B.Sc (H) MATHS

COURSE OUTCOMES

CORE COURSES

Core Course-I: Calculus (Theory)

By the end of the course, the students will be able to:

CO1	Learn first and second derivative tests for relative extrema and apply the knowledge in problems in business, economics and life sciences.
CO2	Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference.
CO3	Compute area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.
CO4	Understand the calculus of vector functions and its use to develop the basic principles of planetary motion.

Core Course-II: Algebra (Theory)

CO-1	Employ De Moivre's theorem in a number of applications to solve numerical problems.
CO-2	Learn about equivalent classes and cardinality of a set.
CO-3	Use modular arithmetic and basic properties of congruences.
CO-4	Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix.
CO-5	Find eigenvalues and corresponding eigenvectors for a square matrix.

Core Course-III: Real Analysis (Theory)

CO-1	Understand many properties of the real line $\mathbb{R}$, including completeness and Archimedean properties.
CO-2	Learn to define sequences in terms of functions from $\mathbb{N}$ to a subset of $\mathbb{R}$.
CO-3	Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
CO-4	Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

Core Course-IV: Differential Equations (Theory)

CO-1	Learn basics of differential equations and mathematical modeling.
CO-2	Formulate differential equations for various mathematical models.

CO-3	Solve first order non-linear differential equations and linear differential equations of higher order using various techniques.
CO-4	Apply these techniques to solve and analyze various mathematical models.

Core Course-V: Theory of Real Functions (Theory)

CO-1	Have a rigorous understanding of the concept of limit of a function.
CO-2	Learn about continuity and uniform continuity of functions defined on intervals.
CO-3	Understand geometrical properties of continuous functions on closed and bounded intervals.
CO-4	Learn extensively about the concept of differentiability using limits, leading to a better understanding for applications.
CO-5	Know about applications of mean value theorems and Taylor's theorem.

Core Course-VI: Group Theory-I (Theory)

CO-1	Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc.
CO-2	Link the fundamental concepts of groups and symmetrical figures.
CO-3	Analyze the subgroups of cyclic groups and classify subgroups of cyclic groups..
CO-4	Explain the significance of the notion of cosets, normal subgroups and factor groups.
CO-5	Learn about Lagrange's theorem and Fermat's Little theorem
CO-6	Know about group homomorphisms and group isomorphisms

Core Course-VII: Multivariate Calculus (Theory)

CO-1	Learn the conceptual variations when advancing in calculus from one variable to multivariable discussion
CO-2	Understand the maximization and minimization of multivariable functions subject to the given constraints on variables.
CO-3	Learn about inter-relationship amongst the line integral, double and triple integral formulations
CO-4	Familiarize with Green's, Stokes' and Gauss divergence theorems.

Core Course-VIII: Partial Differential Equations (Theory)

CO-1	Formulate, classify and transform first order PDEs into canonical form.
CO-2	Learn about method of characteristics and separation of variables to solve first order PDE's.
CO-3	Classify and solve second order linear PDEs.
CO-4	Learn about Cauchy problem for second order PDE and homogeneous and nonhomogeneous wave equations.

CO-5	Apply the method of separation of variables for solving many well-known second order PDEs.

Core Course-IX: Riemann Integration & Series of function (Theory)

CO-1	Learn about some of the classes and properties of Riemann integrable functions, and the applications of the Fundamental theorems of integration.
CO-2	Know about improper integrals including, beta and gamma functions.
CO-3	Learn about Cauchy criterion for uniform convergence and Weierstrass M-test for uniform convergence.
CO-4	Know about the constraints for the inter-changeability of differentiability and integrability with infinite sum.
CO-5	Approximate transcendental functions in terms of power series as well as, differentiation and integration of power series.

Core Course-X: Ring Theory & Linear AlgebraI (Theory)

CO-1	Learn about the fundamental concept of rings, integral domains and fields
CO-2	Know about ring homomorphisms and isomorphisms theorems of rings.
CO-3	Learn about the concept of linear independence of vectors over a field, and the dimension of a vector space.
CO-4	Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation, and the change of coordinate matrix.

Core Course-XI: Metric Spaces (Theory)

CO-1	Learn various natural and abstract formulations of distance on the sets of usual or unusual entities. Become aware one such formulations leading to metric spaces.
CO-2	Analyse how a theory advances from a particular frame to a general frame.
CO-3	Appreciate the mathematical understanding of various geometrical concepts, viz. balls or connected sets etc. in an abstract setting.
CO-4	Know about Banach fixed point theorem, whose far-reaching consequences have resulted into an independent branch of study in analysis, known as fixed point theory
CO-5	Learn about the two important topological properties, namely connectedness and compactness of metric spaces.

Core Course-XII: Group Theory-II (Theory)

CO-1	Learn about automorphisms for constructing new groups from the given group.
CO-2	Learn about the fact that external direct product applies to data security and electric circuits.
CO-3	Understand fundamental theorem of finite abelian groups.

CO-4	Be familiar with group actions and conjugacy in .
CO-5	Understand Sylow theorems and their applications in checking nonsimplicity.

Core Course-XI: Complex Analysis (Theory)

CO-1	Learn the significance of differentiability of complex functions leading to the understanding of Cauchy–Riemann equations.
CO-2	Learn some elementary functions and valuate the contour integrals.
CO-3	Understand the role of Cauchy–Goursat theorem and the Cauchy integral formula
CO-4	Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.

Core Course-XIV: Ring Theory and Linear Algebra-II (Theory)

CO-1	Appreciate the significance of unique factorization in rings and integral domains.
CO-2	Compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result.
CO-3	Compute inner products and determine orthogonality on vector spaces, including Gram–Schmidt orthogonalization to obtain orthonormal basis
CO-4	Find the adjoint, normal, unitary and orthogonal operators.

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE)

DSE-1: Numerical Analysis (Theory)

CO-1	Learn some numerical methods to find the zeroes of nonlinear functions of a single variable and solution of a system of linear equations, up to a certain given level of precision.
CO-2	Know about methods to solve system of linear equations, such as Gauss–Jacobi, Gauss–Seidel and SOR methods.
CO-3	Interpolation techniques to compute the values for a tabulated function at points not in the table.
CO-4	Applications of numerical differentiation and integration to convert differential equations into difference equations for numerical solutions.

DSE-2: Probability Theory and Statistics (Theory)

CO-1	Learn about probability density and moment generating functions.
CO-2	Know about various univariate distributions such as Bernoulli, Binomial, Poisson, gamma and exponential distributions.
CO-3	Learn about distributions to study the joint behavior of two random variables.
CO-4	Measure the scale of association between two variables, and to establish a formulation helping to predict one variable in terms of the other, i.e., correlation and linear regression
CO-5	Understand central limit theorem, which helps to understand the remarkable fact that: the empirical frequencies of so many natural populations, exhibit a bell-shaped curve, i.e., a normal distribution.

DSE-3: Discrete Mathematics (Theory)

CO-1	Understand the notion of ordered sets and maps between ordered sets.
CO-2	Learn about lattices, modular and distributive lattices, sublattices and homomorphisms between lattices.
CO-3	Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuits and their applications.
CO-4	Learn about basics of graph theory, including Eulerian graphs, Hamiltonian graphs.
CO-5	Learn about the applications of graph theory in the study of shortest path algorithms.

DSE-4: Biomathematics (Theory)

CO-1	Learn the development, analysis and interpretation of bio mathematical models such as population growth, cell division, and predator-prey models.
CO-2	Learn about the mathematics behind heartbeat model and nerve impulse transmission model.
CO-3	Appreciate the theory of bifurcation and chaos
CO-4	Learn to apply the basic concepts of probability to molecular evolution and genetics.
CO-9	Learn properties and applications of various useful polymers in our daily life

DSE-5: Number Theory (Theory)

CO-1	Learn about some fascinating discoveries related to the properties of prime numbers, and some of the open problems in number theory, viz., Goldbach conjecture etc.
CO-2	Know about number theoretic functions and modular arithmetic.
CO-3	Solve linear, quadratic and system of linear congruence equations

CO-4	Learn about public key crypto systems, in particular, RSA.

DSE-6: Linear Programming and Applications (Theory)

CO-1	Learn about the graphical solution of linear programming problem with two variables.
CO-2	Learn about the relation between basic feasible solutions and extreme points.
CO-3	Understand the theory of the simplex method used to solve linear programming problems.
CO-4	Learn about two-phase and big-M methods to deal with problems involving artificial variables.
CO-5	Learn about the relationships between the primal and dual problems.
CO-6	Solve transportation and assignment problems.
CO-7	Apply linear programming method to solve two-person zero-sum game problems.

SKILL ENHANCEMENT ELECTIVE COURSES (SEC)

SEC-1: Latex and HTML

CO-1	Create and typeset a LaTeX document
CO-2	Typeset a mathematical document using LaTex.
CO-3	Learn about pictures and graphics in LaTex.
CO-4	Create beamer presentations.
CO-5	Create web page using HTML

SEC-2: Computer Algebra System and Related Software

CO-1	Use of computer algebra systems (Mathematica/MATLAB/Maxima/Maple etc.) as a calculator, for plotting functions and animations
CO-2	Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigenvectors.
CO-3	Understand the use of the statistical software R as calculator and learn to read and get data into R
CO-4	Learn the use of R in summary calculation, pictorial representation of data and exploring relationship between data.
CO-5	Analyze, test, and interpret technical arguments on the basis of geometry.