Programme: B.Sc. Non-Medical (Three-year degree programme)

PROGRAMME OUTCOMES (POs)

PO 1: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 2: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 3: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO 4: Apply appropriate techniques, resources using computer software skills, models, IT tools to solve complex problems with an understanding of the limitations.

PO 5:, and demonstrate the knowledge of, and need for sustainable development.

PO 6: Demonstrate ethical principles and commit to professional ethics and responsibilities and norms of the scientific practice.

PO 7: Communicate effectively on complex activities with the scientific community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Students will be able to clearly understand the concepts and applications in the field of Physics, Chemistry and Mathematics along with Environment and Management, Social and Professional Ethics and Computer Applications.

PSO2: Students have the capability to grasp the technological advancements in the usage of physical science to analyse and design techniques/methods for a variety of applications.

PSO3: Students will be capable for placement opportunities and to pursue career oriented higher education in an interdisciplinary areas in India as well as abroad in the practice of Project, Aptitude and Management and Leadership.

PSO 4: Students will be able to develop and demonstrate knowledge of statistical tools used in sciences.

PSO 5: Learners can also acquire practical skills to work as chemist, faculty and other industrial supporting services.

COURSE OUTCOMES (COs)

B.Sc. Non-Medical First Semester	
Course	**Course Outcomes (COs)**
Mechanics (PHY-111)	CO1: Develop an understanding of Mathematical Tools: Partial differential equations, vector algebra, integration, differentiation, spherical polar co-ordinates. CO2: Explain the law of conservation of Energy, Conservative forces, internal forces and conservation of linear momentum, centre of mass, internal torque. CO3: Describe elastic and inelastic scattering, laboratory and centre of mass systems, scattering cross-section, Rutherford scattering. CO4: Explain angular momentum, moment of inertia, radius of gyration, Euler's equation. CO5: Clearly define the inverse square law, gravitational force, gravitational and electrostatic self-energy.
Basic Communication Skills (ENG-101)	CO1: To learn basic about English language and its importance in global commutation. CO2: Develop skills to read and write poems, essays and short stories. CO3: To know how to make effective sentences and use of grammar.
Introduction to Computer Applications (COMP-101)	CO1: To know basic applications of computers in different organizations. CO2: Understanding, types of Computer systems like Micro, Mini, Mainframe and Super Computers. CO2: To know about input and output devices, Data Processing and storage.
Basic Organic Chemistry (CHEM-111)	CO1: To understand the basic concepts of Organic Chemistry. CO2: Learn about different type of reagents and reaction intermediates used in chemical reactions. CO3: Get familiarize with the initial concepts of stereochemistry with special emphasis on optical isomerism, relative and absolute configurations. CO4: Acquire knowledge regarding geometrical isomerism and conformational isomerism. CO5: Gather information pertaining to the synthesis and chemical reactions of alkanes and cycloalkanes. CO 6: Develop the understanding of practical knowledge and apply them in experiments.
Electricity and Magnetism - I (PHY-112)	CO1: Develop an understanding and use of mathematical tools: complex numbers, complex plane, Euler's formula, power numbers etc. CO2: Develop an understanding of Vector Calculus: Differentiation of vectors, curl of a vector field and its physical significance, Stokes' theorem, combination of grad, div and curl. CO3: Develop an understanding of Conservation and quantization of charge, Coulomb's Law, Energy of a system of charges. Flux and Gauss's law. Brief review of electric fields of a spherical charge distribution.

	CO4: Clearly define the electric potential: Potential as line integral of field, potential difference, gradient of a scalar function, Gauss's theorem and differential form of Gauss's law, Laplacian and Laplace's equation, Poisson's equation CO5: Develop an understanding of electric fields and electric current, general electrostatic problems, uniqueness theorem, charge transport and current density, energy dissipation in current flow, variable currents in capacitors and resistors.
Physics Laboratory - I (PHY-113)	CO1: Able to use Vernier callipers, Screw gauge, Spherometer. CO2: Explain the concept of simple pendulum and moment of inertia. CO3: Classify the Young's modulus, modulus of rigidity. CO4: Able to use sextant to measure dimensions of unknown objects. CO5: Explain Coefficient of viscosity of a given liquid by Stoke's method. Study its temperature dependence.
B.Sc. Second Semester	
Electricity and Magnetism – II (PHY-122)	CO1: Describe dielectrics, moments of a charge distribution, Potential and field of a dipole, Atomic and molecular dipoles, Induced dipole moments. CO2: Explain magnetic forces, measurement of a charge in motion, invariance of charge, Electric field measured in different frames of reference. CO3: Describe and explain magnetic field, vector field and hall effect. CO4: Explain the concept of electromagnetic induction, mutual inductance and impedance. CO5: Describe the external field, electron spin, magnetic moment and magnetic susceptibility.
Physics Laboratory – II (PHY-123)	CO1: Explain B-H curves for different ferromagnetic materials using C.R.O. CO2: Explain the concept low inductance by Maxwell-Wein bridge. CO3: Describe the temperature coefficient of resistance of Cu. CO4: Explain the functioning and working of He-Ne laser. CO5: Understanding of photoelectric effect, photocell.
Basic Inorganic Chemistry (CHEM-121)	CO1: To learn importance of de Broglie matter waves, Schrodinger wave equation and some important basic principles of atomic structure. CO2: To understand the principle of atomic, ionic radii, ionization energy, and electron affinity and electron negativity. CO3: To learn about chemical bonding,VBT theory,and hybridization and VSEPR theory. CO4:To understanding the chemical bonding and Molecular orbital theory. CO5:To understanding the ionic structures, radius ratio effects and coordination numbers.
Calculus (MATH-123)	CO1: Students will be able to understand limit, continuity, and able to apply differentiation in different type practical problems.

	CO2: They understand different properties of curves. CO3: Students will be able to draw different type Cartesian and polar curves. CO4: Students will be able to know how to calculate area, volume and length of different shapes.
Algebra (MATH-122)	CO1: Students will be able to recognize different type of Matrices. CO2: They will be able to find out Eigen Values and Eigen Vectors CO3: Students will be able to solve system of linear equations. CO 4: Students will be able to apply the knowledge of solving cubic and biquadrate equations in practical problems. CO5: Students will know the property of bilinear and quadratic forms.
Special Theory of Relativity (PHY-121)	CO1: Explain the Lorentz force, motion of charges particles in uniform constant electric field in uniform alternating electric field and in uniform magnetic field. CO2: Describe inertial and non-inertial frames of references, absolute and relative velocity and acceleration, fictitious force, collisions. CO3: Explain Michelson-Morley Experiment, Basic postulates of special relativity, Lorentz transformations, length contraction and time dilation. CO4: Describe Conservation of Momentum, Relativistic momentum, Relativistic Energy, Transformation of Momentum and Energy, Equivalence of Mass and Energy. CO5: Explain acceleration by a Transverse Electric field, charged particle in a magnetic field, centre of mass system and Threshold Energy. Energy available from Moving charge, Antiproton Threshold, Photo production of mesons.
Environmental Science (EVS-301)	CO1: To understand the need for public awareness for environment. CO2: To learn aboutv renewable and non-renewable resources, problems associated with Natural resources. CO3: To know about ecosystems, structure and function of an ecosystem. CO4: Understand biodiversity and impact on environment, conservations of bio resources. CO5: Environmenal pollution and causes and remedies.
B.Sc. Third Semester	
Vibrations and Waves (PHY-211)	CO1: Describe dielectrics, moments of a charge distribution, Potential and field of a dipole, Atomic and molecular dipoles, Induced dipole moments. CO2: Explain magnetic forces, measurement of a charge in motion, invariance of charge, Electric field measured in different frames of reference. CO3: Describe and explain magnetic field, vector field and hall effect. CO4: Explain the concept of electromagnetic induction, mutual inductance and impedance.

	CO5: Describe the external field, electron spin, magnetic moment and magnetic susceptibility.
Electronics and Network Theory – I (PHY-212)	CO1: Describe the Series and parallel addition of V-I characteristics, KCL and KVL, Mesh and Node analysis, Superposition theorem, Thevenin's and Norton's theorem. CO2: Understanding of Band diagram, Mobility and conductivity, generation and recombination of charges, Diffusion, CO3: Describe the pnp and npn junction transistors, transistor current components, CB, CC and CE configurations, CO4: Describe Diode and transistor based clipping and clamping circuits, clamping circuit theorem. CO5: Explain the concept of Rectifiers, Filter circuits, efficiency, Ripple factor, voltage multiplying circuits.
Physics Laboratory – III (PHY-213)	CO1: Describe the working of Ge, Si, LED and Zener diode. CO2: Understand the concept of voltage regulation and ripple factor. CO3: Classify the common emitter and common base transistors. CO4: Describe high resistance by leakage method. CO5: Explain the laws of probability and radioactivity.
Basic Physical Chemistry (CHEM-211)	CO1: Student will lean about gaseous state of matter, postulates of Kinetic theory of gases, critical phenomenon. CO2: To understand qualitative discussion of the Maxwell's distribution of molecular velocities and liquefaction of gases. CO3: To learn basic about chemical kinetics and its scope, factors influencing the rate of a reaction-concentration CO4: To understand the importance of second law of thermodynamics with statements, Carnot cycle and its efficiency, some impotant thermodynamic parameters in thermodynamics and their variation. CO5: To learn the physical significance of Free energy and work function, their variation with temperature and pressure, Maxwell relation and third law of thermodynamics.
Statistics (STAT-311)	CO 1: They understand about static forces and its resolution. CO 2: They understand about equilibrium of forces. CO 3: They apply the knowledge of friction, Centre of gravity, virtual work in real life situation. CO4: They will understand about Stable and unstable equilibrium position. CO5: Students will be able to apply the knowledge of forces in three dimension.
Advanced Calculus (MATH-211)	CO1: Student understand the concept of Continuity, Sequential continuity, properties of continuous functions uniform continuity CO2: Understand the basic knowledge of Chain rule of differentiability, Mean value theorems Rolle's theorem and Lagrange's mean value theorem and their geometrical interpretations. CO3: Application of Taylor's theorem with various form of remainders, Darboux intermediate value theorem for derivatives Indeterminate forms.

	CO4: Basic idea of Limit and continuity of real valued functions of two variables, Partial differentiation, Total differentials, Composite functions and implicit functions, change of variables, CO5: Application of Homogeneous functions and Euler's theorem on homogeneous functions. CO6: Application Taylor's theorem for functions of two variables Differentiability of real valued functions of two variables, CO7: Learn about Implicit function theorem, Maxima, Minima and saddle points of two variables, Lagrange's method of multipliers Curves, CO8: Learn about Tangents, Principal normal, Binomials, Serret-Frenet formulas, Locus of the center of curvature, Spherical curvature, Locus of center of spherical CO9: Learn about curvature, Involutes, Evolutes, Bertrand curves, Surfaces, Tangent planes, one parameter family of surfaces.
Ordinary Differential Equations (MATH-213)	CO1: They will be able to solve homogeneous and non-homogeneous linear differential equation and its application. CO2: They will be able to solve different type differential equations. CO3: students will be able to apply Variation of Parameter for solving differential equations. CO4: students will be able to apply Method of Undetermined Coefficient for solving differential equations. CO5: They will be able to apply Lagrange's Method for solving linear differential equation.
Human Values and Ethics (EDU-101)	CO1: Understanding the need, basic guidelines, content and process of value education, self-exploration, continuous happiness and prosperity, fulfillment of basic aspirations of human being. CO2: To learn importance of universal human values and ethical human conduct, basis for holistic alternative towards universal human order CO3: To learn about Professional ethics and issues in professional ethics.
Punjabi Lazmi (PBI-111)	CO: To learn basic about the Punjabi language, writing and speaking.
B.Sc. Fourth Semester	
Electromagnetic Theory (PHY-221)	CO1: Describe the Maxwell's equations, wave equation, e.m. waves in a medium with finite ε and μ, Plane waves, Energy flux. CO2: Explain the plane harmonic waves, linear, circular and elliptical polarization, natural light, production of polarized light, Malus law. CO3: Describe the theory of interference. Young's double slit experiment, Fresnel's Biprism, displacement of fringes CO4: Explain the Michelson's interferometer with its working principle. CO5: Explain Helmholtz Kirchhoff's integral, scalar diffraction theory, Fraunhoffer diffraction: single slit, circular aperture, diffraction grating, Rayleigh's criterion for resolution.
Quantum Mechanics and Statistical	CO1: Describe the mathematical tools and origin of quantum theory related phenomenon. CO2: Explain foundation of wave mechanics and physical interpretation of Schrödinger equation.

Physics (PHY-224)	CO3: Describe basic Ideas of statistical physics and probability and its applications. CO4: Describe Maxwell-Boltzmann Statistics and related problems. CO5: Explain Bose-Einstein and Fermi-Dirac Statistics and related problems.
Physics Laboratory – IV (PHY-225)	CO1: Describe the specific rotation, refractive index, resolving power. CO2: Explain ionization potential of mercury. CO3: Classify the thermal conductivity and thermal diffusivity. CO4: Able to Measurement of the electrical and thermal conductivity of copper CO5: Explain the G M Counter, Stefan's Constant of radiation and temperature dependence of refractive index.
Numerical Methods (MATH-221)	CO1: Explain the consequences of finite precision and the inherent limits of the numerical methods considered. CO2: Select appropriate numerical methods to apply to various types of problems in engineering and science inconsideration of the mathematical operations involved, accuracy requirements, and available computational resources. CO3: Demonstrate they understand the mathematics concepts underlying the numerical methods considered. CO4: Demonstrate understanding and implementation of numerical solution algorithms applied to the following classes of problems: CO5: Student will be able to apply different numerical techniques to solve real world problems through programming in C.
Vector Calculus (MATH-224)	CO1: They understand about scalar, vectors and their different properties. CO2: They will be able to apply different type operators in practical problems. CO3: They will be able to solve vector integration, CO4: Students will be able to apply Greens, Stokes and Divergence theorem. CO5: Students will be able to transform problems from one system to another.
Inorganic Chemistry-III (CHEM-221)	CO1: To learn importance of hydrides of nitrogen,nitrogen halides, oxides and oxyacid. CO2: To understand the principle of chemical reactivity and dioxygen as a ligand (basic idea only), structure of O_3 and H_2O_2, clathrate hydrates allotropic forms of S & Se, structures of halides. CO3: To learn about the halogen Family (chemicalreactivity, group trends, chemistry of preparation of fluorine, hydrogen halides. CO4:To understanding the symmetry, group theorysymmetry elements and symmetry operations. CO5:To understanding the properties of irreducible representations and character tables.
Physical Chemistry-III (CHEM-222)	CO1: To enhance scientific knowledge in kinetic theory of gases, understand transport properties and some important laws of diffusions.

	CO2: To understand thermodynamics of diffusion, relation between transport properties. CO3: To learn basic about equilibrium electrochemistry, some important laws, theories and application of conductometric titrations. CO4: To know dynamic electrochemistry, processes at electrodes, double layer at the interface, applications of dynamic electrochemistry in power generation, power storage (batteries). CO5: To enhance knowledge about chemical , kinetics of complex reactions, Importance of catalysts in kinetics.
B.Sc. Fifth Semester	
Condensed Matter Physics (PHY-313)	CO1: Describe the Lattice, basis and primitive cell, Symmetry operations, Bravais lattices in two and three dimensions, Index system for crystal planes. CO2: Explain the Reciprocal Lattice, Miller indices, Brillouin zone of sc, fcc and bcc lattices, Experimental diffraction methods, Bragg diffraction, scattered wave amplitude. CO3: Describe the Cohesive energy and bulk modulus in inert gas and ionic crystal, Binding in metallic, covalent and H-bonded crystals (basic ideas only). Lattice Vibrations: Dynamics of monatomic and diatomic linear chains, optical and acoustic modes, CO4: Explain the Fermi Gas of non-interacting electrons, heat capacity of electron gas, electrical conductivity, Ohm's Law, Hall Effect, thermal conductivity and Pauli Paramagnetism. CO5: Explain and describe Bloch functions, Kronig-Penney model, bands in metals,semi-metals, semiconductors and insulators, Fermi surface-basic idea.
Nuclear Physics (PHY-314)	CO1: Develop an understanding of nuclear masses, nuclear mass formula, stability of nuclei, Nuclear Properties and Binding Energy. CO2: Enumerate and explain the Radioactive decays; Modes of decay of radioactive nuclides and decay Laws, chart of nuclides and domain of instabilities. CO3: Develop an understanding of Alpha decay: Stability of heavy nuclei against break up, Geiger-Nuttal law, barrier penetration as applied to alpha decay, reduced widths, deducing nuclear energy levels. CO4: Clearly define the Types of nuclear reactions, cross-sections, Types of nuclear reactions, reactions cross section, conservation laws, Kinematics of nuclear reaction CO5: Enumerate and explain nuclear shell Model and Magic Numbers
Physics Laboratory – V (PHY-316)	CO1: Describe the flashing and quenching of neon and argon bulb. CO2: Explain the hall coefficient and mobility of given semiconductor. CO3: Classify the Q-factor for different resistances. CO4: Understand the concept of clipping and clamping circuits. CO5: Explain and identify the series and parallel LCR circuits.

	CO6: Able to describes law of conservation of linear momentum in collision with initial momentum, using air track.
Partial Differential equations (MATH-312)	CO1: They will understand basic knowledge of Partial Differential Equations. CO2: Most of the real-world problems are formulated in Mathematical models, which are formulated in the form of partial differential equations. CO3: They will be able incorporate this knowledge in mathematical models. CO4: They will be able to classify partial differential equations and change into canonical form. CO5: Students will be able to solve one- and two-dimensional Heat equation, Wave equation and Laplace equations.
Real Analysis (MATH-313)	CO1: They understand about basic idea of integration of functions. CO2: They will be able to understand application of Mean value theorems. CO3: students will be able to analyze convergence and divergence of improper integrals through different tests. CO4: Students will apply this knowledge in boundedness, finite intersection property, compactness, connectedness, components, continuity in relation with continuity in relation connectedness in Metric Space.
Inorganic Chemistry-IV (CHEM-311)	CO1: To learn importance of coordination compounds,classical ligands, non-classical ligandsand multidentate ligands. CO2:To understand the concept ofisomerism in coordination compounds,nomenclature and stability of coordination compounds. CO3:To learn about the valence bond theory for bonding in coordination compounds, concept of multiple bonding, strength and weaknesses of valence bond approach. CO4:To understanding the splitting of d-orbitals in different fields for example octahedral and tetrahedral complexes. CO5:To understanding theconcept of thermodynamic effects of crystal field splittingand enthalpies of hydration of M2+ ions.
Organic Chemistry-IV (CHEM-313)	CO 1: Learn the synthesis and chemical reactions of nitrogen and organosulphur compounds. CO 2:Develop the understanding of five and six membered heterocyclic compounds along with condensed five and six membered heterocyclics. CO 3: Recognize the importance and chemistryof saccharides, disaccharides and polysaccharides. CO 4: Understand the difference between fats and oil, soaps and detergents and get acquaint with the synthesis of synthetic dyes. CO 5: To know the chemistry related to amino acids, peptides, proteins and nucleic acids. CO 6: Practice to perform single and multi-step organic reactions.
Group and Rings (MATH-311)	CO1: Students will be able to understand different type of theorems in algebra.

	CO2: students will be able to apply Group, Ring and Field theory in practical applications. CO3. They apply the knowledge of Groups and Rings in coding theory, quantum mechanics and many other fields. CO4: They understand about Unique Factorization Domain, Euclidean Domain and Principle Ideal Domain.
B.Sc. Sixth Semester	
Atomic and Molecular Physics (PHY-322)	CO1: Describe the Series in hydrogen, circular motion, nuclear mass effect, elliptical orbits, and energy levels. Fine structure, Sommer field and lamb shift. CO2: Explain General features, doublet structure, Larmor's theorem and magnetic levels, elementary theory of weak and strong magnetic fields, Zeeman Effect CO3: Systems with several electrons and spin functions. Complex Spectra: LS-Coupling scheme, normal triplets, selection rules and j-j coupling CO4: Explain rigid rotator, energy levels, Raman effect, Quantum theory of Raman effect. CO5: Describe the Non-rigid rotator: energy levels, spectrum, Vibrating-rotator energy levels, Infrared and Raman spectrum (no derivation of Dunham coefficients). CO6: Describes the Electronic Spectra: Electronic energy and potential curves, resolution of total energy, vibrational Structure of Electronic transitions. General formulae, Deslandre's table, absorption sequences (qualitative) and Vibrational analysis, Rotational Structure of Electronic bands CO7: Classification of electronic states: Orbital angular momentum, Spin, total angular momentum of electrons, Symmetry properties of electronic Eigen-functions.
Particle Physics (PHY-324)	CO1: Describe the energy loss of electrons and positrons, positron annihilation in condensed media, stopping power and range of heavier charged particles, Bethe-Bloch formula, interaction of gamma rays with matter. CO2: Explain and discuss nuclear detectors and counters. CO3: Describe accelerators: linear accelerators, cyclic accelerators, ion sources, focussing, stability, electron synchrotron, colliding beam machines, particle beams for fixed target experiments, CERN Super Proton Synchrotron (SPS) and Fermi lab Tevatron. CO4: Describe elementary particles and types of interactions, quantum numbers and conservation laws, isospin, charge conjugation, Yukawa theory, Introduction to quarks and qualitative discussion of the quark model, high energy physics units. CO5: Explain particle properties and their reactions, CO6: Discuss observations of different strange particles, strange particle
Physics Laboratory – VI (PHY-326)	CO1: Explain the characteristics of LED, photodiodes, silicon and GaAs solar cells. CO2: Explain the concept of a stable multi-vibrator, working of LASER.

	CO3: Understanding of Michelson interferometer and its applications. CO4: Describe the mechanism behind the production of electronic charge by Millikan oil drop method. CO5: Classify the heat capacity of different given materials.
Dynamics (MATH-321)	CO1: Basic terminologies of Dynamics CO2: Understand General motion of a rigid body, and apply in practical problems CO3: Able ability to apply knowledge of Dynamics in science and engineering CO4: Be proficient in the use of mathematical methods to analyze the forces and motion a system. CO5: Be able to identify, formulate, and solve science and engineering problems.
Programming in C & Numerical Methods (MATH-324)	CO1: Student will understand about the basic concept of C language. CO2: They will apply C language in solution of different practical problems. CO3: Students will be able to solve problems through programming in C and also handling functions CO4: They will solve linear and nonlinear problems using C language. CO5: They will be able to solve Integration, and solution of ordinary differential
Physical Chemistry-V (CHEM-322)	CO1: To learn importance of quantum mechanics, failure of classical concepts and some important basic principles of quantum mechanics. CO2: To understand the behaviour of particle in one and three dimensional box with translational energy, energy levels, quantization of energy and applications of particle in a box model. CO3: To learn about angular momentum, approximate Methods, operators used in quantum mechanics. CO4: Developing understanding for Valence-bond and molecular orbital approaches, electronic structures and pi-electron approximation.
Organic Chemistry-V (CHEM-323)	CO1: To learn importance of acyclic molecules, conformation, steric stereoelectronic effects and enantiomeric relationships. CO2: To understand the concept of free radical, carbanion nucleophile substitution reaction mechanism and regioselectivity. CO3: To learn about the alkylation of aldehydes, Favorskii rearrangements and aldol condensations. CO4: To understanding the concept of photochemistry, Jablonskidiagram, inter-system crossing singlet and triplet states. CO5: To understanding the concept of concerted reactions, unimolecular rearrangement and elimination reactions.