DEPARTMENT OF MATHEMATICS
COURSE OUTCOME
UNDER CBCS

Course	Outcomes
CC1: **Calculus ,Geometry & Vector Analysis**	At the end of the course student will be able 1. To do higher order derivative of functions . 2. To learn the applications in different areas. 3. To use reduction formulae to make the integration process less complex. 4. To familiar with the shapes of important geometrical figures with their equations 5. To understand the important applications of coordinate geometry to computer graphics including computer games. 6. To demonstrate the problems of mechanics , and other fields of mathematics and physics by using the ideas of vector analysis.
CC2: **Algebra**	At the end of the course student will be able 1. To use the basic inequalities . 2. To find the solution and can be sure about the existence of solutions of algebraic equations with real coefficients . 3. To acquire the proper knowledge of complex number system. 4. To learn the concepts of Number theory which are useful in abstract algebra and in future in the study of computer languages. 5. To familiar with the link between any two entities 6. To distinguish different types of relations and functions. 7. To understand the concept of partitions, equivalence classes on a set.
CC3: **Real Analysis**	At the end of the course student will be able to 1. Demonstrate competence with elementary propertiesof sets by proving identities involving union and intersection and CartesianProducts of sets. 2. Use mathematical induction to prove results involving natural numbers. 3. Demonstrate competence with the algebraic andorder properties of real numbers. 4. Demonstrate competence with properties of realnumbers by finding supremum and infimum of sets and using thecompleteness property of real numbers. 5. Demonstrate competence with elementary propertiesof sequences by finding limits and proving results involvingsum/difference/product/quotients of sequences. 6. Apply the monotone convergence theorem to proveconvergence of

	bounded monotone sequences. 7. Find the convergent and divergent series of real numbers.

Course	Outcomes
CC4: **Group Theory-I**	At the end of the course student will be able to 1. To understand different type of algebraic structure with different binary operations and the elementary properties of group theory 2. To decide whether a given group is cyclic 3. To find the generators of a given cyclic group. 4. To understand the applications of group theory in harmonic analysis, combinatorics, algebraic topology, algebraic number theory, algebraic geometry, and cryptography 5. to investigate any object or system attribute that is invariant under change because of its symmetry 6. Identify the normal subgroup of a group. 7. Identify the factor groups of a group. 8. Construct homomorphism and Isomorphism between to groups to study the algebraic properties of unknown groups.
CC5: **Theory of Real functions**	At the end of the course student will be able to 1. Demonstrate the definition and sequential criterion of existence Of limit for a real valued functions. 2. Demonstrate the continuity criterion for a real valued function. 3. Prove the speciality of continuous real valued function defined on a bounded and closed interval . 4. Demonstrate the uniform continuity and Lipschitz condition. 5. Use mean value theorems to solve different mathematical problems. 6. Toexpand the Taylor series representation of differentiable functions.
CC6: **Ring Theory &Linear algebra -I**	At the end of the course student will be able to 1. Understand the basic ideas of vector algebra, linear dependence and

	independence of vectors and spanning sets. 2. To find the row space ,column space of matrices and be familiar with the concepts of basis and dimension of vector spaces. 3. To find the matrix representation of a linear transformation when the linear transformation and the bases are given. 4. Interpret a matrix as a linear transformation from Rn to Rm 5. Understand the relationship between a linear transformation and its matrix representation. 6. Interpret the inverse matrix as representing the inverse linear transformation. 7. Decide whether a linear transformation is one-to-one or onto and how these questions are related to matrices. 8. Discuss the kernel and image of a linear transformation in terms of nullity and rank of the matrix.

Course	Outcomes
CC7: **ODE & Multivariate Calculus-I**	At the end of the course student will be able to 1.To familiar the important applications of Ordinary differential equations in real life to calculate the movement or flow of electricity, motion of an object to and fro like a pendulum. 2. To explain thermodynamics concepts. 3. To check the growth of diseases in graphical representation. 4.Demonstrate the continuity and differentiability of vector and scalar fields. 5. To find the partial derivatives and total derivatives of vector valued functions. 6. Generalize the concepts of real analysis in higher dimension. 7. To find the Directional derivatives and the equations of tangent planes of surfaces. 8. Apply Lagarange's multiplier methods to

	find the maximum and minimum values of vector field.
CC8: **Riemann Integration & Series of Functions**	At the end of the course student will be able to 1. Demonstrate the knowledge of Riemann integrablefunctions and can enlarge the concepts of class of integrable functions. 2. Demonstrate the ideas of Fundamental theory of Integration which result they have already used in school mathematics without proof. 3. Know preliminary ideas on Lebesgue integrals, measure zero sets that will motivate them for future studies in integration course. 4. To check the uniform convergency of sequence of functions and also the properties that transmitted through the uniform convergence. 5. To learn Series of functions , Power series concepts are very much useful in higher mathematics and also physics. 6. To learn the concepts about Fourier series which is a particular type of series of function and it gives the idea of expanding the sectionaly continuous functions in to infinite series.
CC9: **PDE & Multivariate Calculus-II**	At the end of the course student will be able to 1. Learn the different methods of solutions such as Lagrang's methods, Charpit's method of both linear and non-linear partial differential equations 2. To classify whether a given partial differential equation is parabolic, elliptic or hyperbolic by transforming a second order PDE into its canonical form. 3. To be familiar with heat equation, wave equation and Laplace equation 4. Learn application of PDE in fluid mechanics, elasticity theory, electrodynamics, quantum mechanics, etc. 5. Help to calculate directional derivatives and gradient and illustrate geometric ideas of 3D objects. 6. To solve the problem involving normal vectors to level surfaces. 7. Explain the concept of vector integration

	on a line ,use of Green's theorem, Stoke's theorem etc.
CC10: **Mechanics**	At the end of the course student will be able to 1. Understand the virtual work, stable and unstable equilibrium . 2. Students will be able to solve the problems on stability of nearly orbit, motion in a particle in 3D and motion on a smooth sphere ,cone and any surface. 3. Students will be able to understand degree of freedom, D'Alembert's Principle, compound pendulum and conservation of momentum and energy
CC11: **Probability & Statistics**	At the end of the course student will be able to 1.Compute probabilities and conditional probabilities in appropriate ways. 2.Solve word problems using combinatorial analysis. 3.Represent and statistically analyse data both graphically and numerically. 4.Demonstrate the ability ofconditional probabilities statistically analyse data both graphically and numericallyby presentation.

Course	Outcomes
CC12: **Group Theory –II & Linear Algebra -II**	At the end of the course student will be able to 1.Understand how to determine the angle between vectors and the orthogonality of vectors. 2.Discuss rigid motions and orthogonal matrices 3.Discuss general inner product spaces and symmetric matrices, and associated norms 4.Explain how orthogonal projections relate to least square approximations orthonormal bases 5.Explain the Gram-Schmidt orthogonalization process to find orthogonal basis. 6.Define orthogonal complements and orthogonal projections. 7.Compute the orthogonal projection of a vector onto a subspace, 8.Demonstrate the automorphism between two groups,innerautomorphism. 9. Demonstrate the external and internal direct product of groups, Cauchy theorem, converseLagaranges theorem.

DSE-A(1) **Advanced Algebra**	At the end of the course student will be able to 1.Demonstrate the knowledge of Group actions, different approach of Permutation Groups by using Group action theories. 2. Demonstrate the knowledge of Sylow theorems, Class equations , Cauchy theorems and its applications to verify simplicity of different groups. 3. Demonstrate the knowledge of PID,UFD,ED. 4.Demonstrate the knowledge of Polynomial rings ,different examples and their ideals also Quotient ring theories . 5. Demonstrate the ideas of Ring isomorphism to study the abstract ring structures with well -known rings.
DSE-B(1) **Linear Programming & Game Theory**	At the end of the course student will be able to 1. Formulate optimization problems; Solving problems using different methods. 2. Place a Primal linear programming problem into standard form and use the Simplex Method or Revised Simplex Method to solve it and find the dual, and identify and interpret the solution of the Dual Problem from the final tableau of the Primal problem. 3. Explains the Transportation Problem and formulate it as an LPP and hence solve the problem. 4. Determine that an Assignment Problem is a special case of LPP and hence solve by Hungarian method. 5. To understand the theory of games for solving simple games. 6. Students will demonstrate the ability of Solving problems using different methods and the theory of games for solving simple games and its applications in real life .
CC13: **Metric Space & Complex analysis**	At the end of the course student will be able to 1. Generalize idea of distance in arbitrary spaces and also can get an idea of different nature of open sets in different spaces. 2. Demonstrate the idea of convergent

	and divergent sequences for metric spaces. 3. Demonstrate the knowledge of Cauchy sequence , Cantors theorem ,Completeness properties for metric spaces. 4. Conceive the concepts of analytic functions and will be familiar with the elementary complex functions and their properties, and apply the concept and consequences of analyticity and the Cauchy Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra. 5. Applies the theory into application of the power series expansion of analytic functions, and understand the basic methods of complex integration and its application in contour integration. 6. Evaluate complex contour integrals directly and by the fundamental theorem ,apply the Cauchy integral theorem in its various versions, and the Cauchy integral Formula 7. Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem. 8. Compute Laurent series and its examples ,absolute and uniform convergence of power series,
CC14: **Numerical Methods & Practical**	At the end of the course student will be able to 1. Acquire basic knowledge in solving interpolation with equal intervalproblems by various numerical methods. Estimate the missing terms through interpolation methods. 2. Develop skills in analyzing the methods of interpolating a given data, properties of interpolation with unequal intervals and derive conclusions, approximate a function using an appropriate numerical method. 3. Implement numerical methods for a variety of multidisciplinary applications and a variety of

	numerical algorithms using appropriate technology. 4. Use relevant numerical techniques for interpolation with equal and unequal intervals by using various central difference formulae and code a numerical method in a modern computer language. 5. Apply appropriate numerical methods to solve the problem with most accuracy. 6. Be able to derive Least – Squares curve fitting procedures, fitting a straight line, fitting a parabola, nonlinear curve fitting, Curve fitting by a sum of exponentials. 7. Be able to find the derivatives using Newton's forward difference formula ,Newton's backward difference formula, Derivatives using central difference formulae, Stirling's interpolation formula, Newton's divided difference formula, Maximum and minimum values of a tabulated function. 8. Be able to derive Trapezoidal rule, Simpson's 1/3 – rule, Simpson's 3/8 – rule, and Weddle's rules from General Quadrature formula and find the Euler – Maclaurin Formula of summation and The Euler transformation. 9. Be able to find the solution of linear systems by using Direct methods, Matrix inversion method, Gaussian elimination methods, Gauss-Jordan Method, Method of factorization, Solution of Tri diagonal Systems. 10. Be able to find the find the solution of ordinary differential equation of first order by Euler, Taylor and Runge-Kutta methods 11. Compare different methods in numerical analysis with accuracy and efficiency of solutions.
DSE-A(2) **Mathematical Modelling**	At the end of the course student will be able to 1.To understand concept of modelling and simulation 2.To construct mathematical models of real world problems

	3.Demonstrate power series solution of Bessel's equation and Legendre's equations,Laplace transform and inverse transform. 4.Solve the initial value problems upto second order. 5.Able to learn different types of models and their behaviors like Monte Carlo simulating model,queuingmodel,linear programming model. 6.To learn the solution techniques e.g middle square method,geometric solution algebraic solution,simplex method.
DSE-B(2) **Point Set Topology**	At the end of the course student will be able to 1. State the definitions of a topological space, a basis, closed set, continuous function and homeomorphism. 2. Explain the product and metric topologies with their properties. 3. Explain the compactness of a topological space. 4. Explain the connectedness of a topological space and the differences between the connectedness and path connectedness. 5. Explain the countability and separation axioms. 6. Compare the topological spaces with the help of countability and separation axioms. 7. Explain the quotient topology and its properties.