2016-2022

OUTCOME OF DEPARTMENT OF PHYSICS

Physics is the natural science to gives us the knowledge about the nature at the fundamental level. It is one of the most fundamental scientific discipline and its main aim to understand how the universe behaves.

Course	Outcome
Sem-I: Mechanics	*It is a branch of Physics which deals with energy and forces and their effect on bodies. It develop skills how to design, construction, or operation of machines or tools*
Mathematical Methods	*It develops the knowledge of Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1st order homogeneous differential equations. 2 nd order homogeneous and inhomogeneous differential equations with constant coefficients.*
Particle Dynamics	*It gives us the knowledge about the Laws of Motion.: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.*
Gravitation	*It develops the knowledge about Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).*
Oscillations	*It develop the skills about Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Forced harmonic oscillations, resonance.*
Elasticity	*It provide us the knowledge about Hooke's law: Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio- Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion –Page 78 Torsional pendulum.- Bending of beam.*
Special Theory of Relativity	*It develops the knowledge about the Special Theory of Relativity:*

(STR)	*Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.*
Sem-II: *Electricity & Magnetism*	
Vector Analysis	*It develop the skills of the vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors.*
Electrostatics	*It develops the knowledge about the Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field. Electric potential due to an electric dipole. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.*
Magnetism	*It develops the concept of the Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.*
Electromagnetic Induction	*It enhances the knowledge about the Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.*
Linear Network	*It develops the idea of the Impedance of L, C, R and their combinations. Thevenin & Norton's Theorem. Maximum power transfer theorem and superposition theorem. Anderson's bridge.*

Maxwell's Equations and Electromagnetic Wave Propagation	*It provide us the knowledge about the Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.*
Sem-III: *Thermal Physics and Statistical Mechanics*	
Laws of Thermodynamics	*To acquire the knowledge about Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy,* *Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.*
Thermodynamic Potentials	*To develop the skillls about the Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.*
Thermodynamic Potentials	*To develop the skills regarding the derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.*
Theory of Radiation	*To acquire the knowledge about the Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.*
Statistical Mechanics	*To develop the skills about the Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law, distribution of velocity - Quantum statistics (qualitative discussion only) - Fermi-Dirac distribution law (statement only) - electron gas as an example of Fermi gas - Bose-Einstein distribution law (statement only) , photon gas as an example*

	of Bose gas- comparison of three statistics.
Sem-IV: *Sounds and Optics*	
Superposition of Two Collinear Harmonic oscillations	*To develop the knowledge about the linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).*
Superposition of Two Perpendicular Harmonic Oscillations	*To develop the skills about the graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.*
Waves Motion- General	*To enhances the knowledge about the transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.*
Fluids	*To develop the skills about the Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Qualitative discussion on water waves.*
Sound	*To acquire the knowlege about the simple harmonic motion forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound -*

	Decibels - Intensity levels - musical notes – musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient – Sabine's formula - measurement of reverberation time. Acoustic aspects of halls and auditoria.
Wave Optics	*To develop the skills regarding the electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.*
Interference	*To acquire the knowledge about the Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.*
Michelson's Interferometer	*To develop the skills about the idea of formation of fringes, Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.*
Diffraction	*To develop the knowledge about the Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.*
Polarization	*To develop the knowledge about the transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.*
Sem-V : *Perspectives of Modern Physics*	
Relativistic Dynamics	*To acquire the knowlege about the brief summary of Lorentz transformation and time dilation, length contraction, velocity addition etc. (no derivation required). Elastic collision between two particles as observed from two inertial frames with relative velocity, idea of relativistic momentum and relativistic mass. Mass-energy equivalence.*

Quantum Theory of Light	*To develop the skills about the limitations of classical theory of electromagnetic radiation within a cavity and its solution by Planck's quantum hypothesis. Statement of Planck's law of black body radiation. Photoelectric effect. Einstein's postulate on light as a stream o photons. Compton's scattering and its explanation.*
Bohr's Model	*To acquire the knowledge about the limitations of Ruherford's model of atomic structure. Bohr's model, its successes and limitations.*
Wave-Particle Duality	*To develop the skills about the De Broglie's hypothesis – wave particle duality. Davisson-Germer experiment. Connection with Einstein's postulate on photons and with Bohr's quantization postulate for stationary orbits. Heisenberg's uncertainty relation as a consequence of wave-particle duality. Demonstration by* **ϒ***-ray microscope thought experiment. Estimating minimum energy of a confined particle using uncertainty principle.*
Wave-function Description	*To acquire the knowledge about the two slit interference experiment with photons, atoms & particles; linear superposition principle of associated wave functions as a consequence; Departure from matter wave interpretation and probabilistic interpretation of wave function; Schroedinger equation for non-relativistic particles; Momentum and Energy operators; stationary states. Properties of wave function. Probability and probability current densities in one dimension.*
Stationary State Problems	*To develop the skills about the One Dimensional infinitely rigid box, energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example. Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier (qualitative discussion with statements of end results only).*
Atomic Physics	*To acquire the knowledge about the Quantization rules energy and orbital angular momentum from Hydrogen and Hydrogen like atoms s, p, d, shells-subshells. Space quantization. Orbital Magnetic Moment and Magnetic Energy of electron, Gyromagnetic Ratio and Bohr magneton. Zeeman effect. Electron Spin as relativistic quantum effect (qualitative discussion only), Spin Angular Momentum. Spin*

	Magnetic Moment. Stern-Gerlach Experiment. Larmor Precession. Spin-orbit interaction. Addition of angular momentum (statement only). Energy correction due to relativistic effect and spin-orbit ineraction (statement only). Fine-structure splitting. Multi-electron atoms. Pauli's Exclusion Principle (statement only). Spectral Notations for atomic States. Aufbau principle, n+l rule (qualitative discussion only). Periodic table.
X-ray and Crystal Structure of Solids	*To develop the skills regarding the generation of X-ray. Mosley's law, explanation from Bohr's theory. Amorphous and crystalline solids. Lattice structure of crystalline (no categorisation required). Unit cell and basis vectors of a lattice. Diffraction of X-ray by crystalline solid. Bragg's law.*
Nuclear Physics	*To acquire the knowledge regarding the size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph. Binding energy curve. Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay, beta decay, gamma emission – basic characteristics. Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Basic principle of a nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and basic principle of thermonuclear reactions*
Sem-VI *Nuclear & Particle Physics*	
Preliminary Topics	*To acquire the knowledge about the mass-energy equivalence, quantum tunnelling. Qualitative discussion on properties of semiconductors.*
General Properties of Nuclei	*To develop the knowledge regarding the onstituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.*

Nuclear Models	*To develop the skills about the liquid drop model, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.*
Radioactivity decay	*To enhance the knowledge about (a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) beta-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.*
Nuclear Reactions	*To enhance the knowledge about the types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering)*
Interaction of Nuclear Radiation with matter	*To acquire the knowlege about the energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.*
Detector for Nuclear Radiations	*It provides the knowledge about the basic principles of ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector*
Particle Accelerators	*It gives the knowledge about the linear accelerator, Cyclotron, Synchrotron's.*

Particle physics	*It gives the knowledge about the particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.*