GOVERNMENT COLLEGE ROPAR

(Affiliated To Punjabi University, Patiala)

PROGRAMME OUTCOMES

Graduate Programme Outcomes-BA/BCom/BSc

Graduate programmes at Government College Ropar are outcome-based, with the following expected outcomes:

PO1	**Critical Thinking and Problem-Solving Skills:** Learners will gain advanced critical thinking and problem-solving abilities. They will be able to analyze complicated topics, assess evidence, examine many points of view, and develop novel solutions.
PO2	**Advanced Knowledge and Expertise:** Graduate programs aim to provide students with a deep understanding of their chosen field or specialization. Graduates will have acquired advanced knowledge, theories, methodologies, and skills specific to their area of study.
PO3	**Research and Scholarly Abilities:** Graduates will have the ability to design and conduct independent research, critically analyze existing literature, and contribute to the advancement of knowledge in their field.
PO4	**Effective Communication:** Focusing on developing strong communication skills. Students will be able to articulate complex ideas and research findings clearly and effectively, both in written and oral forms, to both specialized and non-specialized audiences.
PO5	**Cross-Disciplinary Knowledge:** Depending on the program, graduates may acquire cross-disciplinary knowledge, enabling them to integrate and apply concepts and methodologies from multiple fields to address complex problems and contribute to interdisciplinary collaboration.
PO6	**Professional Ethics and Responsibility:** emphasizing professional ethics, integrity, and social responsibility. Graduates will be equipped with ethical decision-making skills and an understanding of the social and ethical implications of their work.
PO7	**Professional and Career Development:** Providing students with opportunities for professional development, including internships, industry collaborations, and networking events.
PO8	**Adaptability and Lifelong Learning:** Programs aim to cultivate a growth mindset and a commitment to lifelong learning. Graduates will be prepared to adapt to new challenges, acquire new knowledge, and continuously develop their skills throughout their careers.

GOVERNMENT COLLEGE ROPAR

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PROGRAMME SPECIFIC OUTCOMES

B.Sc. Non Medical

The Bachelor of Science (Non-Medical) Programme at Government College Ropar is outcome-based, with the following PSOs required.

PSO1	**Proficiency in Physical Sciences**: Students will gain in-depth knowledge of physical sciences, including physics and chemistry. They will understand the fundamental principles, laws, and theories governing these subjects and be able to apply them in practical applications.
PSO2	**Solid Foundation in Mathematics:** Graduates will have a strong understanding of mathematical concepts, including calculus, algebra, statistics, and numerical methods, providing them with a solid foundation for further study or careers in fields such as mathematics, physics, or computer science.
PSO3	**Laboratory Techniques and Experimental Skills:** Learners will have practical experience in laboratory techniques, experimental design, data collection, analysis, and interpretation. They will be skilled in conducting experiments and utilizing laboratory equipment effectively and safely.
PSO4	**Scientific Research and Methodology:** Graduates will have a good understanding of scientific research methodologies and be able to design and conduct scientific experiments, analyze data, and draw meaningful conclusions.
PSO5	**Problem-Solving and Critical Thinking:** BSc Non-Medical programs cultivate problem-solving and critical thinking skills. Graduates will be able to analyze complex problems, think critically, and apply logical reasoning to propose effective solutions based on scientific principles and evidence.
PSO6	**Effective Communication of Scientific Concepts**: Graduates will be able to communicate scientific concepts and findings effectively. They will have strong written and oral communication skills and be proficient in presenting scientific information in a clear and concise manner.
PSO7	**Continuous Learning and Professional Development: P**rogram aim to instill a passion for continuous learning and professional development. Graduates will be equipped with the skills and motivation to pursue further education, such as postgraduate studies or professional certifications, and to keep up with advancements in their field.

The Bachelor of Science (Non-Medical) Programme at Government College Ropar is outcome-based, with the following COs required.

B.Sc. First Year Semester-I		
Course Name	**Course Outcomes**	
PHYSICS		
Mechanics-I	CO1	Students will develop a solid understanding of fundamental concepts and principles in mechanics, including Newton's laws of motion, kinematics, forces, energy, momentum, and equilibrium.
	CO2	Students will learn to apply mathematical and physical principles to solve mechanics problems
	CO3	Students will explore real-world applications of mechanics, such as motion of objects, gravitational forces, friction, projectile motion
Vibration and Waves-I	CO1	Students will develop a comprehensive understanding of wave phenomena, including the properties of waves, wave motion, wave types
	CO2	Students will learn to analyze and model vibrational systems, including single-degree-of-freedom systems and multi-degree-of-freedom systems.
	CO3	Students will gain proficiency in using mathematical models to describe and analyze wave behavior.
Electricity and Magnetism-I	CO1	Students will gain an understanding of the practical applications of electricity and magnetism in various fields
	CO2	They will develop problem-solving and analytical skills specific to electricity and magnetism.
CHEMISTRY		
Inorganic Chemistry	CO1	Graduates will learn about the periodic table, chemical symbols, atomic

		structure, and the properties of elements.
	CO2	Students will learn about the different types of chemical bonding in inorganic compounds
	CO3	Students will study the principles of coordination chemistry, including coordination compounds and complex ions.
Organic Chemistry	CO1	To help them understand the stereochemistry of organic compounds i.e. isomerism , conformations and configurations.
	CO2	Students will develop a fundamental understanding of the structure and bonding in organic compounds.
	CO3	Students will gain knowledge of spectroscopic techniques used in the characterization of organic compounds.
Physical Chemistry	CO1	Students will get a clear understanding of evaluation of analytical data ,liquid and gaseous states and physical properties like optical activity, dipole moment etc.
	CO2	They will learn about the principles of quantum mechanics, including wave-particle duality, atomic orbitals, and quantum numbers.
	CO3	Students will gain an understanding of chemical equilibrium and reaction rates.
MATHEMATICS		
Calculus 1	CO1	Students will understand the fundamental concepts of differential calculus and their applications
	CO2	They understand the basic concepts of integral calculus and their applications in problems.
	CO3	They also understand the relationship between the derivative and the definite integral as expressed in both parts of the

		Fundamental Theorem of Calculus.
Differential Equations	CO1	Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.
	CO2	Student will be able to find the complete solution of a non homogeneous differential equation as a linear combination of the complementary function and a particular solution.
Linear Algebra	CO1	Course demonstrate knowledge and understanding of topics including, but not limited to divisibility, prime numbers, congruences, quadratic reciprocity, Diophantine equations.
	CO2	Graduates can use mathematical induction and other types of proof writing techniques.

B.Sc. First Year Semester-II		
Course Name		**Course Outcomes**
PHYSICS		
Mechanics-II	CO1	Students will develop mathematical and computational skills necessary to solve mechanics problems, including vector algebra, calculus, trigonometry, and numerical methods.
	CO2	Mechanics courses may include laboratory components where students engage in hands-on experiments related to concepts covered in the course.
	CO3	Students will develop critical thinking skills and the ability to analyze complex mechanics problems.
Vibration and Waves-II	CO1	Students will explore the propagation of

		waves in different media, including solids, fluids, and gases.
	CO2	Students will learn about the practical applications of wave phenomena in various fields, such as acoustics, optics, signal processing
	CO3	Vibration and Waves courses often involve laboratory components where students conduct experiments related to wave phenomena.
Electricity and Magnetism-II	CO1	Students will develop a solid understanding of electrostatics, including Coulomb's law, electric fields, electric potential, electric flux, Gauss's law, and the concept of electric potential energy.
	CO2	Students will gain knowledge of magnetism and magnetic fields, including magnetic forces, magnetic materials, magnetic fields due to current-carrying wires, and the behavior of magnets.
	CO3	Students will study Maxwell's equations, which describe the fundamental principles of electromagnetism.
CHEMISTRY		
Inorganic Chemistry	CO1	tudents will learn about the chemical reactions involving inorganic compounds, including redox reactions, precipitation reactions, acid-base reactions, and complexation reactions.
	CO2	They will study acid-base reactions, pH, pOH, and acid-base titrations.
	CO3	Students will explore the periodic trends in the properties of elements, including atomic size, ionization energy, electron affinity, electronegativity, and metallic character.
Organic Chemistry	CO1	Students get a clear understanding about the nomenclature and classification, preparation and chemical properties of

		various organic compounds like alkanes,alkenes, alkynes and their derivatives.
	CO2	Students will be introduced to the principles and strategies of organic synthesis.
	CO3	Students will study the properties and reactions of aromatic compounds, including benzene and its derivatives.
Physical Chemistry	CO1	Students will get to know about physical and chemical properties of solutions and colloids.
	CO2	They will have knowledge about chemical kinetics and catalysis.
MATHEMATICS		
Calculus-II	CO1	Students Can determine asymptotes for rational expressions .
	CO2	They can locate the x and y intercepts, any undefined points, and any asymptotes
	CO3	Graduates can determine if there is any symmetry to aid in the graphing process.
Partial differential equation	CO1	Course enables students to classify partial differential equations and transform into canonical form
	CO2	They can solve linear partial differential equations of both first and second order
	CO3	They can apply partial derivative equation techniques to predict the behavior of certain phenomena
Analytic Geometry	CO1	It Describe the various forms of equation of a plane, straight line, Sphere, Cone and Cylinder.
	CO2	Students can find the angle between planes, Bisector planes, Perpendicular distance from a point to a plane, Image of a line on a plane, Intersection of two lines

B.Sc. Second Year Semester-III

Course Name	Course Outcomes	
PHYSICS		
Statistical and Thermodynamic Physics-I	CO1	Students will learn how to apply statistical methods to describe and analyze the behavior of large systems of particles.
	CO2	They will study distributions such as the Maxwell-Boltzmann distribution, Fermi-Dirac distribution, and Bose-Einstein distribution, and how these distributions relate to the properties of particles in different quantum states.
	CO3	Students will explore the concepts of phase transitions and critical phenomena in statistical and thermodynamic systems.
Optics	CO1	Students will develop a solid understanding of the principles of optics, including the behavior and properties of light
	CO2	They will learn how to analyze and design optical systems using geometrical optics principles.
	CO3	Students will gain an understanding of the wave nature of light and its applications in various optical phenomena.
Quantum Physics- I	CO1	Graduates will learn about the mathematical formalism of quantum mechanics, including wave functions, operators, and the Schrödinger equation.
	CO2	Students will study the behavior of quantum systems, including particles in potential wells, harmonic oscillators, and central potentials.
	CO3	Students will learn about fundamental quantum phenomena and experiments that support quantum mechanics, such as the double-slit experiment, the photoelectric effect, and the Stern-

		Gerlach experiment.
CHEMISTRY		
Inorganic Chemistry	CO1	Students will deepen their understanding of coordination chemistry by studying advanced topics such as isomerism, crystal field theory, ligand field theory, and spectrochemical series.
	CO2	They will learn about the structure, reactivity, and applications of compounds containing these elements.
Organic Chemistry	CO1	Students will get a clear understanding about the nomenclature, classification, preparation and chemical properties of various organic compounds like alcohols ,phenols ,aldehydes and ketones.
	CO2	They will learn about reaction intermediates, reaction kinetics, and factors influencing reaction rates and selectivity.
Physical Chemistry	CO1	Students will be able to understand the thermodynamics, chemical equilibrium.
	CO2	Students will be studying statistical approaches to chemical systems.
MATHEMATICS		
Analysis 1	CO1	Students will be able to understand the concept of limit for real functions and be able to calculate limits of standard functions and construct simple proofs involving this concept;
	CO2	Student will be introduced to the concept of continuity and be familiar with the statements and proofs of the standard results about continuous real functions;
	CO3	Student will understand the concept of the differentiability of a real valued function and be familiar with the statements and proofs of the standard results about differentiable real functions.
Mechanics	CO1	This course enables students to

		understand the reduction of force system in three dimensions to a resultant force acting at a base point and a resultant couple, which is independent of the choice of base of reduction.
	CO2	This course enables students to learn about a nul point, a nul line, and a nul plane with respect to a system of forces acting on a rigid body together with the idea of central axis.
Advanced calculus	CO1	The student is expected to learn about the basic principles of multi-variable calculus with proofs.
	CO2	To have full knowledge of calculus involving the fundamental tools such as continuity and differentiability
	CO3	Students are able to reason rigorously in mathematical arguments. They can follow abstract mathematical arguments and write their own proofs.

B.Sc. Second Year Semester-IV		
Course Name		**Course Outcomes**
PHYSICS		
Statistical and Thermodynamic Physics-II	CO1	Students will gain knowledge of thermodynamic potentials, such as internal energy, enthalpy, entropy, and free energy.
	CO2	courses often involve computational techniques and simulations.
Lasers	CO1	They may study topics such as lasers, optical fibers, spectrometers, optical sensors, holography, and imaging systems.
	CO2	Students will gain knowledge of the principles of lasers, including stimulated emission, population inversion, and laser cavity configurations.
	CO3	students will conduct experiments

		related to optics and laser phenomena.
Quantum Physics- II	CO1	Learners will study the behavior of particles in spherically symmetric potentials, the hydrogen atom, and other quantum systems with rotational symmetry.
	CO2	They may explore topics such as the quantization of electromagnetic fields
	CO3	Students will develop problem-solving and mathematical skills specific to quantum physics.
CHEMISTRY		
Inorganic Chemistry	CO1	Graduates will learn about the synthesis, structure, bonding, and reactivity of organometallic compounds and their applications in catalysis.
	CO2	Students will expand their knowledge of the properties and reactions of inorganic compounds.
Organic Chemistry	CO1	Students get a clear understanding about the nomenclature and classification, preparation and chemical properties of various organic compounds like carboxylic acids and its derivatives, nitro and amine compounds.
	CO2	Students will study the principles of stereochemistry in organic chemistry.
Physical Chemistry	CO1	Students will get to know about phase equilibrium and electrochemistry.
	CO2	Students will study advanced topics in chemical kinetics and reaction dynamics.
MATHEMATICS		
Analysis-II	CO1	This course enables students to compute sums, products, quotients, conjugate, modulus, and argument of complex numbers
	CO2	They can write equation of straight line, circle in complex form
	CO3	Find parameterizations of curves, and

		compute complex line integrals directly.
Numerical Method	CO1	Students will learn various techniques for numerical approximation, including interpolation, curve fitting, and numerical differentiation and integration.
	CO2	Students will study methods for solving equations numerically, including root-finding algorithms such as the bisection method, Newton-Raphson method, and secant method.
Number Theory	CO1	Students will develop an understanding of prime numbers, composite numbers, and the fundamental theorem of arithmetic.
	CO2	Students will study modular arithmetic and its applications in Number Theory.
	CO3	They will learn techniques such as the Euclidean algorithm and continued fractions to find solutions.

B.Sc. Third Year Semester-V		
Course Name		**Course Outcomes**
PHYSICS		
Condensed Matter Physics-I	CO1	Graduates will learn about the classification of materials, the importance of length scales, and the key characteristics of condensed matter systems.
	CO2	Students will study the crystal structure of materials and the symmetry principles that govern their properties.
Electronics-I	CO1	Students will develop a solid understanding of various electronic components
	CO2	Students will learn the principles and techniques of electronic circuit design.
	CO3	Students will gain knowledge of analog electronic circuits and systems.
Nuclear and Radiation	CO1	Students will develop an understanding

Physics		of nuclear structure and properties.
	CO2	Students will explore nuclear reactions and their applications
	CO3	Students may explore the applications of nuclear physics in medicine and healthcare.
CHEMISTRY		
Inorganic Chemistry	CO1	Students will be given the knowledge of metal ligand bonding , thermodynamic , kinetic, spectral and magnetic properties of transition metals.
	CO2	They will learn to interpret and analyze periodic trends.
	CO3	They will study coordination geometries, isomerism, and electronic structure of transition metal complexes.
Organic Chemistry	CO1	Students will be introduced to complete concepts of of UV,IR and NMR spectroscopy .
	CO2	They will be given sufficient knowledge of organometallic compounds.
Physical Chemistry	CO1	Students will be introduced to concepts of Quantum Chemistry , rotational and vibrational spectroscopy.
	CO2	They will apply quantum mechanical principles to understand the electronic structure of atoms and molecules, including molecular orbital theory and computational methods.
	CO3	Students will explore the principles and applications of molecular spectroscopy.
MATHEMATICS		
Algebra 1	CO1	This course enables students to Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces
	CO2	This course enables students to Use matrix algebra and the related matrices to

		linear transformations,
	CO3	They can identify and construct linear transformations of a matrix.
Mathematical methods -I	CO1	This course enables students to understand the importance of algebraic properties with regard to working within various number systems.
	CO2	Graduates can extend group structure to finite permutation groups (Cayley's Theorem).
	CO3	This course enables students to understand the three major concrete models of Boolean algebra: the algebra of sets, the algebra of electrical circuits, and the algebra of logic.
Discrete Mathematics- I	CO1	Graduates can Learn about partially ordered sets, lattices and their types.
	CO2	This course enables students to understand Boolean algebra and Boolean functions, logic gates,switching circuitsand their applications.
	CO3	They can solve real-life problems using finite-state and Turing machines.

B.Sc. Third Year Semester-VI		
Course Name		**Course Outcomes**
PHYSICS		
Condensed Matter Physics-II	CO1	Students will gain knowledge of lattice vibrations in solids and the role of phonons in determining thermal and mechanical properties.
	CO2	Students will gain an understanding of the physics of semiconductors, including the behavior of charge carriers and the principles of semiconductor devices.
	CO3	Students may study the phenomenon of superconductivity

Electronics-II	CO1	Students will study semiconductor devices, including diodes and transistors.
	CO2	Students will gain practical skills in electronic measurement and testing techniques.
Nuclear and Particle Physics	CO1	Students will study the fundamental particles and their interactions
	CO2	Students will gain knowledge of particle detectors and experimental techniques used in nuclear and particle physics research.
CHEMISTRY		
Inorganic Chemistry	CO1	Students will be given the knowledge of silicon ,phosphazenes bioinorganic chemistry and HSAB concept.
	CO2	Students will gain an understanding of solid state chemistry, focusing on the structure, properties, and applications of solids.
Organic Chemistry	CO1	Students get a clear understanding about the nomenclature and classification, preparation and chemical properties of various organic compounds like heterocyclic compounds ,carbohydrates and amino acids.
	CO2	Students will deepen their knowledge of spectroscopic techniques for structural analysis.
	CO3	They will learn about concepts such as reaction kinetics, thermodynamics, reaction intermediates, and transition state theory.
Physical Optimization Techniques Chemistry	CO1	Students will get to know the Raman and Electronic Spectroscopy
	CO2	They will also study different laws of crystallography under solid state.
	CO3	Students may study advanced spectroscopic techniques used in physical chemistry research.

MATHEMATICS		
Optimization Techniques	CO1	Students will gain an understanding of the fundamental concepts and principles of optimization.
	CO2	Students will study linear programming, which involves optimizing a linear objective function subject to linear constraints.
Mathematical method-II	CO1	This course enables students to introduce the concepts of partial differential equations, Calculus of Finite differences, statistics, Fourier series and Fourier transform. Identify real phenomena as models of partial derivative equations.
	CO2	This course enables students to solve real problems by identifying them appropriately from the perspective of partial derivative equations.
	CO3	Students can apply the concept of probability to find the physical significance of various distribution phenomena.
Discrete mathematics-II	CO1	The course aims at introducing the concepts of ordered sets, lattices, sublattices and homomorphisms between lattices.
	CO2	The course aims at introducing the concepts of ordered sets, lattices, sublattices and homomorphisms between lattices.
	CO3	The second part of this course deals with introduction to graph theory, paths and circuits, Eulerian circuits, Hamiltonian graphs and finally some applications of graphs to shortest path algorithms.