DEPARTMENT OF MATHEMATICS

Course Outcomes:

SEMESTER-I (CCF)

Course Code & Name	Course Outcome
MATH-H-CC1-1-TH **Calculus**	• Develop skills to evaluate higher order derivatives and apply the Leibnitz rule to solve problems related to such derivatives. • Learn about the Hyperbolic functions. • Apply the concept and principles of differential calculus to find the curvature, Concavity, points of inflection, envelopes, rectilinear asymptotes (Cartesian & parametric form only) of different curves. • Trace the standard curves in polar and cartesian coordinates. • Apply the concept and principles of differential calculus to solve different geometric and physical problems that may arise related fields of science. • Develop skills to solve problems related to L' Hospital's rule· • Understand and apply the knowledge of Reduction formulae for some complex integrations and hence Integrate functions of a much higher degree which are applicable in real life situations. • Develop the skill and use the integral calculus to find arc length of a curve, arc length of parametric curves, area under a curve, surface area and volume of surface of revolution. • Graphically obtain the surface of the revolution of curves.

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Geometry	• Learn to Transform the co-ordinate system through Rotation of axes, thus reducing different second-degree equations to their corresponding simplest forms and also classify the conics using the discriminant. • Learn the concept of the polar equations of conics & their tangents and normal. • Understanding in details of Planes, Straight lines in 3D, Spheres, Cylindrical surfaces, Central conicoid, Paraboloids, and their related properties. • Have an idea of classification of quadrics. • Develop an idea of the generating lines. • Be familiar with the illustrations of graphing standard quadric surfaces like cones, paraboloids, hyperboloids, ellipsoids etc. • Understand the basic applications of the analytical plane and solid geometry.
Vector	• Learn to calculate the vector triple product and their applications. • Deduce the Vector equations of lines and planes subject to different conditions. • Understand the applications of vector algebra in geometry and mechanics: concurrent forces in a plane, theory of couples, system of parallel forces. • Develope skills to operations with vector-valued functions. • Find the limits and continuity of vector functions. • Differentiate and integrate vector functions of one variable.
MATH-H-SEC1-1-TH C-Language with Mathematical Application	• Students will learn Operation and Expressions, Decision Making and Branching, Control Statements, Arrays, User-defined Functions. Introduction to Library functions. Students will learn to solve various mathematical problems using C-program language.

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MATH-H-IDC1-1-TH	• Students will learn Propositional and Predicate Logic. Students will learn about the use of logic theory in development of mathematics.

SEMESTER- I (CBCS)

Course Code & Name	Course Outcome
CC-1: Calculus	• Develop skills to evaluate higher order derivatives and apply the Leibnitz rule to solve problems related to such derivatives. • Learn about the Hyperbolic functions. • Apply the concept and principles of differential calculus to find the curvature, • Concavity, points of inflection, envelopes, rectilinear asymptotes (Cartesian & parametric form only) of different curves. • Trace the standard curves in polar and cartesian coordinates. • Apply the concept and principles of differential calculus to solve different geometric and physical problems that may arise related fields of science. • Develop skills to solve problems related to L' Hospital's rule· • Understand and apply the knowledge of Reduction formulae for some complex integrations and hence Integrate functions of a much higher degree which are applicable in real life situations. • Develop the skill and use the integral calculus to find arc length of a curve, arc length of parametric curves, area under a curve, surface area and volume of surface of revolution. • Graphically obtain the surface of revolution of curves.

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CC-1: Geometry	• Learn to Transform the co-ordinate system through Rotation of axes, thus reducing different second-degree equations to their corresponding simplest forms and also classify the conics using the discriminant. • Learn concept of the polar equations of conics & their tangents and normal. • Understanding in details of Planes, Straight lines in 3D, Spheres, Cylindrical surfaces, Central conicoids. • Paraboloids, and their related properties. • Have an idea of classification of quadrics. • Develop an idea of the generating lines. • Be familiar with the illustrations of graphing standard quadric surfaces like cones, paraboloids, hyperboloids, ellipsoids etc. • Understand the basic applications of the analytical plane and solid geometry.
CC-1: Vector	• Learn to calculate the vector triple product and their applications. • Deduce the Vector equations of lines and planes subject to different conditions. • Understand the applications of vector algebra in geometry and mechanics: concurrent forces in a plane, theory of couples, system of parallel forces. • Develope skills to operations with vector-valued functions. • Find the limits and continuity of vector functions. • Differentiate and integrate vector functions of one variable.
CC-2: Algebra Unit 1	• De Moivre's theorem for rational indices and its applications. Learn about the Exponential, logarithmic, trigonometric and hyperbolic functions of the complex variable. • Theory of equations: Relation between roots and coefficients, transformation of the equation, Descartes rule of signs, Sturm's theorem, cubic

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	equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method). • Inequality: The inequality involving AM ≥ GM ≥ HM, Cauchy-Schwartz inequality. • Linear difference equations with constant coefficients (up to 2nd order).
CC-2: Algebra Unit 2	• Learn about Relation and Mapping in details with their properties and developed skills in solving related problems. • Learn some basic of numbers systems and various theory like: Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di-visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, arithmetic functions such as φ, τ, σ and their properties.
CC-2: Algebra Unit 3	• Learn about basic properties of matrix and determinant, with applications.

SEMESTER- II

Course Code & Name	Course Outcome
CC-3: Real Analysis-Unit 1	• After completion of Unit 1 learner should learn about: • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their important properties. Grasp the concept of countable sets, un-countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom.

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	Archimedean property of R. Density of rational (and Irrational) numbers in R. • Learn about basic point set topology, like interval, neighbourhood, interior and limit points, open set, closed set and related properties. • Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. • Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. • Dense set in R as a set having non-empty intersection with every open interval.
CC-3: **Real Analysis-Unit 2**	Learn about real sequence and its properties, convergence, Cauchy sequence. Confirm their concepts by solving problems of sequence to test boundedness, convergence etc.
CC-3: **Real Analysis-Unit 3**	Students become familier with Infinite series, its convergence and non-convergence Cauchy criterion,of convergence tests for convergence: comparison test, limit comparison test, ratio test, Cauchy's n-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence. Develop skills by solving problems related to series.
CC-4: Group Theory-1	Students will learn Basic properties of groups, dihedral groups, cycle decomposition and symmetric groups, subgroups, cosets, and Lagrange's Theorem. The concept of cyclic groups and subgroups, quotient groups and normal subgroups. Group homomorphism and Isomorphism basic properties and theorems.

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SEMESTER- III

Course Code & Name	Course Outcome
CC-5: Theory of Real Functions: Unit-1,2	Students should familiar with concept of limit, continuity, boundedness, uniform continuity and developed these concepts by solving problems.
CC-5: **Differentiability of functions Unit 3**	They learn about differentiability of a function. Learn various important properties and theorems like: Rolls theorem, Lagrange theorem etc. Mean value theorem. They learn how to find infinite series expansion of a function, which is very important concept in physical problem and space science.
CC-6: Ring Theory	Students will learn Basic properties of rings and Subrings, homomorphisms, isomorphisms, quotient rings and the Isomorphism Theorems; ideals, prime ideals, maximal ideals, integral domains.
CC-6: Linear Algebra	Students will learn Vector spaces, spanning sets, independence, bases, subspaces, quotient spaces, linear transformations and their matrix representation, computation of the image, rank, nullity and kernel of a linear transformation; change of basis, similarity; determinants; eigenvalues and eigenvectors; characteristic and minimal polynomials, Gram-Schmidt orthonormalization process, Hessian matrix, Sylvester's law of inertia, Cayley-Hamilton Theorem.
CC-7: Ordinary Differential Equation	Students will learn Ordinary Differential Equation and Partial Differential Equation. Develop their skills by solving problems and about their use in various branches of science and engineering.

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CC-7: Multivariate Calculus-I	Students will learn functions from R2 to R3, limit and continuity, partial derivatives, total derivative and differentiability, directional derivatives, Extrema of functions of two variables, Lagrange multipliers, constrained optimization problems.
SEC-A: C Programming	Students will learn Operation and Expressions, Decision Making and Branching, Control Statements, Arrays, User-defined Functions, Introduction to Library functions.

SEMESTER- IV

Course code & Name	Course Outcome
CC-8: Unit-1: Riemann integration	Understand the concept of Riemann integration and its properties and develop skills by solving problems.
CC-8: Unit-2: Improper integral	Learn about improper integration and its properties.
CC-8: Unit-3: Series of functions	Students will learn about series of function and be able to discriminate between real series and this concept.
CC-9: Unit-1 Partial Differential Equation	Learn to solve problems in pde and can relate its use in physics and other branch of science.
CC-9: Unit-2 Multivariate Calculus-II	Learn about Multiple integral, vector field, divergence, curl, Line integrals, applications, Green's theorem, surface integrals, Stoke's theorem, Divergence theorem.

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CC-10: Mechanics	Students will learn Coplanar forces in general, An arbitrary force system in space, Equilibrium in the presence of sliding Friction force, Virtual work, Stability of equilibrium, Kinematics of a particle, Newton laws of motion and law of gravitation, Problems in particle dynamics, Planar motion of a particle, Motion of a particle in three dimensions, linear momentum principle, angular momentum principle, energy principle.
SEC-B: Mathematical Logic	Students will learn Propositional and Predicate Logic.

SEMESTER- V

Course Code & Name	Course Outcome
CC-11: Probability & Statistics	Students will learn Random experiment, Sample space, probability axioms, probability, Conditional probability, probability mass/density functions, mathematical expectation, moments, distributions, Joint cumulative distribution function, joint probability density functions, moments, covariance, correlation, regression, Bivariate normal distribution, Markov and Chebyshev's inequality, Convergence, weak law of large numbers and strong law of large numbers, Central limit theorem, Sampling and Sampling Distributions, Sampling Distributions, Estimation of parameters, Maximum likelihood method, Statistical hypothesis, Bivariate frequency distribution.
CC-12: **Group Theory-II**	Students will learn Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

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CC-12: Linear Algebra-II	Students learn about inner product and its application, properties in details. Gram-Schmidt orthonormalization process, Hessian matrix, Sylvester's law of inertia, Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).
DSE-A1: Advance Algebra	Students learn about group actions, Cayley's Theorem, Class Equation, Sylow's Theorem and applications; simplicity of An; direct products, the Fundamental Theorem of Finitely Generated Abelian Groups and Applications. Simplicity test of A_n. lso Euclidean Domains, Principal Ideal Domains, Unique Factorization Domains, polynomial rings, factorization in one variable, Gauss' Lemma, irreducibility criteria, Eisenstein's Criterion.
DSE-B1: L.P.P. & game Theory	Students will learn Definition and formation of LPP, Hyperplane and Convex set, Simplex method, Two phase method, Duality, Transportation & Assignment, Game Theory concept and methods.

SEMESTER- VI

Course Code & Name	Course Outcome
CC-13: Metric Space	Students will learn basic of metric space formalism, subspace, closed sets and limit points, continuous functions, metric topology, connectedness in the real line and in general spaces, components, compactness, limit point compactness, countability axioms, separation axioms, normal spaces and Urysohn's Lemma, complete metric spaces, Banach contraction.
CC-13: Complex Analysis	Students will learn Stereographic projection. Regions in the complex plane. Limits, Continuity of functions of complex

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	variable, Derivatives, Cauchy-Riemann equations, sufficient conditions for differentiability, Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic functions, Mobius transformation, Power series, Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.
CC-14: Numerical Analysis (Theory)	Students will learn Errors, Operators, Interpolation, numerical differentiation and integration, solution of nonlinear equations, system of linear equations, eigenvalue problems, numerical solution of ODE, find eigen value by power method.
CC-14: Numerical Analysis (Practical)	Students will solve problems of various numerical methods using C/ Fortan Computer programming.
DSE-A2: Mathematical Modelling	Students will learn Power series solution of Bessel's equation and Legendre's equation, Laplace transform and application to IVP Monte Carlo simulation modelling, generating random numbers, queuing models, Overview of optimization modelling, Linear programming model.
DSE-B2: Topology	Students will learn Topological space, comparing topologies; subspace, finite product topologies, closed sets and limit points, continuous functions, metric topology, quotient topology (including projective spaces and gluing cells), connectedness in the real line and in general spaces, components, compactness, limit point compactness, countability axioms, separation axioms, normal spaces and Urysohn's Lemma, complete metric spaces, Banach spaces.

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