KHALISANI MAHAVIDYALAYA

AISHE CODE – C44706

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ESTD 1970

Enlightenment through Education

PROGRAM OUTCOMES (PO) of the deparment of Mathematics

- **Comprehensive Knowledge and Understanding:** Develop a deep and thorough understanding of fundamental mathematical concepts, principles, and theories. Graduates will be well-versed in core areas such as calculus, algebra, geometry, and statistics.
- **Advanced Problem-Solving Skills:** Utilize advanced logical reasoning and critical thinking to identify, analyze, and solve complex mathematical problems. Graduates will be skilled in applying various mathematical techniques to develop solutions.
- **Enhanced Analytical Skills:** Gain proficiency in analyzing and interpreting data using appropriate mathematical tools and methodologies. Graduates will be able to draw meaningful conclusions from quantitative data.
- **Effective Communication:** Communicate mathematical ideas, theories, and solutions clearly and effectively. This includes writing precise mathematical proofs and explanations, as well as presenting complex information orally in a coherent manner.
- **Teamwork and Collaborative Skills:** Work efficiently in collaborative settings, demonstrating the ability to function well within a team. Graduates will also exhibit leadership skills when necessary and contribute effectively to group projects.
- **Ethical Standards and Professionalism:** Adhere to high ethical standards in all academic and professional activities. Graduates will demonstrate integrity, honesty, and responsibility in their work, upholding the values of the mathematical profession.
- **Commitment to Lifelong Learning:** Engage in continuous learning and self-improvement to keep abreast of the latest developments in mathematics and related fields. Graduates will be motivated to pursue further education and professional growth.
- **Application of Mathematical Knowledge:** Apply mathematical theories and methods to solve practical problems in various real-world contexts. Graduates will be equipped to use their mathematical knowledge in interdisciplinary fields and diverse applications.
- These Program Outcomes (POs) ensure that graduates from the undergraduate mathematics program possess a balanced and robust education, equipped with both general competencies skills tailored to their field, preparing them for successful careers and further academic pursuits.

PROGRAM SPECIFIC OUTCOMES (PSO) of the deparment of Mathematics

- **Analytical and Logical Thinking:**
  PSO 1: Develop and demonstrate the ability to think critically and logically, enabling the solving of complex mathematical problems through systematic analysis and reasoning. This includes recognizing patterns, formulating conjectures, and constructing rigorous proofs.
  PSO 2: Apply advanced mathematical concepts and techniques to identify, formulate, and solve real-world problems across various domains such as physical sciences, engineering, economics, and technology, using logical reasoning and structured problem-solving approaches.
- **Mathematical Knowledge and Skills:**
  PSO 3: Attain a comprehensive understanding of essential mathematical areas, including but not limited to calculus, linear algebra, differential equations, probability and statistics, abstract algebra, and discrete mathematics. This foundational knowledge should support further study and research.

PSO 4: Develop proficiency in utilizing mathematical software and computational tools (such as MATLAB, Mathematica, R, and Python) for performing calculations, visualizing data, and conducting research. This skill set is crucial for solving complex problems and conducting experiments in both academic and professional settings.

- **Application of Mathematics:**

PSO 5: Utilize mathematical modeling techniques to represent real-world scenarios quantitatively. This includes formulating models, solving them analytically or numerically, and interpreting the results to provide insights and make informed decisions in various applications such as finance, engineering, biology, and environmental science.

PSO 6: Apply theoretical mathematical principles to practical situations. This involves translating abstract mathematical ideas into practical tools for solving problems in fields like optimization, data analysis, risk management, cryptography, and operations research.

- **Research and Development:**

PSO 7: Conduct independent and collaborative research to explore and develop advanced mathematical theories. This includes formulating hypotheses, designing and executing experiments, analyzing data, and drawing meaningful conclusions to contribute to the body of mathematical knowledge.

PSO 8: Present research findings effectively through various formats such as written reports, academic papers, oral presentations, and posters. This involves clear communication of complex ideas and results, adhering to the standards and conventions of mathematical scholarship.

- **Communication and Collaboration:**

PSO 9: Communicate mathematical concepts, findings, and solutions clearly and effectively to diverse audiences, including those with and without a technical background. This includes the ability to write technical documents, prepare visual aids, and deliver presentations that make mathematical ideas accessible.

PSO 10: Work collaboratively in interdisciplinary teams to address and solve complex problems. This includes the ability to engage in productive discussions, integrate diverse viewpoints, and leverage the strengths of team members to achieve common goals.

- **Ethics and Professionalism:**

PSO 11: Demonstrate a commitment to ethical practices and professional responsibilities in all mathematical endeavors. This includes upholding academic integrity, responsibly using data and resources, and recognizing the broader impact of mathematical work on society.

PSO-12: Engage in lifelong learning and professional development to continuously update and expand mathematical knowledge and skills. This involves staying current with the latest advancements in mathematics through courses, workshops, conferences, and self-directed study.

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COURSE OUTCOMES (CO) of the deparment of Mathematics

Semester	Program	Course Code	Course Title	Credit	Course Outcomes
I	Honours	CC-1	Calculus, Geometry & Differential Equations	6	In this course each unit covers different aspects of mathematics, ranging from hyperbolic functions, higher-order derivatives, Leibnitz rule, applications in business, economics, and life sciences to reduction formulae, integration techniques, conics, quadric surfaces, and differential equations with mathematical models. Overall, the course seems to provide a comprehensive understanding of advanced calculus, differential equations, and their applications in various fields.
I	Honours	CC-2	Algebra	6	These course outcomes cover a broad range of topics in Complex Numbers, Theory of Equations, Inequalities, and Linear Algebra. Students completing the course should have a solid understanding of these mathematical concepts and their applications. Below are the main outcomes covered in this course: Understanding complex numbers in polar form, calculate n-th roots of unity. Understanding and applying De Moivre's theorem for rational indices. Practical applications in solving complex equations. Techniques for solving systems of linear equations, Applications of linear systems. Understanding row reduction and echelon forms of matrices, etc
II	Honours	CC-3	Real Analysis	6	This course will have a strong understanding of fundamental concepts in real analysis, including properties of real numbers, sequences, and infinite series. Here are the expected course outcomes: Understand the algebraic and order properties of real numbers. Distinguish between countable and uncountable sets; comprehend the uncountability of $\mathbb{R}$. Define sequences and understand the concepts of bounded and convergent sequences. Define and understand monotone sequences and the Monotone Convergence Theorem.
II	Honours	CC-4	Differential Equations and Vector Calculus	6	These course outcomes cover a broad range of topics in Differential Equations and Vector Calculus. Below are the main outcomes covered in this course: Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous equation of second order. Wronskian: its properties and applications. Apply Euler's equation to solve differential equations, etc.

III	Honours	CC-5	Theory of Real Functions & Introduction to Metric Spaces	6	The expected course outcomes are given below: Understand the concept of limits of functions using the ε-δ approach. Analyze limit theorems, including one-sided limits and limits at infinity Understand open and closed balls, neighborhoods, open sets, and the interior of a set. Study Taylor's theorem with Lagrange's form of remainder and Cauchy's form of remainder, etc.
III	Honours	CC-6	Group Theory I	6	This course appears to cover a comprehensive range of topics in group theory, from basic definitions to advanced theorems and their applications. Here are the expected course outcomes: Introduction to abstract algebraic structures with examples like permutation groups and quaternion groups (represented through matrices). Applications of Lagrange's theorem, etc.
III	Honours	CC-7	Numerical Methods & Numerical Methods Lab	6	The course cover various topics in numerical methods and computational mathematics. Here are the potential course outcomes: Understand and apply algorithms in numerical computations. Apply the Bisection, Newton's, Secant, Regulafalsi, fixed point iteration, and Newton-Raphson methods for solving transcendental and polynomial equations. Apply Gauss Jacobi and Gauss Seidel methods and analyze their convergence, etc.
III	Honours	SEC-1	Logic and Sets	2	This course aims to equip students with a strong foundation in propositional logic, set theory, and relations. Students should be able to apply these concepts to solve problems and analyze real-world scenarios that involve logical reasoning and set operations.
IV	Honours	CC-8	Riemann Integration and Series of Functions	6	This course appears to provide a comprehensive understanding of advanced calculus concepts, including various types of integrals, convergence of sequences and series of functions, and the study of Fourier series and power series. Students are likely to gain a strong foundation in theoretical and applied aspects of calculus through this course.
IV	Honours	CC-9	Multivariate Calculus	6	Here are the potential course outcomes: Understand limits and continuity for functions of multiple variables. Learn how to take partial derivatives of functions with respect to multiple variables. Learn about Jacobian matrices and their applications. Calculate volumes using triple integrals in different coordinate systems, etc.
IV	Honours	CC-10	Ring Theory	6	The course covers fundamental topics in abstract algebra and linear algebra. Each unit

			and Linear Algebra I		seems to build on the previous one, providing a comprehensive understanding of algebraic structures and linear transformations. Here are some expected outcomes: Understand and apply various properties of rings. Define integral domains and fields and recognize their properties. Define integral domains and fields and recognize their properties. Understand the concepts of basis and dimension, etc.
IV	Honours	SEC-2	Graph Theory	2	This course covers fundamental concepts in graph theory, including basic definitions, types of graphs, properties of graphs, Eulerian and Hamiltonian paths, matrix representations of graphs, weighted graphs, and algorithms for solving practical problems such as the traveling salesman's problem and finding the shortest path in a graph. Students taking this course can expect to gain a solid understanding of these graph theory concepts and their applications.
V	Honours	CC-11	Partial Differential Equations and Applications	6	The outcomes for the mentioned course can be summarized as follows: Gain a thorough understanding of basic concepts and definitions related to partial differential equations. Develop the ability to formulate and solve mathematical problems involving partial differential equations. Students should be able to derive the heat equation, wave equation, and Laplace equation from appropriate physical contexts, etc.
V	Honours	CC-12	Mechanics I	6	This course covers a broad range of topics in classical mechanics, providing a comprehensive understanding of statics, dynamics, and rigid body motion. Below are the main outcomes: Understanding and analyzing forces acting in the same plane. Exploring the effects of friction on objects and surfaces. Analyzing equilibrium conditions for a particle on a curved surface with friction. Differentiating between stable and unstable equilibrium situations, etc.
V	Honours	DSE-1	Linear Programming	6	Linear programming (LP) is a mathematical optimization technique used for finding the best outcome in a mathematical model with linear relationships. Courses on linear programming typically cover a range of topics, and the outcomes can vary based on the level and focus of the course. However, here are some common course outcomes associated with linear programming: Define and understand the basic concepts of linear programming. Apply the simplex method to solve optimization problems with multiple variables.

					Understand the duality concept and its applications in linear programming, etc.
V	Honours	DSE-2	Probability & Statistics	6	This course cover fundamental concepts in probability theory, random variables, joint distributions, expectations, conditional probabilities, statistical inference, and hypothesis testing. The course seems to progress from basic probability concepts to more advanced topics such as Markov Chains and hypothesis testing.
VI	Honours	CC-13	Metric Spaces and Complex Analysis	6	The course seems to be focused on real and complex analysis, specifically covering topics related to metric spaces, continuity, compactness, complex analysis, and power series. Here are the expected outcomes: Understand the concept of metric spaces. Examine connectedness and connected subsets of R. Understand compactness, sequential compactness, and the Heine-Borel property. Explore analytic functions and examples, etc.
VI	Honours	CC-14	Ring Theory and Linear Algebra II	6	The course outcomes are given below: Understanding polynomial rings over commutative rings. Knowledge of principal ideal domains and their significance. Skill in factorization of polynomials and understanding reducibility tests. Application of Least Squares Approximation in linear algebra, etc.
VI	Honours	DSE-3	Project Work	6	The course outcomes for a project work can vary depending on the program, and specific course requirements. Here are some potential course outcomes: Develop the ability to identify, analyze, and solve mathematical problems. Acquire proficiency in conducting independent research, including literature review, data collection, and analysis. Gain proficiency in using mathematical software, programming languages, and other technical tools relevant to the chosen project, etc.
VI	Honours	DSE-4	Mechanics II	6	Students completing this course should have a solid understanding of classical mechanics, fluid equilibrium, thermodynamics, and principles of constraints in physics. They should also be able to apply these concepts to solve complex problems in the respective domains. They can apply the principle in relevant physics problems, analyze isothermal and adiabatic changes in gases etc.

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Semester	Program	Course Code	Course Title	Credit	Course Outcomes
I	B.Sc. PureGeneral	GE1/CC1A	Differential Calculus	6	This course seems like a comprehensive calculus course covering fundamental concepts such as limits, continuity, differentiability, analytical geometry, and various calculus theorems and series. Students should gain a solid understanding of calculus and its applications through these topics.
II	B.Sc. PureGeneral	GE2/CC1B	Differential Equations	6	Below are the main outcomes covered in this course: • Understanding and solving differential equations, exploring general, particular, explicit, implicit, and singular solutions. • Solving exact differential equations and using integrating factors. • Solving separable and Bernoulli differential equations.
III	B.Sc. PureGeneral	GE3/CC1C	Real Analysis	6	This course will have a strong understanding of fundamental concepts in real analysis, including properties of real numbers, sequences, and infinite series. Here are the expected course outcomes: • Understand the algebraic and order properties of real numbers. • Distinguish between countable and uncountable sets; comprehend the uncountability of $\mathbb{R}$. Define sequences and understand the concepts of bounded and convergent sequences, etc.
IV	B.Sc. PureGeneral	GE4/CC1D	Algebra	6	This course appears to cover a comprehensive range of topics in group theory, from basic definitions to advanced theorems. Here are the expected course outcomes: • Introduction to abstract algebraic structures with examples like permutation groups and quaternion groups (represented through matrices). • Introduction to abstract algebraic structures with examples like permutation groups and quaternion groups (represented through matrices). • Applications of Lagrange's theorem, etc.
V	B.Sc. PureGeneral	DSE1A	Linear Algebra	6	This course will have a strong understanding of fundamental concepts in Vector spaces and Linear transformation. Some outcomes are given below: • Understanding vector spaces and subspaces in $\mathbb{R}_n$. • Determining the dimension of subspaces in $\mathbb{R}_n$.

					• Calculating the rank of matrices. • Understanding eigenvalues and eigenvectors. Solving characteristic equations, etc.
V	B.Sc. PureGeneral	SEC3	Probability & Statistics	2	This course cover fundamental concepts in probability theory, random variables, joint distributions, expectations, conditional probabilities, statistical inference, and hypothesis testing. The course seems to progress from basic probability concepts to more advanced topics such as Markov Chains and hypothesis testing.
VI	B.Sc. PureGeneral	DSE1B	Linear Programming	6	Linear programming (LP) is a mathematical optimization technique used for finding the best outcome in a mathematical model with linear relationships. Courses on linear programming typically cover a range of topics, and the outcomes can vary based on the level and focus of the course. However, here are some common course outcomes associated with linear programming: • Define and understand the basic concepts of linear programming. • Apply the simplex method to solve optimization problems with multiple variables. Understand the duality concept and its applications in linear programming, etc.
VI	B.Sc. PureGeneral	SEC4	Transportation and Game Theory	2	On completion of this course, the student should understand the concept of transportation problems in the context of logistics and supply chain management, formulate transportation problems and apply optimization techniques to find the optimal solution and gain a solid understanding of the fundamental principles of game theory.