Gerlach experiment, electron spin and fine spectra, the exclusion principle and its use in understanding the periodic table, the vector atom model and the coupling between orbital and spin angular momenta

Unit II: **Atomic Structure** Spectra of hydrogen, Alkali atoms spectral terms, doublet fine structure, Zeeman effect, the Pashchen-Back effect, selection rules for transitions.

Unit III: **Weak spectra**: continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristics X-rays. Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra.

Unit IV Molecular spectra: Classification of molecular spectra, (qualitative) rotation spectra of diatomic molecules, vibration spectra, the Raman effect.

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Text books:

1. Introduction to Atomic Spectra -H. E. White.
2. Physics of atoms and molecules B. H. Bransden, C J. Joachain
3. Modern Atomic Physics (Vol I)-B Cagnac and J C Pabey
4. Fundamentals of Molecular Spectroscopy C. N. Banwell, E. M. McCash.
5. Atomic Physics -S.N.Ghoshal
6. Modern Spectroscopy –Hollas

Reference books

1. Spectra of Diatomic Molecules (Vol. 1) - G. Herzberg

Paper XX (BP-602): Basic Nuclear Physics

UNIT I: **Structure of nucleus** Introduction of the nucleus, discovery of the nucleus, Rutherford's theory of the scattering of Alpha particle, Discovery of neutron, Basic properties of nuclei: mass, radii, charge, spin, angular momentum, magnetic moment, electric quadrupole moment, stability, Binding energy per nucleon and its observed variation with mass number of the nucleus, Coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve.

UNIT II: **Radioactivity** Laws of radioactive decay, disintegration constant, decay constant and half-life, units of radioactivity, methods of measurement of half life, Alpha decay and its energy spectrum, Geiger-Nuttal law, Gamow's explanation (no derivation), Beta decay and its energy spectrum (for example, 137Cs), Fermi's theory and need for neutrinos, Q-value for beta decay, Gamma decay, selection rules for gamma transitions (no derivation), Internal conversion.

Unit III: **Nuclear reactions and Models** Rutherford's experiments of nuclear transmutation, Nuclear reactions, Types of reactions and conservation theorems, Q-value, threshold energy, cross-section of nuclear reactions. Fission and fusion reactions, Introductory concept of shell model and liquid drop model.

UNIT III: **Nuclear detectors and Accelerators:** Interaction of radiations with matter, working principle of nuclear detectors, Gas field counters: GM Counter, proportional counter, Particle detectors, electrostatic accelerator, Cyclotron, Linear accelerator.

Text books:

1. Introduction to Nuclear Physics: S.B. Patel
2. Introduction Nuclear Physics: K.S. Krane
3. Nuclear Physics: S.N. Ghosal
4. Modern Physics: HS Mani & G K Mehta
5. Nuclear Physics: R C Bhandari & D Somayajulu
6. Nuclear and Particle Physics: V.K. Mittal, R.C. Verma, S.C. Gupta

Reference Books:

1. Nuclear Physics: Irving Kaplan
2. Concepts of Nuclear Physics: B.L. Cohen
3. Introduction to Nuclear Physics: Wong

Paper XXI (BP-603): Solid State Physics II

Unit I: Magnetic Properties of Matter: Response of substances of magnetic field, Dia, Para, Ferri and ferromagnetic materials, Classical Langevin theory of dia and paramagnetic domains, Quantum mechanical treatment of paramagnetic Curie's law, Weiss's theory of ferromagnetism (Qualitative) and Ferromagnetic domains and discussion of B-H hysteresis.

Unit II: Dielectric Properties of materials: Dipole moment, Polarization, Local electric field at an atom, Dielectric constant and its measurement, Polarizability, Classical theory of electronic polarizability, Dipolar polarizability, Piezo, Pyro and Ferroelectric properties of crystals, Ferroelectricity, Ferroelectric domain, Antiferroelectricity and ferrielectricity

Unit III: Optical properties of materials: Absorption process, photoconductivity, Photoelectric effect, Photovoltaic effect, photoluminescence, colour centres, Types of colour centres, generaton of colour centres

Unit IV: Superconductivity (Qualitative discussion only): Zero Resistance, Meissner effect, Type I and II superconductors, Isotope effect.

Text books:

1. Solid State Physics – M.A. Wahab

2. Elementary Solid State Physics- M.A.Omar

3. Numerical Problems in Solid State Physics- M.A.Wahab

4. Introduction to Solid State Physics –C. Kittel

Paper XXII (BP-604): Elements of Nanoscience

Unit I: Introduction to Nanoscience and nanotechnology

Introduction to nanotechnology and importance of nanoscience, summary of electronic properties of atoms and solids (qualitative), Modifications in properties of materials due to nanoscale dimensions.

Unit II: Synthesis and characterization of nanomaterials

Physical and Chemical Synthesis of Nanomaterials, Top – down approach (CVD) and Bottom – up approach (sol – gel process), wet – deposition techniques (spin coating and dip coating), Structure and imaging of nanomaterials: XRD, scanning and tunneling electron microscopies; & SPM (qualitative)

Unit III: Topics on some important classes of nanomaterials

Metal Nanoparticles, Carbon Nanostructures – fullerene, carbon nanotubes and graphene (introduction); low dimensional semiconductors – 0D, 1D, 2D & 3D systems, quantum wells, wires and dots (introduction) - Quantum confinement in semiconductor nanostructures (qualitative) - The electronic density of states; Characterization of semiconductor nanostructures and applications of semiconductor nanostructures

Unit IV: Applications of nanotechnology

Societal Implications of Nanoscience and Nanotechnology, important applications of nanomaterials (energy, sensors, electronics and medicine) and Future directions of nanotechnology

Text books:

1. Introduction to Nanotechnology, Charles P. Poole & Frank J. Owens

2. Introduction to Nanoscience and Nanotechnology, K.K.Chattopadhyay and A.N.Banerjee

Reference books:

1. Nanostructured materials and nanotechnology, Hari Singh Nalwa

2. Nanocrystals: Synthesis, Properties and Applications, C. N. R. Rao, P. J. Thomas and G. U. Kulkarni, Springer (2007).

3. Nanochemistry: A Chemical Approach to Nanomaterials – Royal Society of Chemistry, Cambridge, UK (2005).

Paper XXIII(BP-605)

Experiments list

1. Stern-Gerlach experiment
2. To study hydrogen spectrum and determination of Rydberg Constant with the help of a spectrometer diffraction grating and hydrogen discharge tube.
3. To study the absorption spectra of iodine vapour and determine the dissociation energy of iodine molecule.
4. Fine structure of Hydrogen atom
5. Moseley Law
6. Curie Weiss law
7. Dielectric constant
8. Photoelectric effect
9. Photoluminescence
10. Magnetic susceptibility of a solid (Gouy's method)
11. Magnetic susceptibility of liquid (Quinke's method)
12. Determine the operating plateau for the Geiger Tube
13. Counting Statistics using GM tube

Paper XIV: (BP – 606)

Project Work