

## **PROGRAMME OUTCOMES (PO)**

**Programme Name:**

**FIRST DEGREE PROGRAMME IN MATHEMATICS (CORE)**

<b>PO1</b>	A thorough knowledge of fundamental mathematical facts
<b>PO2</b>	Enhanced skills of reasoning, analytical and problem solving
<b>PO3</b>	Students become capable to pursue further studies in mathematics and research.
<b>PO4</b>	Students become capable to teach the mathematics curriculum at the secondary level.
<b>PO5</b>	Uphold scientific integrity and objectivity in professional endeavors.
<b>PO6</b>	Communicate Mathematics effectively by oral, written, computing and graphical means.
<b>PO7</b>	Demonstrate skills in the use of computers for control, data acquisition, and data analysis in experimental investigations

**Programme Name:**

**FIRST DEGREE PROGRAMME IN CHEMISTRY  
(COMPLEMENTARY)**

<b>PO1</b>	Apply mathematical tools and methods for understanding the theory of Chemistry and develop the capability of applying the same in solving problems in Chemistry
<b>PO2</b>	Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.
<b>PO3</b>	Provide a systematic understanding of the concepts and theories of mathematics and their application in the real world – to an advanced level, and enhance career prospects in a huge array of fields.
<b>PO4</b>	Demonstrate a range of appropriate Mathematical and logical skills including IT competency.

**Programme Name:**

**FIRST DEGREE PROGRAMME IN PHYSICS  
(COMPLEMENTARY)**

<b>PO1</b>	Apply mathematical tools and methods for understanding the theory of Physics and develop the capability of applying the same in solving problems in Physics
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<b>PO2</b>	Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.
<b>PO3</b>	Provide a systematic understanding of the concepts and theories of mathematics and their application in the real world – to an advanced level, and enhance career prospects in a huge array of fields.
<b>PO4</b>	Demonstrate a range of appropriate Mathematical and logical skills including IT competency.

**Programme Name:**

**FIRST DEGREE PROGRAMME IN ECONOMICS  
(COMPLEMENTARY)**

<b>PO1</b>	Apply mathematical tools and methods for understanding the theory of Economics and develop the capability of applying the same in solving problems in Economics
<b>PO2</b>	Evaluate hypotheses, theories, methods and evidence within their proper contexts.
<b>PO3</b>	Solve complex problems by critical understanding, analysis and synthesis.
<b>PO4</b>	Understand the relevance of multidisciplinary studies in developing a subject

**Programme Name:**

**PG PROGRAMME IN MATHEMATICS**

<b>PO1</b>	Students will acquire the knowledge theory and methods in mathematics, including some from the research frontier of the field, as well as knowledge of the application of these models and methods to problems pertaining to other scientific areas and to the business world.
<b>PO2</b>	The graduates get skills in using computer calculations as a tool to carry out scientific investigations and in planning and performing calculations, usually computer-based, using mathematical models.
<b>PO3</b>	The students obtain proficiency in solving scientific problems by using a combination of theory, numerical simulation, and experiments, as well as in developing new variants of the acquired methods, if required by the problem at hand.
<b>PO4</b>	The students are able to make contributions to the generation of new scientific insights or to the innovation of new applications of research within the field
<b>PO5</b>	Select, interpret and critically evaluate information from a range of sources

	that include books, scientific reports, journals, case studies and the internet.
<b>PO6</b>	Recognize the need to engage in lifelong learning through continuing education and research.
<b>PO7</b>	Demonstrate engagement with current research and developments in the subject.

<b>COURSE OUTCOMES (CO) for UG</b>	
<b>Course Name: Methods of Mathematics</b>	
<b>Semester:1</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Gain practice in writing algebraic proofs. Intuitive idea on the methods of Induction and Principle of Well Ordering. Study Euclid's Algorithm and the Fundamental Theorem on Arithmetic
<b>CO2</b>	Approximate solutions to problems through graphical methods. Use of computers in plotting graphs should be demonstrated, using Open Source Software such as <i>GeoGebra</i> or <i>Gnuplot</i> .
<b>CO3</b>	A complete characterization of graphs of second degree equations in two variables, thus getting an algebraically unified description of conics.
<b>Course Name: Mathematics-I (Differentiation and Analytic Geometry)</b>	
<b>Semester:1</b>	
<b>Type of Course: Complementary (for Chemistry)</b>	
<b>CO1</b>	Applying methods of Differentiation in understanding principles of Chemistry and in solving problems
<b>CO2</b>	Getting idea on Rolle's Theorem and Mean Value Theorem and the velocity interpretation of Mean Value Theorem.
<b>CO3</b>	Getting familiarity of equations of surfaces such as sphere, cylinder, cone, paraboloid, ellipsoid, hyperboloid etc.
<b>CO4</b>	A complete characterization of graphs of second degree equations in two variables, thus getting an algebraically unified description of conics.
<b>Course Name: Mathematics-I (Differentiation and Analytic Geometry)</b>	
<b>Semester:1</b>	
<b>Type of Course: Complementary (for Physics)</b>	
<b>CO1</b>	Applying methods of Differentiation in understanding principles of Physics and in solving problems

<b>C02</b>	Getting idea on Rolle's Theorem and Mean Value Theorem and the velocity interpretation of Mean Value Theorem.
<b>C03</b>	Getting familiarity of equations of surfaces such as sphere, cylinder, cone, paraboloid, ellipsoid, hyperboloid etc.
<b>C04</b>	A complete characterization of graphs of second degree equations in two variables, thus getting an algebraically unified description of conics.
<b>Course Name: Mathematics for Economics-I</b>	
<b>Semester:1</b>	
<b>Type of Course: Complementary (for Economics)</b>	
<b>C01</b>	Getting awareness on the increased use of mathematical methods in Economics.
<b>C02</b>	Study different functions in economic theory
<b>C03</b>	Applying methods of Differentiation in understanding principles of Economics and in solving problems
<b>Course Name: Foundations of Mathematics</b>	
<b>Semester:2</b>	
<b>Type of Course: Core</b>	
<b>C01</b>	Study more properties and applications of the idea of congruence. Getting ideas on Fermat's and Euler's Theorems.
<b>C02</b>	Understand how the ideas of maxima and minima can be used to solve practical problems. Enhance skill in various techniques of integration.
<b>C03</b>	Demonstrate areas in polar coordinates and the polar equations of conics and apply the knowledge in problems in astronomy
<b>Course Name: Mathematics-II (Integration, Power Series and Linear Algebra)</b>	
<b>Semester:2</b>	
<b>Type of Course: Complementary (for Chemistry)</b>	
<b>C01</b>	The idea of approximating the volume under a bounded surface in 3-space by volumes of boxes, leading to the definition of double integrals of functions of two variables over bounded regions.
<b>C02</b>	Use of cylindrical and spherical co-ordinates in evaluating triple integrals. Applications of triple integrals to finding volumes of solid objects.
<b>C03</b>	Taylor series and Maclaurin series and representation of functions by Taylor series.
<b>C04</b>	Vector Space $R^n$
<b>Course Name: Mathematics-II (Integration, Power Series and Linear Algebra)</b>	

<b>Semester:2</b>	
<b>Type of Course: Complementary (for Physics)</b>	
<b>CO1</b>	The idea of approximating the volume under a bounded surface in 3-space by volumes of boxes, leading to the definition of double integrals of functions of two variables over bounded regions.
<b>CO2</b>	Use of cylindrical and spherical co-ordinates in evaluating triple integrals. Applications of triple integrals to finding volumes of solid objects.
<b>CO3</b>	Taylor series and Maclaurin series and representation of functions by Taylor series.
<b>CO4</b>	Vector Space $R^n$
<b>Course Name: Mathematics for Economics-II</b>	
<b>Semester:2</b>	
<b>Type of Course: Complementary (for Economics)</b>	
<b>CO1</b>	Application of differentiation in finding marginal concepts and Elasticity
<b>CO2</b>	Apply the knowledge of partial derivatives in finding inferior and normal goods, competitive and complementary goods, partial elasticity, maxima and minima problems in economics.
<b>CO3</b>	Formulating LPP and solving the same using graphical method
<b>Course Name: Algebra and Calculus-I</b>	
<b>Semester:3</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Critically study the units of the ring of congruence classes leading to the definition of an abstract group, which culminates in the Abstract Fermat's Theorem
<b>CO2</b>	Study the origin of the concept of vectors in physics and engineering
<b>CO3</b>	extend the operations of differentiation and integration to vector valued functions of a real variable, with emphasis on geometry and physics
<b>Course Name: Mathematics-III (Vectors and Differential Equations)</b>	
<b>Semester:3</b>	
<b>Type of Course: Complementary (for Chemistry)</b>	
<b>CO1</b>	Develop proficiency in the analysis of vector valued functions.
<b>CO2</b>	Applying Green's theorem, Divergence theorem and Stoke's theorem in solving vector problems
<b>CO3</b>	Acquiring the skill of solving first and second order ordinary differential equations with appropriate methods
<b>Course Name: Mathematics-III (Vectors and Differential</b>	

<b>Equations)</b>	
<b>Semester:3</b>	
<b>Type of Course: Complementary (for Physics)</b>	
<b>CO1</b>	Develop proficiency in the analysis of vector valued functions.
<b>CO2</b>	Applying Green's theorem, Divergence theorem and Stoke's theorem in solving vector problems
<b>CO3</b>	Acquiring the skill of solving first and second order ordinary differential equations with appropriate methods
<b>Course Name: Mathematics for Economics-III</b>	
<b>Semester:3</b>	
<b>Type of Course: Complementary (for Economics)</b>	
<b>CO1</b>	Getting proficiency in Integration techniques. Familiarize some immediate applications of integration in economics such as finding total from marginal.
<b>CO2</b>	Study various infinite series namely, Geometric series, Taylor series and Exponential series.
<b>CO3</b>	Introduction to Matrix Algebra.
<b>Course Name: Algebra and Calculus-II</b>	
<b>Semester:4</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Demonstration of irreducible polynomials with real coefficients
<b>CO2</b>	A clear idea of functions of two variable and their graphs, differentiability and differentials of such functions
<b>CO3</b>	Integration in space
<b>Course Name: Mathematics-IV (Theory of Equations, Abstract Algebra and Linear Transformations)</b>	
<b>Semester:4</b>	
<b>Type of Course: Complementary (for Chemistry)</b>	
<b>CO1</b>	Fundamental theorem of Algebra and different methods of solving equations upto degree 4.
<b>CO2</b>	Introductory Group theory with illustrations
<b>CO3</b>	Linear transformations from $R^n$ to $R^m$
<b>Course Name: Mathematics-IV (Complex Analysis, Theory of Equations, Fourier Series and Fourier Transforms)</b>	
<b>Semester:4</b>	
<b>Type of Course: Complementary (for Physics)</b>	

<b>CO1</b>	Fundamental theorem of Algebra and different methods of solving equations upto degree 4.
<b>CO2</b>	Functions of a complex variable and Sufficient conditions for differentiability
<b>CO3</b>	Fourier series, Fourier integrals and Properties and applications of Fourier transforms.
<b>Course Name: Mathematics for Economics-IV</b>	
<b>Semester:4</b>	
<b>Type of Course: Complementary (for Economics)</b>	
<b>CO1</b>	Thorough with solution of first and second order differential equations with constant coefficients, the solutions of which are important in most mathematical models.
<b>CO2</b>	Familiar with some applications of integration to Economics, like Domar's capital expansion model
<b>CO3</b>	Study difference equations and its applications in Economics
<b>Course Name: Real Analysis I</b>	
<b>Semester:5</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Study the notion of real numbers and the ideas of limits in a formal manner
<b>CO2</b>	Students attain skills of doing problems on their own, to gain practice in writing rigorous proofs.
<b>CO3</b>	Get exposed to plotting softwares such as Geogebra to plot various functions
<b>Course Name: Complex Analysis I</b>	
<b>Semester:5</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Study the basic properties of complex numbers and extend the notions of differentiation and integration to complex functions
<b>CO2</b>	The use of complex numbers in number theory and geometry, behaviour of different power series on the circle of convergence.
<b>CO3</b>	Connect the integral of the function along a contour with limit of the Riemann sums
<b>Course Name: Differential Equations</b>	
<b>Semester:5</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Get an idea on how differential equations arise in various physical problems and study some methods to solve first order and second order linear

	differential equations
<b>CO2</b>	Understand integration from the viewpoint of differential equations and direction fields and able to work out problems related to these ideas
<b>Course Name: Vector Analysis</b>	
<b>Semester:5</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Study the notion of a vector field and its divergence and curl, the del and Laplacian operators. A clear idea on conservative vector fields.
<b>CO2</b>	Green's Theorem and its significance
<b>CO3</b>	Study the notion of a surface integral, Gauss's Theorem and Stoke's Theorem and their applications
<b>Course Name: Abstract Algebra I</b>	
<b>Semester:5</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Study definitions and properties of abstract groups and subgroups with illustrations and problems.
<b>CO2</b>	Study group of permutations in detail and understand the significance of Lagrange's Theorem
<b>CO3</b>	Students get training to write proofs and to do problems, based on axioms
<b>Course Name: Operations Research</b>	
<b>Semester:5</b>	
<b>Type of Course: Open</b>	
<b>CO1</b>	Beat the fear of Mathematics
<b>CO2</b>	Understand meaning, scope and utility of the subject OPERATIONS RESEARCH.
<b>CO3</b>	Study the formulation and solution of LPP, study some optimization techniques.
<b>Course Name: Real Analysis II</b>	
<b>Semester:6</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Study the three properties of continuity, differentiability and Riemann integrability of real functions.
<b>CO2</b>	Able to demonstrate differentiation from a conceptual point of view.
<b>CO3</b>	establish the links between anti-differentiation and Riemann integration
<b>Course Name: Linear Algebra</b>	
<b>Semester:6</b>	
<b>Type of Course: Core</b>	



<b>CO1</b>	Familiar with the basics of linear algebra and matrix theory with emphasis on their geometrical aspects.
<b>CO2</b>	Able to bring together some aspects of analytic geometry of two dimensions, solutions of simultaneous equations in two unknowns and theory of $2 \times 2$ matrices under the unified theme of linear transformations of the plane
<b>CO3</b>	Extend the above aspect to three dimensional and arbitrary spaces
<b>Course Name: Complex Analysis II</b>	
<b>Semester:6</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Study some of the basic properties of functions analytic in a disc or on a punctured disc.
<b>CO2</b>	Critically evaluate application of the Residue Theorem in the evaluation of some integrals.
<b>CO3</b>	Study the application of Contour Integral Methods to Evaluation and Estimation of Sums
<b>Course Name: Abstract Algebra II</b>	
<b>Semester: 6</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Study more theory and problems in group theory and also the basics of ring theory
<b>CO2</b>	Study homomorphisms and factor rings
<b>Course Name: Computer Programming (Practicals)</b>	
<b>Semester:6</b>	
<b>Type of Course: Core</b>	
<b>CO1</b>	Become experts in document preparation in computers using the LATEX
<b>CO2</b>	Acquire the basics of computer programming using Python
<b>CO3</b>	Understand the fundamentals of operating systems namely, gnu/Linux
<b>Course Name: Graph Theory</b>	
<b>Semester:6</b>	
<b>Type of Course: Elective</b>	
<b>CO1</b>	Understand some of the fundamental concepts in Graph Theory and develop better knowledge of the subject so as to use these ideas skillfully in solving real world problems.
<b>CO2</b>	Study the Konigsberg problem, the Chinese postman problem and the Teleprinter's problem and their graph models and solutions
<b>CO3</b>	Study Kuratowski's graphs and their importance in the theory of planar

graphs
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<b>COURSE OUTCOMES (CO) for UG Statistics</b>	
<b>Course Name: Descriptive Statistics and Introduction to Probability</b>	
<b>Semester:1</b>	
<b>Type of Course: Complementary</b>	
<b>CO1</b>	To understand characteristics of statistical data and describing data through illustrating examples using charts and diagrams
<b>CO2</b>	Collection of primary and secondary data for sampling and various sampling techniques for data analysis.
<b>CO3</b>	Types of descriptive statistics for the calculation of characteristics of data
<b>CO4</b>	Concept of random experiments and the introduction of probability. Practical based on the above techniques is done
<b>Course Name: Random Variables</b>	
<b>Semester:2</b>	
<b>Type of Course: Complementary</b>	
<b>CO1</b>	Introduction of elementary ideas of random variables
<b>CO2</b>	Getting idea of bivariate data including fitting of curves
<b>CO3</b>	A complete characterization of correlation and regression and their practical based problems
<b>Course Name: Probability Distributions and Theory of Estimation</b>	
<b>Semester:3</b>	
<b>Type of Course: Complementary</b>	
<b>CO1</b>	Introduces the basic probability models, limit theorems and sampling distributions
<b>CO2</b>	Getting idea on statistical inference and related methods of statistical estimation.
<b>CO3</b>	Getting familiarity of statistical tables and can judge the quality of estimators.
<b>CO4</b>	Practical based on probability distributions and applications, law of large numbers and CLT, Point estimation and interval estimation
<b>Course Name: Testing of Hypotheses and Analysis of Variance</b>	

<b>Semester:4</b>	
<b>Type of Course: Complementary</b>	
<b>CO1</b>	Getting awareness on the testing of hypothesis using various distributions
<b>CO2</b>	Introducing the concept of analysis of variance
<b>CO3</b>	Practical problems based on testing of hypotheses and analysis of variance
<b>Course Name: Practical using Excel (Practical)</b>	
<b>Semester: 4</b>	
<b>Type of Course: Complementary</b>	
	Learn to use statistical tools available in Excel for training in data analysis
	Evaluate hypotheses, theories, methods and evidence within their proper contexts
	Develop Minor Projects designed with the syllabus in which the students formulate a project works