Programme outcome/Course outcome (Department of Mathematics)

Programme Specific Outcome (PSO) – After successful completion of three year honours degree course in Mathematics-

1. Students will acquire thorough knowledge on different branches of Mathematics and can evaluate hypothesis, theories, methods and evidence within their proper contexts.
2. Students will develop proficiency in solving complex mathematical problems by critical thinking and analysis.
3. Students will be prepared with mathematical skills and techniques which can be applied in both academic and non-Academic areas.
4. Students will have engagement in future life in academic areas including jobs as teaching faculties at Government and Non-Government schools, colleges, space research, Oceanography, Banking corporate and I.T sectors etc.
5. Students will be acquainted with different computer languages and mathematical software.
6. Learn advanced topics in mathematics that will help students in further studies of applied sciences.
7. Students will be able to work individually or as a team member or leader in uniform and multidisciplinary settings.
8. Develop the ability of analytical and logical thinking which will help them in all aspects of life.

CC-1T: Calculus, Geometry & Differential Equation	**Course Content:** Hyperbolic functions, Higher order derivatives, Leibnitz rule, concavity, Envelopes, Asymptotes, Curve tracing, L'Hospital's rule, Reduction formulae, Length of a curve, Area under a curve, Area and Volume of surface of revolution, Second degree equation & Classification of conics, Polar equation, Spheres, Central conicoids, Singular solutions of a differential equation, Exact differential equation and integrating factors, Linear & Bernoulli equation	After completion of this course students will be able to: 1. Achieve clear concepts of Higher order derivative, Leibnitz rule and its applications. 2. Gain knowledge of L'Hospital rule and evaluate the limits of indeterminate forms. 3. Acquire the concepts of concavity, convexity and point of inflection, Envelope & rectilinear asymptotes. 4. Understand the concepts of reduction formulae and also evaluate arc length of a curve, area and volume of surface of revolution. 5. Explain the idea of sphere, cone, conicoids(hyperboloid, paraboloid, ellipsoid) and generating lines. 6. Understand the basic idea of differential equation and apply its knowledge to solve real life problems. 7. Solve the first order differential equation using different types of method With an emphasis on Linear equations and Bernoulli equations.
CC-2T: Algebra	**Course Content:** Complex Number Theory of Equation Inequality Relations and Functions Well ordering Principle and Division Algorithm of Integer	After completion of this course students will be able to: 1. Find the domain of a function defined by an equation. 2. Use a graph to determine where a function is increasing, decreasing, or constant 3. Solve quadratic equations by factoring and by the square root property 4. Solve equations involving linear, polynomial, radical, rational, exponential,

	Principles of Mathematical induction Fundamental Theorem of Arithmetic.	or logarithmic expressions
CC-3T: Real Analysis	**Course Content:** The Natural Number Integers and rational Numbers Count ability, Extension of Rational number Elements of point set theory, Neighborhood, open set and closed set, Bolzano-Weierstrass Theorem	After the completion of the course, Students will be able to 1. Determine if an infinite sequence is bounded, monotonic convergent or divergent. 2. Find the sequence of partial sums of an infinite series. 3. Determine if a geometric series is convergent or divergent. 4. Find the sum of a convergent geometric series. 5. Determine if an infinite series is convergent or divergent by selecting the appropriate test from the following: (a) test for divergence; (b) integral test; (c) p-series test; (d) the comparison tests; (e) alternating series test; (f) absolute convergence test; (g) ratio test; and(h) root test.8.Determine if an infinite series converges absolutely or conditionally
CC-4T:	Differential Equations and Vector Calculus.	1. Students acquired knowledge of differential equations of 2nd order system of linear differential equations. 2. In addition, it provides the basic concept of vector algebra and Power Series solution of a differential equation.
CC-5T: Theory of Real Functions & Introduction To Metric Space	**Course Content:** Limits of functions, Sequential criterion, Infinite limits, Continuity, Intermediate value theorem, Uniform continuity, Differentiability, Rolle's theorem, Mean value theorem, Darboux's theorem. Taylor's theorem and its application, relative extrema, Metric spaces, open and closed balls, neighbourhood, open set, dense sets	After the completion of the course, Students will be able to 1. Understand limit of functions, sandwich theorem, Cauchy criterion for the existence of limit. 2. Explain continuity of functions, Bolzano's theorem, Intermediate value theorem, Uniform continuity and their properties. 3. Make a clear concept differentiability of a function at a point and in an interval. 4. Acquire knowledge of mean value theorem, Darboux's theorem. 5. Gain a clear concept of maxima and minima of functions, sufficient condition For the existence and their applications. 6. Expand functions using Taylor's series. 7. Gain clear concepts about Metric spaces, open and closed balls, limit point, Interior point, closure, open set, dense subset, separable space.
CC-6T: Group	**Course Content:** definition and examples of groups, Subgroup, permutation	After completion of this course students will be able to: 1. Use techniques and theorems of Group

Theory-I	groups, centralizer, normalizer product of two subgroups, Cyclic group and Lagrange's theorems, Normal Subgroups, Factor Group, Direct product of Groups	2. Determine whether a given set and binary operation form a group by checking group axioms 3. Analyze the structure of finite groups 4. Apply the Internal Direct Product Theorem in simple cases
CC-7T:	Numerical Analysis	1.The students acquired knowledge of Polynomial interpolation, Numerical integration, Solution of equations. 2.Students can learn its importance by using programme through computer for practical purpose
CC-8T: Riemann Integration And Series Of Functions	**Course Content:** Riemann Integration: upper sum and lower sum, properties of the Riemann integral, Intermediate Value theorem for Integrals; Fundamental theorem of Integral Calculus, Improper integrals. Beta and Gamma functions. Pointwise and uniform convergence of sequence of functions, Series of functions, Fourier series, Power series, Differentiation and integration of power series, Weierstrass approximation theorem	After completion of this course students will be able to: 1. Describe a regular partition of an interval, a Riemann sum for a function on a given interval and how they can be used to approximate area. 2. Read and interpret an expression in sigma notation as the sum of a series of numbers; conversely, be comfortable with using sigma notation to concisely describe a particular sum. 3. Define a definite integral as the limit of Riemann sums; conversely, be able to recognize a given limit of Riemann sums as corresponding to a definite integral. 4. Compute definite integrals of polynomial functions using the limit definition.
CC-9T	Multivariate Calculus	1. Students developed their basic idea of several variables, double and triple integrals. 2. Students have knowledge about line integrals, surface integrals application of calculus in daily life.
CC-10T: Ring Theory and Linear Algebra I	**Course Content:** Ring and Integral Domain, Field, Ideal, Factor Ring, Ring homomorphisms, Isomorphism theorems I, II and III. Vector space and subspace, linear independence, basis and dimension, linear transformation, range, rank and nullity,	After completion of this course students will be able to: 1. Find and use eigenvalues and eigenvectors of a matrix. 2. Solve the matrix equation Ax = b using row operations and matrix operations. 3. Test the linear independency of system of equations 4. Understand Sylow's Theorems 5. Understand the three major concrete models of Boolean algebra: the algebra of sets, the algebra of electrical circuits, and the algebra of logic.
CC-11T	Partial Differential Equation and Application	1. With the help of this course, students can solve Partial differential equations of first and second order.

		2. Specially Heat Equation, Wave Equation, and Laplace Equation with different
CC-12T: Group Theory II	**Course Content:** Automorphism and Automorphism groups, automorphism groups of finite and infinite cyclic group, external direct products, internal direct products, Group actions, stabilizers and kernels, Groups acting, Sylow's theorems and consequences, Cauchy's theorem	After completion of this course students will be able to: 1. Students should be able to determine appropriate techniques and knowledge necessary to solve problems and prove theorems in Group Theory 2. Students should know the basic definitions and theorems of Group Theory, including Sylow theorems, subnormality, split extensions, Hall subgroups, and transfer. 3. Reading and studying the text; solving problems assigned in class.
CC-13T: Metric Spaces and Complex Analysis	**Course Content:** Metric spaces: sequences in metric spaces, Cauchy sequences. Complete metric spaces, Cantor's theorem, Continuous mappings, Uniform continuity, Compactness, Heine-Borel property, Homeomorphism, Properties of complex numbers, Derivatives, Cauchy-Riemann equations, Analytic functions, definite integrals, Contours, Contour integrals, Liouville's theorem, Convergence of sequences and series, Taylor series and its examples.	1. Demonstrate understanding of the basic concepts underlying complex analysis. 2. Demonstrate familiarity with a range of examples of these concepts. 3. Prove basic results in complex analysis. 4. Apply the methods of complex analysis to evaluate definite integrals and infinite series. 5. Demonstrate understanding and appreciation of deeper aspects of complex analysis such as the Riemann Mapping theorem. 6. Demonstrate skills in communicating mathematics orally and in writing. 7. Define open/closed balls and open/closed sets and understand their properties 8. Define Cauchy sequences and complete metric spaces 9. Define continuous function between metric spaces and demonstrate equivalence of alternative definitions
CC-14T: Ring Theory and Linear Algebra II	**Course Content:** Polynomial rings, Principal ideal domains, Factorization of Polynomials, irreducibility tests, Eisenstein criterion, unique factorization domains, Euclidean domains, Dual space, Dual basis, annihilators, Cayley-Hamilton theorem, Minimal polynomial, Inner product spaces, Gram-Schmidt process, adjoint of a linear operator, Normal and Self-adjoint operators, Spectral theorem	After completion of this course students will be able to: 1. Understand polynomial rings, Principal ideal domain clearly. 2. Gain the concept of irreducibility test using Eisenstein criterion. 3. Acquire knowledge about dual space, dual basis, invariant subspaces. 4. Gain the concept of Cayley-Hamilton theorem and its applications. 5. Make clear concept of Inner product spaces, Bessel's inequality, Gram-Schmidt orthogonalization method. 6. Understand normal and self-adjoint operator and spectral theorem
DSE-IT	Linear Programming and Game Theory.	1. Linear Programming problem is being applied to find out the optimum output to attain economic viability of various fields of calculation, as a part of operational Research.

		2. Special emphasis has been given on various types of problems which are particularly relevant to the students of the various courses.
DSE-2T: Probability	**Course Content:** Probability axioms, Probability mass functions, Mathematical Expectation, Moments, Characteristic function, uniform, binomial, poisson, geometric, normal…etc distribution, joint distribution, marginal distribution, bivariate normal distribution, joint moment generating function, covariance, linear regression, Chebyshev's inequality, law of large numbers,, central limit theorem, Markov chains, sampling distribution, estimation of parameters, Testing of hypothesis.	After completion of this course students will be able to: 1. Know the basic concept of probability, its axioms, Bayes' theorem. 2. Understand about Bernoulli trials and Binomial law, Poisson trials, Probability distribution function, continuous and discrete distribution: binomial, poisson, gamma, uniform and normal distributions. 3. Acquire knowledge about transformation of random variables, two dimensional probability distributions, discrete and continuous distributions conditional distribution. 4. Understand the concepts of expectation, mean, variance, moments, dispersion, skewness and kurtosis, median, mode quartiles, characteristic Equation, regression curves, least regression lines. 5. Know the idea of Chebyshev's inequality, law of large number and central limit theorem. 6. Understand about sampling distribution, estimation of parameter. 7. Gain a clear idea about statistical hypothesis.
DSE-3T	Number Theory	1. Students will learn Natural numbers, Prime numbers, Division algorithm, Euclidean algorithm, Congruence. 2. The concept of congruence which laid the foundation of modern theory of numbers. 3. Now-a-days congruence is applied in many of our daily life problems. ISBN of a book is one such application.
DSE-4T: Mathematical Modelling	**Course Content:** Power series solution of Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order, Monte Carlo simulation modeling, middle square method, linear congruence, queuing models, Linear programming model	After completion of this course students will be able to: 1. Create mathematical models of empirical or theoretical phenomena in domains such as the physical, natural, or social science; 2. Create variables and other abstractions to solve college-level mathematical problems in conjunction with previously-learned fundamental mathematical skills such as algebra. 3. Define inferences from models using college-level mathematical techniques including problem solving, quantitative reasoning, and exploration using multiple representations such as equations, tables, and graphs. 4. Take an analytical approach to problems in their future endeavors.
SEC-1(H)T: Logic and Sets	**Course Content:** Propositions, truth table, negation, conjunction and disjunction.	After completion of this course students will be able to: 1. Analyze logical propositions via truth tables.

	Implications, biconditional propositions, convers, inverse propositions and precedence of logical operators. Propositional equivalence, Sets, subsets, Partition of sets. Power set. Difference and Symmetric difference, Relation, Composition of relations, Types of relations, Partitions, Equivalence Relations	2. Apply the appropriate set theoretic concepts, thinking process, tools and techniques in the solutions to various conceptual problems. 3. Express mathematical properties formally via the formal language of proposi-tional logic and predicate logic. 4. Familiar with the construction of different types of functions and relations using set theory.
SEC-2(H)T: Graph Theory	**Course Content:** Definition, examples and basic properties, pseudo graphs, complete graphs, bipartite graphs, Eulerian graph, Hamiltonian cycles, representation of a graph by matrix, adjacency matrix, weighted graph, Travelling salesman's problem, tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm,	After completion of this course students will be able to: 1. Define basic concepts of graph, directed graph and weighted graph. 2. Gain idea about bipartite graphs, its properties, particularly in trees. 3. understand Eulerian and Hamiltonian graphs and explain the basic results With them. 4. Acquire knowledge on Travelling salesman's problem, spanning tree and Dijkstra's algorithm.
G.E-1T:	Calculus, Geometry and Differential Equation	1.The students well equipped about the application of Derivatives and Integration and Analytical Geometry 2. It assists the students to develop the skill of sketching curves.
G.E-2T:	Algebra	1. The course discusses with the basic concept numbers, inequalities, theory of equation and set theory. 2.Students improved the knowledge of materials and linear transformation
DSC-1A(G): Differential Calculus	**Course Content:,** Limit and Continuity, Differentiability, successive differentiation, Leibnitz rule, Partial differentiation, Euler's theorem, Tangents and normals, curvature, asymptotes, curve tracing, mean value theorem, Taylor's theorem, maxima and minima, Indeterminate forms. Real Analysis	After completion of this course students will be able to: 1. Gain idea of limit and continuity of a function and its types. 2. Know higher order derivatives, Leibnitz rule and its application. 3. Understand concept of envelope, asymptotes and curve tracing. 4. Gain the concept of maxima-minima, evaluate limits using L'Hospital rule. 5. Know about Taylor's theorem and its application, Partial differentiation, Euler's theorem and its application.
DSC-1B(G): Differential Equation	**Course Content:** First order exact differential equation, Integrating factors, method for solving higher order differential equation, Wronskian, Linear homogeneous equation with constant	After completion of this course students will be able to: 1. Make clear concepts on exact differential equation, integrating factors and its application. 2. Understand wronskian and its application to solve equation.

	coefficients, Method of variation of parameters, Cauchy-euler equation, simultaneous differential equation, partial differential equation, Lagrange's method, Charpit's method, Classification of partial differential equation.	3. Know about method of variation of parameters, solve Cauchy-euler equation. 4. Acquire knowledge on partial differential equation and learn different Method to solve them. 5. know about different type of partial differential equation.
DSC-1C(G): Real Analysis	**Course Content:** Set theory, Bolzano-Weierstrass Theorem, Sequence and its properties, Infinite series, absolute and conditional Convergence Series. Sequences and series of functions, Real Analysis Pointwise and uniform convergence. μ-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence	After completion of this course students will be able to: 1. Work with logarithmic, exponential, and inverse trigonometric functions. 2. Work with infinite sequences and series. 3. Work with power series and its radius of convergence. 4. Test the convergence and uniform convergence of series of functions.
SEC-1(G): **Logic and Sets**	**Course Content:** Propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, convers, inverse propositions and precedence of logical operators. Propositional equivalence, Sets, subsets, Partition of sets. Power set. Difference and Symmetric difference, Relation, Composition of relations, Types of relations, Partitions, Equivalence Relations	After completion of this course students will be able to: 1. Analyze logical propositions via truth tables. 2. Apply the appropriate set theoretic concepts, thinking process, tools and techniques in the solutions to various conceptual problems. 3. Express mathematical properties formally via the formal language of proposi-tional logic and predicate logic 4. Familiar with the construction of different types of functions and relations using set theory
DSC-1D(G) Algebra	**Course Content:** Group theory and its properties, permutations and permutations group, subgroup, cyclic group, cosets, lagrange's theorem, normal subgroup, ring, subring, integral domain, field,	After completion of this course students will be able to: 1. Work with different binary operations in set. 2. Investigate the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers. 3. Extend group structure to finite permutation groups (Cayley's Theorem) 4. Understand Sylow's Theorems.
SEC-2(G) **Integral Calculus**	**Course Content:** Integration by Partial fractions, integration of rational and irrational functions. definite integrals. Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations. Evaluation of areas and lengths of curves in the plane, valuation of volumes and surfaces of solids of revolution. Double and Triple integrals	After completion of this course students will be able to: 1. Evaluate indefinite and definite *integrals.* 2. Determine the exact length of a line connecting two points. 3. Estimate the area and volume of a region using double and triple integral. 4. Understand a wide range of real-world problems related to physics and engineering.
DSE-1(G) Linear	**Course Content:**	After completion of this course students will be able to:

Programme outcome/Course outcome (Department of Mathematics)

Algebra	Vector spaces, subspaces, quotient spaces, linear span, linear independence, basis and dimension, Linear transformations, null space, range, rank and nullity of linear transformation, matrix representation of linear transformation, isomorphism theorems, invertiility.	1. Gain knowledge about Vector space, subspaces and dimension of subspaces. 2. Understand basis and dimension of Vector space. 3. Acquire knowledge about linear transformation, rank, nullity and the matrix Representation of linear transformation. 4. Understand isomorphism theorem.
DSE-2(G) Numerical Methods	**Course Content:** Bisection method, False position method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Seidel method, Lagrange and Newton interpolation, finite difference operator, Numerical differentiation, forward difference, backward difference, integration: trapezoidal rule, Simpson's rule, solving ordinary differential equations: Euler's method, Runge-Kutta method.	After completion of this course students will be able to: 1. Make a clear concept of polynomial interpolations like Lagrange's and Newton's interpolation formula. 2. Gain a clear concept of finding solution of numerical equations by Bisection method, Newton's method. 3. Gain the concept of numerical differentiation, numerical integration, their formulae and application in solving problems. 4. Know the method to solve the system of linear equations by Gauss-Jacobi And Gauss-Seidel method. 5. Solve the ordinary differential equations by Euler method and Runge-Kutta Method.