Department of Mathematics
Maulana Azad College
8, Rafi Ahmed Kidwai Road, Kolkata - 700013

Programme Outcomes (POs) for Mathematics Honours

- **PO-1: Develop disciplinary knowledge and observation skill.**
  This emphasizes building a solid foundation in the subject matter and honing the ability to observe and analyze details within that field.
- **PO-2: Grow analytical and logical thinking ability.**
  This aims to enhance students' critical thinking skills, enabling them to break down complex problems into smaller, manageable parts, and reason logically to arrive at solutions.
- **PO-3: Learn to formulate model from observation of specific real-world problems.**
  This encourages students to apply their knowledge to real-world scenarios, observe and analyze specific problems, and develop models or frameworks to understand and address them.
- **PO-4: Acquired problem-solving skills / Numerical skill.**
  This focuses on equipping students with practical problem-solving strategies and a strong foundation in numerical skills, which are essential in many fields.
- **PO-5: Cultivate computer programming skill and its applications.**
  This emphasizes the importance of developing programming skills and the ability to apply them in various contexts, given the increasing role of technology in today's world.
- **PO-6: Develop innovative thinking and interdisciplinary knowledge.**
  This encourages students to think creatively and come up with novel solutions, while also fostering an understanding of how different disciplines connect and interact.
- **PO-7: Motivate towards higher studies & research.**
  This aims to inspire students to pursue further education and engage in research, contributing to the advancement of knowledge in their field.
- **PO-8: Empower to appear for various competitive examinations.**
  This focuses on preparing students for competitive examinations, such as those for higher education or professional careers, by equipping them with the necessary knowledge and skills.

Programme Specific Outcome (PSO) for Mathematics Honours

- **PSO-1. Foundation of core mathematical concept.**
  The program will provide students with a strong understanding of fundamental mathematical concepts, which include areas like Real Analysis, Complex Analysis, Calculus, Linear algebra, Abstract algebra, Differential equations, Number theory, Probability and statistics, Discrete mathematics.
- **PSO-2. Application of Mathematical tools to solve real-world problems.**
  The students should be able to use mathematical models to analyze and solve problems in various fields like engineering, finance, economics, and data science. They can apply mathematical techniques to real-world data to extract meaningful insights and make informed decisions. They develop and implement algorithms for solving complex problems.
- **PSO-3. Research communication and lifelong learning.**
  The student will develop essential skills for a successful career in mathematics or related fields:
  Research communication: Students should be able to effectively communicate their research findings through presentations, reports, and publications.
  Lifelong learning: Mathematics is a constantly evolving field. Students should be equipped with the skills and motivation to continue learning and adapting to new developments throughout their careers.

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Programme Outcomes (POs) for Mathematics as Generic Elective (GE) under CBCS

The **Programme Outcomes** (POs) describe the knowledge, skills, and attitudes that students are expected to acquire upon completing Mathematics as a Generic Elective course. These outcomes focus on the interdisciplinary application and foundational understanding of Mathematics for students pursuing other disciplines. The POs can be articulated as follows:

- **PO-1. To enhanced Analytical Skills**
  Develop the ability to analyze complex problems logically and systematically, using mathematical reasoning and methodologies.
- **PO-2. To acquired fundamental knowledge of Mathematics**
  Acquire a foundational understanding of key mathematical concepts, including algebra, calculus, statistics, and linear programming, which are essential across various domains.
- **PO-3. To acquired problem-solving abilities**
  Foster critical thinking and problem-solving skills by working through mathematical models and real-life scenarios, enabling students to approach challenges methodically.
- **PO-4. To improved Logical Reasoning**
  Strengthen logical reasoning skills, contributing to better decision-making and a structured approach to problem-solving in various fields.
- **PO-5. Awareness of the Role of Mathematics and Interdisciplinary Integration**
  Appreciate the importance and universality of mathematics in addressing global challenges, contributing to innovation and development. Apply mathematical tools and techniques in fields such as economics, physics, computer science, and social sciences, enhancing their interdisciplinary utility.
- **PO-6. Lifelong Learning and Adaptability**
  Instil an enthusiasm for mathematics, promoting continuous learning and adaptability to new mathematical concepts and tools throughout life.
- **PO-7. Ethical and Social Responsibility**
  Encourage the ethical use of mathematical knowledge and skills to address societal challenges responsibly and sustainably.

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Course Outcomes (COs) of Mathematics Honours under CBCS

Corse Code	Course Name	Course Outcome
CC1	Calculus, Geometry& Vector Analysis	**On completion of this course, the student will be able to** • **CO-1. Understand Fundamental Concepts** Develop a solid foundation in the principles of calculus, analytical geometry, and vector analysis, including differentiation, integration, and vector operations. • **CO-2. Apply Calculus for solving several problems** Solve real-world problems involving rates of change, optimization, and areas/volumes using techniques of single-variable and multivariable calculus. • **CO-3. Acquired knowledge on Analytical Geometry** Analyze and interpret the properties of lines, planes, and conic sections in two and three dimensions and solve geometric problems in 3D space. • **CO-4. Apply Vector Calculus in various field** Apply concepts of gradient, divergence, and curl to physical and engineering problems, using integral theorems such as Green's, Stokes', and Gauss' theorems. • **CO-5. Solve Interdisciplinary Problems** Utilize mathematical tools from calculus, geometry, and vector analysis to model and solve problems in physics, engineering, and other sciences.
CC2	Algebra	**On completion of this course, the student will be able to** • **CO-1. Complex Numbers** Develop proficiency in handling complex numbers and their applications, including De Moivre's theorem and roots of complex equations. This will be foundation of complex analysis. • **CO-2. Theory of Equations** Analyze and solve polynomial equations using techniques like factorization, synthetic division, and fundamental theorems of algebra. • **CO-3. Inequalities** Develop a solid understanding of classical inequalities such as the Cauchy-Schwarz inequality, AM-GM inequality and their applications. • **CO-4. Set theory and Number theory** Develop proficiency in handling relation, mapping, basic concepts of number theory which will foundation of DiscreteMathematics. • **CO-5. Matrix Theory and Applications** Acquired concepts of matrix theory and its application to linear system of equations which will be an introduction of linear algebra.
CC3	Real Analysis	**On completion of this course, the student will be able to** • **CO-1. Understand the Rigorous Foundations of Real Analysis** Develop a deep understanding of the Real number system as a complete ordered field with celebrated Bolzano Weierstrass theorem,open set, closed set and dense set in R. • **CO-2. Learn the concept of sequence & its Convergence.** Develop the concept of sequence, convergence of a sequence and its important theorems. This course will make a foundation of sequence of functions and its convergence. • **CO-3. Learn the Concept of Series of Real Numbers.** Develop the concept of a series as a sequence of partial sum, series of positive terms, series of arbitrary termsand related theorems. This course will make a foundation of series of functions and its convergence. • **CO-4. Learn Problem-Solving Skill and Proof Techniques.** Enhance problem-solving skills by constructing rigorous proofs for theorems in real analysis, sequence and series of real numbers and related results. • **CO-5. Demonstrate Graphically using software.** Develop the concept of plotting of recursive sequence, concept of convergence of sequence and series

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Corse Code	Course Name	Course Outcome
CC4	**Group Theory-I**	**On completion of this course, the students will acquire knowledge on** • **CO-1. Understanding Group Structures** Develop a foundational understanding of basic concept of group theory with the help of several examples, several properties, concept of sub-groups, center of a group and centralizer of a group. • **CO-2. Symmetries and Permutations** Analyze the role of symmetries in mathematical objects and physical systems using permutation groups and their properties. • **CO-3. Lagrange's Theorem, Fermat's theorem and Its Consequences** Understand and apply the concept of cyclic group, finite group, coset and its applications. Lagrange's theorem to determine the structure and order of subgroups in finite groups. Fermat's theorem. • **CO-4. Group Homomorphisms and Isomorphisms** Explore the concepts of Normal subgroup, Quotient group, Cayley's theorem, group homomorphisms, isomorphisms, and their kernel and image, enabling a deeper understanding of group equivalence and structure. First, Second and Third isomorphism theorems. • **CO-5. Applications of Group Theory** Apply group theory concepts to solve problems in algebra and understand its applications in other fields, such as physics, cryptography, and computer science.
CC5	**Theory of real Functions**	On completion of this course, the students will acquire knowledge on • **CO-1. Understanding Fundamental Concepts** Demonstrate a rigorous understanding of fundamental concepts in real analysis, including limit, continuity, uniform continuity of a function (ϵ-δ) approach, sequential criterion, properties of continuous and uniform continuous function, related theorems. Types of discontinuity of a function. • **CO-2. Differentiability of Real Functions** Differentiability of a function at appoint. Relation between continuity and differentiability of a function and the concept of maxima and minima of a function in an interval. • **CO-3. Application of Theorems** Formulation and prove key theorems such as the Intermediate Value Theorem, Mean Value Theorem, and their applications. • **CO-4. Problem-Solving Skills** Develop problem-solving skills by applying real analysis techniques to theoretical and applied problems, with an emphasis on constructing rigorous proofs. • **CO-5. Advanced Real Analysis Techniques** Explore and solve problems involving advanced topics such as monotonic functions, inverse functions, and the maxima and minima of a function in an interval and applications towards various problems. This portion plays to key role in the applied sciences, especially on ordinary differentialequations, Multivariate Calculus-I .
C6	**Ring Theory & LinearAlgebra-I**	On completion of this course, the students will acquire knowledge on • **CO-1. Understand Fundamental Concepts:** Explain and apply the fundamental concepts of ring theory, such as rings, subrings, ideals, prime ideal, maximal ideals, ring homomorphisms, isomorphism to abstract and concrete mathematical problems. • **CO-2. Analyze Ring Structures:** Analyze the properties of special types of rings, including commutative rings, integral domains, and fields, and their applications in algebra. • **CO-3. Basic concepts on Vector Spaces:** Demonstrate knowledge of vector spaces, subspaces, basis, and dimension, algebra of subspaces, significance of subspace, quotient spaces, lineartransformation, algebra of linear transformations, Isomorphisms, eigenvalues, eigenvectors and characteristic equation of a matrix and apply these concepts to solve problems in linear transformations and matrix theory. Quotient Space. • **CO-4. Determine Eigenvalues and Eigenvectors:** Compute eigenvalues, eigenvectors and characteristic equation of a matrix.in theoretical and applied contexts. • **CO-5. Link Abstract Theory with Applications:** Connect the abstract structures of ring theory and linear algebra to real-world applications in fields such as cryptography, coding theory, and system design.

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Corse Code	Course Name	Course Outcome
CC7	**Ordinary Differential Equation & Multivariate Calculus-I**	On completion of this course, the students will acquire knowledge on • **CO-1. Formulation and solving first order linear and non-linear ODE.** Students will be able to formulate, classify and solve first-order ordinary differential equations, including separable, linear, and exact equations, and apply them to real-world problems. • **CO-2: Analyze and solve second and higher-order linear & non-linear ODE.** Students will learn to construct solve second and higher-order linear ordinary differential equations with constant coefficients, apply methods like D-operator, undetermined coefficients and variation of parameters, and interpret their solutions. • **CO-3. Understand the concept of R^n and functions of two or more variables.** Students will comprehend the basic structure of R^n, concepts on neighbourhood, interior-point, boundary-point, exterior -point, limit-point, definition, domain, range, and visualization of functions of two or more variables, including surface plots and level curves. • **CO-4. Compute and interpret partial derivatives of functions several variables.** Students will calculate partial derivatives, directional derivative, total derivative, chain rule differentiability and understand their geometric and physical interpretations in terms of rate of change along different directions. • **CO-5: Solve optimization problems involving functions of two variables.** Students will determine critical points, classify them using second-order partial derivatives, and solve real-world optimization problems, including those with constraints using Lagrange multipliers. Also solving various problems related to multivariate calculus.
SEC-A	**C Programming Language**	On completion of this course, the students will acquire knowledge on • **CO-1. Understand the fundamentals of C programming.** Students will comprehend the syntax, semantics, and structure of C programs, including data types, operators, control structures, and basic input/output operations. • **CO-2. Develop algorithms and implement them using functions in C.** Students will design modular programs using user-defined functions, including parameter passing, recursion, and scope of variables. • **CO-3. Implement and manipulate arrays, strings, and pointers.** Students will gain proficiency in working with one-dimensional and multi-dimensional arrays, strings, and pointers, including their applications in memory management and dynamic data structures. • **CO-4. Write programs using control structures and loops in C.** Students will construct programs that utilize if, switch, while, for, and do-while loops to implement decision-making and iterative processes. • **CO-5. Implement programs using arrays and pointers for efficient data handling.** Students will manipulate data using single and multi-dimensional arrays, and apply pointers for dynamic memory allocation and advanced data access techniques. They will design reusable and efficient C programs by defining and invoking functions, including recursive functions for solving problems like factorial calculation or Fibonacci series.
CC8	**Riemann Integration& Series of Functions**	On completion of this course, the students will able to • **CO-1. Understand Fundamental Concepts.** Demonstrate an understanding the concept of the Riemann integration, which is a generalization of definite integration. Concept of negligible set,application. of Lebesgue theorem, **CO-2. Integrability of Real Functions.** Analyze the properties of Riemann integrable functions, including boundedness, partition refinement, properties of integrable function, algebra of integrable function,concept of primitive, celebrated Fundamental theorem of integral calculus. • **CO-3. Improper Integration & the Convergence.** Demonstrate an understand the concept of improper integration and their convergence, beta and Gamma functions and theirapplications. • **CO-4. Series of Functions & Power Series.** Students will learn the concept of sequence of functions, point of convergence, uniform convergence, power series and theconvergence to the limit function and solve problems involving them. • **CO-5. Applications of Riemann Integration and Series of Functions.** Students is used Riemann integration to compute the exact area under a curve or surface, volume of a solid, and also for calculating work and energy. Power series is used to approximate function.

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Corse Code	Course Name	Course Outcome
CC9	**Partial differential equation & Multivariate Calculus-II**	On completion of this course, the students will acquire • **CO-1.** Analyze Partial Differential Equations (PDEs) of various orders and types and to understand the classification, formulation, and general properties of PDEs. • **CO-2.** Solve PDEs using analytical methods. Apply techniques such as separation of variables, and transforms to solve classical PDEs like the heat, wave, and Laplace equations. • **CO3.** Evaluate line, surface, and volume integrals using advanced integration techniques. • **CO4**. Utilize vector calculus in multivariable functions and fields. Apply Green's Theorem, Stokes' Theorem, and the Divergence Theorem to solve integrals involving vector fields and their applications. • **CO5.** Aacquire knowledge on certain types of second order partial differential equations and their applications in Mathematical Physics. Developed skill of solving problems on multiple integral and,surface and volume of revolution.
CC10	**Mechanics**	On completion of this course, the students will acquire • **CO-1. Understand the fundamental Concept on statics** Knowledge on basic principles Statics related to coplanar forces, friction,virtual work, forces in three dimension, stable and unstable equilibrium. • **CO-2. Problem Solving Skill** Skill for solving problems on coplanar forces, friction,virtual work, forces in three dimension, stable and unstable equilibrium and Centre of gravity. • **CO-3. Understand Basic Principle on Kinematics.** Analyze and apply Newton's laws of motion to solve problems involving forces and motion. Examine the concepts of work, energy, and power in mechanical systems. • **CO-4. Concept of conservation laws** Use the principles of conservation of energy and work-energy theorem in solving mechanical problems. knowledge and skill for solving problems on system of many particles, collision of elastic bodies,work-power-energy. • **CO-5. Application on Real world problem.** Knowledge of rectilinear and planar motion of a particle in both cartesian and polar system, simple harmonic motion, central orbit, motion under inverse square law and planetary motion.
SEC B	**Scientific computing with Sage Math & R**	On completion of this course, the students will acquire knowledge on • **CO1: Understand the fundamentals of R programming.** Learn the syntax, data structures, and basic functions in R to analyze and manipulate data effectively. • **CO2: Apply statistical and numerical methods using R to solve scientific problems.** Basic concept and skill on numerical and symbolic computations using mathematical functions. Implement techniques such as regression analysis, hypothesis testing, and numerical integration in R. • **CO3: Develop and visualize datasets for scientific analysis using R.** Utilize R's libraries for creating graphs, plots, and interactive visualizations to interpret scientific results. • **CO4: Solve differential equations and other mathematical models in R.** Use R packages to solve a system of linear equations, finding roots of a given polynomial, solving differentialequations. • **CO5: Explore advanced computational techniques and machine learning algorithms using R.** Implement clustering, classification, and predictive models to analyze complex scientific datasets.

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Corse Code	Course Name	Course Outcome
CC11	**Probability & Statistics**	On completion of this course, the students will acquire knowledge • **CO-1. Understand the fundamental concepts of probability & its applications.** Analyze random experiments, probability rules, and conditional probability to solve real-world problems. • **CO-2. Apply discrete and continuous probability distributions.** Use distributions like Binomial, Poisson, Normal, and Exponential to evaluate probabilities and expectations. • **CO-3. Utilize correlation and regression techniques.** Analyze and interpret simple and multiple regression models to predict outcomes and understand associations. • **CO-4. Perform statistical data analysis using descriptive and inferential methods.** Summarize datasets using measures of central tendency and dispersion, and make decisions through hypothesis testing and confidence intervals. • **CO-5. Implement statistical techniques in real-world scenarios.** Solve complex problems involving large datasets using software tools like R, Python, or Excel for statistical analysis.
CC12	**Group Theory-II & Linear Algebra-II**	On completion of this course, the students will acquire • **CO1. Analyze the structure of groups through advanced concepts such as homomorphisms, isomorphisms, and factor groups.** Understand and apply the fundamental theorem of homomorphisms and study group actions on sets. • **CO2. Explore Sylow's theorems and their applications to classify finite groups.** Solve problems involving group decomposition and structure using Sylow's theorems. • **CO3. Understand advanced topics in linear transformations and matrix theory.** Study diagonalization, canonical forms, and the spectral theorem for symmetric matrices. • **CO4. Apply concepts of inner product spaces and orthogonality to solve geometric problems.** Analyze and solve problems involving Gram-Schmidt orthogonalization, projections, and least squares approximations. • **CO5. Integrate concepts from Group Theory and Linear Algebra to solve interdisciplinary mathematical problems.** Explore applications of group representations and eigenvalue analysis in physics, computer science, and engineering.
DSE A1	**Bio Mathematics**	On completion of this course, the students will acquire knowledge • **CO-1. Understand mathematical models and techniques used to analyze biological systems.** Develop differential equations and other mathematical formulations to describe biological phenomena. • **CO-2. Apply linear and non-linear models to study population dynamics and ecological systems.** Solve problems involving logistic growth, predator-prey interactions, and competition models. • **CO-3. Utilize matrix algebra and statistical methods for biological data analysis.** Analyze biological networks, genetic data, and epidemiological studies using mathematical tools. • **CO-4. Develop discrete mathematical models to analyze biological processes.** Construct and study models such as difference equations and Boolean networks to represent population growth, genetic sequences, and disease spread. • **CO-5. Apply graph theory to solve problems in biological systems.** Model and analyze biological networks, such as food webs, and phylogenetic trees, using discrete mathematical tools.

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Corse Code	Course Name	Course Outcome
DSE B1	**Linear Programming & Game Theory**	On completion of this course, the students will acquire • **CO1. Formulate and solve optimization problems using linear programming techniques.** Develop mathematical models for real-life scenarios and solve them using the graphical method, algebraic technique. • **CO2. Analyze the structure and properties of feasible solutions in linear programming.** Understand the concepts of convex sets, basic feasible solutions, and optimality conditions. • **CO3. Apply Linear Programming industrial problem** Skills on the solution of a Linear Programming Problem by Simplex Method. Also acquire knowledge on duality, transportation problem, assignment problem and travelling salesman problem. • **CO4. Understand the fundamentals of game theory to analyze competitive strategies.** Solve problems involving two-person zero-sum games using strategies like saddle points, dominance, graphical and mixed strategies. • **CO5. Integrate linear programming and game theory concepts to solve real-world decision-making problems.** Apply optimization and strategic interaction frameworks to areas such as economics, operations research, and resource allocation.
CC13	**Metric Space & Complex Analysis**	On completion of this course, the students will acquire • **CO1: Understand the fundamental concepts of metric spaces.** Analyze the basic concept of matric space and its properties, convergence sequence, Cauchy sequence, completeness property, Cantor's intersection theorem. **CO2: Apply metric space theory to study convergence, completeness, and compactness.** Use these properties to analyze sequences, series, and functions in metric spaces, continuous mapping, uniform continuity, sequential compactness, Heine-Boral theorem in R. • **CO3: Explore the properties and significance of complex functions and holomorphic functions.** Apply Cauchy-Riemann equations, complex differentiation, and analyticity to study functions of a complex variable. • **CO4: Utilize contour integration and residue theorem in complex analysis.** Apply techniques like Cauchy's integral theorem, Laurent series expansion, and residue calculus in evaluating complex integrals. • **CO5: Integrate concepts from metric space theory and complex analysis to understand functions of complex variables.** Study applications such as conformal mappings, harmonic functions, and Fourier analysis in the complex plane.
CC14	**Numerical Methods** **Numerical Methods Lab.**	On completion of this course, the students will acquire • **CO-1: Understanding & Basic Skills** Concept of Error, Difference Calculus, basic skill for solving problems via computer programming related to various numerical methods on interpolation, numerical differentiation and integration • **CO-2. Apply numerical techniques to solve algebraic and transcendental equations.** Use methods such as the bisection method, Regula-Falsi method, Newton-Raphson method, and iterative methods to find roots of equations. • **CO-3. Implement numerical methods for solving ordinary differential equations** Apply methods like Euler's method, Modified Euler's method, 4-th order Runge-Kutta, methods to approximate solutions of differential equations. • **CO-4. Practical computation using C-Programming & numerical methods.** Practical computation of numerical methods line Interpolation, Differentiation, Integration, Root finding, solving ODE. • **CO-5. Use of C-Language / C++ Language** Skill of using C/C++ Language to solve all numerical problems.

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Corse Code	Course Name	Course Outcome
DSE A2	**Mathematical Modeling**	On completion of this course, the students will acquire knowledge • **CO1. Concept of Laplace Transform and its application.** Exponential order, Laplace Transform, Inverse Laplace Transform, use the Laplace Transform to solve ordinary differential equations. **CO2. Solve problems involving Legendre Polynomials and Legendre's Equation.** Understand the properties of Legendre polynomials, solve the Legendre differential equation, and apply these solutions to problems in physics and engineering, such as electrostatics and quantum mechanics. • **CO3. Utilize Bessel's Equation and its solutions (Bessel functions) to solve problems** Apply Bessel's equation to model phenomena with radial symmetry, such as heat conduction in cylindrical objects, wave propagation, and acoustics. • **CO-4. Understand and apply the principles of Queuing Theory.** Develop and solve queuing models for M/M/1, M/M/∞, and other simple queuing systems using techniques such as the Poisson distribution. • **CO-5. Generate and evaluate random numbers using various methods.** Implement algorithms to generate pseudo-random numbers, test their randomness using statistical tests, and apply them in simulations to solve complex problems in stochastic processes and Monte Carlo methods.
DSE B2	**Point Set Topology**	Course Outcomes: On completion of this course, the students will acquire • **CO-1. Understand the basic concepts of topological spaces, open and closed sets, and continuity.** Concept of topological spaces, basis and sub-basis for a topology, continuity of a function intopological space, finite product topology, homeomorphism, isometry and metric invariants. • **CO-2. Apply the properties of product spaces, subspaces, and quotient spaces.** Explore the construction of product and quotient topological spaces, and use them to understand the relationship between spaces and their properties. Concept of separation axioms of topological spaces, connected and compactness in Topologicalspaces. • **CO-3. Examine different types of continuity, homeomorphisms, and their properties.** Distinguish between different types of continuous functions, study the concept of homeomorphism, and use it to classify topological spaces. • **CO-4. Utilize separation axioms (T0, T1, T2, etc.) to analyze topological spaces.** Apply separation axioms to determine properties like normality, Hausdorff condition, and metrizability, and understand their implications in real-world applications. **CO-5. Integrate concepts from topology to solve problems in metric spaces and functional analysis.** Apply topological concepts to problems involving metric spaces, Banach and Hilbert spaces, and other functional spaces in mathematics, physics, and engineering.

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Course Outcomes (COs) of Mathematics General under CBCS

Corse Code	Course Name	Course Outcome
GE1	**Mathematics GE-1**	**On completion of this course, the students will acquire the** • **CO-1. Understand Core Mathematical Concepts** Demonstrate a clear understanding of algebraic principles , differential calculus, differential equations, and coordinate geometry, along with their interconnections. • **CO-2. Apply Algebraic and Calculus Techniques** Solve mathematical problems using algebraic techniques, including complex number, polynomial and matrix theory , and apply differentiation to analyze functions and optimize solutions. • **CO-3. Formulate and Solve Differential Equations** Develop and solve first-order and second-order differential equations to model and analyze real-world phenomena in physics, engineering, and other disciplines. • **CO-4. Analyze Geometric Problems** Apply the principles of coordinate geometry to solve problems on straight lines, classification of conics and reduction of their standard forms, tangents, normal, chords of a conic , and interpret geometric configurations. Skill three-dimensional analytical geometry plane, straight line, sphere and cone. • **CO-5. Synthesize Mathematical Concepts** Integrate knowledge from algebra, calculus, differential equations, and coordinate geometry to analyze and solve complex mathematical and interdisciplinary problems.

Corse Code	Course Name	Course Outcome
GE2	**Mathematics GE-2**	On completion of this course, the student will be able to • **CO-1. Understand Fundamental Concepts** Demonstrate a thorough understanding of the fundamental concepts of differential calculus, differential equations, vector algebra, and discrete mathematics to solve theoretical and practical problems. • **CO-2. Apply Mathematical Techniques** Apply techniques of differentiation, Sequence, Series, and vector operations to solve real-world problems in science, engineering, and technology. • **CO-3. Solve Differential Equations** Solve Second -order differential equations, including Constant coefficients, variable coefficients, variation of parameters in practical contexts. Also, linear partial differential equation of first order using Lagrange's and Cherpit's method. • • **CO-4. Analyze and Model Problems** Analyze mathematical problems using principles of discrete mathematics such as integers, congruence, application of congruence, congruence class, Boolean algebra, and develop models to represent and solve computational problems. • **CO-5. Synthesize Solutions** Integrate knowledge of vector algebra, calculus, and discrete mathematics to develop innovative solutions to complex interdisciplinary problems.

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Corse Code	Course Name	Course Outcome
GE3	**Mathematics GE-3**	On completion of this course, the students will acquire • **CO-1. Understand Mathematical Concepts** Demonstrate a comprehensive understanding of integral calculus, numerical methods, and linear programming, including their theoretical foundations and applications. • **CO-2. Apply Integral Calculus** Solve real-world problems by evaluating definite integrals, reduction formulae, improper integrals, applying advanced techniques such as multiple integrals, and interpreting their geometric and physical significance. • **CO-3. Implement Numerical Methods** Develop and implement numerical methods such as interpolation, differentiation, integration, and root-finding to approximate solutions for mathematical problems where analytical solutions are not feasible. • **CO-4. Formulate and Solve Optimization Problems** Formulate real-life problems into linear programming models and solve them using graphical and simplex methods, ensuring optimal utilization of resources. • **CO-5. Analyze and Validate Solutions** Evaluate and analyze the accuracy of numerical solutions, and synthesize methods of integral calculus and linear programming to solve interdisciplinary problems effectively.
Corse Code	**Course Name**	**Course Outcome**
GE4	**Mathematics GE-4**	On completion of this course, the students will acquire • **CO-1. Understand Advanced Algebraic Structures** Demonstrate an understanding of advanced algebraic concepts such as rings, fields, and vector spaces, real quadratic form, eigenvalue and eigenvector and their applications in computer science and statistics. • **CO-2. Apply Computational Techniques** Use algorithms and programming techniques & basic knowledge of computer science, idea of different Languages like BASIC, FORTRAN, C to solve the problems related to Mathematical problems & Statistical problems. • **CO-3. Analyze Probabilistic Models** Apply the principles of probability theory to analyze and model uncertainty in real-world scenarios, including problems in data science and algorithmic complexity. • **CO-4. Solve Statistical Problems** Use descriptive and inferential statistical methods to skill for handling statistical data, computation of sample mean, variance and other characteristics, supporting decision-making in technical and business contexts. • **CO-5. Integrate Mathematical and Computational Skills** Synthesize concepts from algebra, computer science, and probability & statistics to design and develop solutions for interdisciplinary problems in fields such as cryptography, data science, and artificial intelligence.