	Program:	**M.A./M.Com./M.Sc. - subject**		**Mathematics**
	PO Code	Programme Outcomes:		
	PO1	To provide students with advanced mathematical and computational skills that prepares them to pursue higher studies and conduct research.		
	PO2	To increase students self-confidence in conducting research independently or within a team.		
	PO3	Develop an in-depth understanding of the fundamentals of Mathematics and create a foundation of lifelong learning to facilitate progressive careers in industry.		
Semester	Course Code	Course Name	CO Code	Course Outcomes
I	M-CC-01	Algebra-I	CO1	1. Determine whether a given set and binary operation form a group by checking group axioms 2. Describe the symmetries of some bounded three-dimensional figures. 3. Write precise and accurate mathematical definitions of objects in ring theory; 4. Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples; 5. Validate and critically assess a mathematical proof; 6. Use a combination of theoretical knowledge and independent mathematical thinking to investigate questions in group theory , ring theory and to construct proofs; 7.

	M-CC-02	Real Analysis	CO2	1. Interpret a volume of revolution of a function's graph around a given axis as a (Riemann) sum of disks or cylindrical shells, convert to definite integral form and compute its value. 2. Express the length of a curve as a (Riemann) sum of of linear segments, convert to definite integral form and compute its value. 3. Improper Integrals: Recognize and evaluate improper integrals of Type I and Type II. 4. Infinite Series: Explain clearly the definition of an infinite series as the limit of a sequence of partial sums. 5. Geometric Series: Recognize a geometric series and correctly apply the convergence theorem. 6. Power Series: Apply the ratio test to determine the radius of convergence for a power series.
	M-CC03	Topology	CO3	1. Distinguish among open and closed sets on different topological spaces. 2. Know the two fundamental topologies:discrete and indiscrete topologies. 3. Identify precisely when a collection of subsets of a given set equipped with a topology forms a topological space. 4. Understand when two topological spaces are homeomorphic. 5. identify the concepts of distance between two sets,connectedness, compactness and separation axioms.

	M-CC-04	Numerical Analysis-I with MATLAB programming	CO4	1. Solve system of linear algebraic equations 2. Explain Gaussian rules for Numerical integration 3.Make use of numerical techniques to find the derivative at a point and evaluate definite integrals 4. Illustrate the numerical solutions for Numerical interpolation linear and nonlinear system of eigen value problems 5.Basic Introduction and learning MATLAb codes for numerical methods
	M-AC-01	Discrete Mathematics	CO5	1. To learn the basic terminology and some of the theory associated with graphs. 2. Modern applications of graph theory will be explored. 3. Use these definitions and theorems from memory to construct solutions to problems and/or proofs. 4. Formulate graph theoretic models to solve real world problems (e.g., scheduling problems). 5. Design a digital communication system by selecting an appropriate error correcting codesfor a particular application. 6. Explain various methods of generating and detecting different types of error correcting codes

				7. Formulate the basic equations of linear block codes.
	M-AC-02	Computational Statistics	CO6	**1.** Understand Some special mathematical expectations and Chebyshev's inequality. **2.** Study Marginal and conditional distributions, the correlation co-efficient . **3.** Study and apply various probability distributions to solve problems. **4.** understand regression Analysis
			CO7	
II	M-CC-05	Functional Analysis	CO1	1. Study Continuous linear transformations and the Hahn-Banach theorem. 2. Understand the Open Mapping Theorem and its applications. 3. Obtain Orthogonal complements, Orthonormal sets and conjugate space. 4. Understand the relevance of Operator Theory. 5. Discuss Determinants and the spectrum of an operator.
	M-CC-06	Complex Analysis	CO2	1. Recall and Analyze the concepts in complex analysis. 2. Define and Evaluate complex integration . 3. Determine and Analyze the calculus of residues . 4. Develop series of complex function and extend its product using

				Jensen‟s and Poisson formula 5. Classify elliptic functions and analyze their properties .

	M-CC-07	Ordinary Differential Equations	CO3	1. Understanding the existence and uniqueness of solutions of general linear differential equations. 2. Extension of theorems to solving problems of differential equations. 3.Understanding of a very important method of solution technique called Green's function technique which has large scale applications. 4.Understanding different methods of solutions to solve linear differential equations of order two. 5.Problems related to methods of solutions is intended to help students in taking up these methods of solution and their application in real world problems. 6.Analyze real-world problems such as motion of a falling body, compartmental analysis, free and forced vibrations, etc.; use analytic technique to develop a mathematical model, solve the mathematical model and interpret the mathematical results back into the context of the original problem.

	M-CC-08	Algebra-II		
			CO4	1. Use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, orthogonality and diagonalization. (Computational and Algebraic Skills). 2. Use visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions. 3. Critically analyze and construct mathematical arguments that relate to the study of introductory linear algebra. (Proof and Reasoning). 4. Communicate and understand mathematical statements, ideas and results, both verbally and in writing, with the correct use of mathematical definitions, terminology and symbolism (Communication Skills). 5. Demonstrate understanding of inner products and associated norms.
			CO5	Be familiar with linear vector spaces relevant to continuum mechanics and able to perform vector and tensor manipulations in Cartesian

	M-AC-03	Continuum Mechanics		and curvilinear coordinate systems 2.Apply the tensor formalism 3.Treat general stresses and deformations in continuous materials, 4.Formulate and solve specific technical problems of displacement, strain and stress 5.Perform experiments with stresses and deformations. 6.Numerically model and analyze the stresses and deformations of simple geometries under an arbitrary load in both solids and liquids. 7.Be able to solve simple boundary value problems for fluids and solids.
			C O6	Research Methodology
			C O7	
III	M-EC-01	Differential Geometry	C O1	.To Understand the concept of curvature of a space curve and signed curvature of a plane curve. 2.To be able to understand the fundamental theorem for plane curves. 3.To get introduced to the notion of Serret-Frenet frame for space curves and the involutes and evolutes of space curves with the help of examples. 4.To be able to compute the curvature and torsion of space

				curves. 5. To be able to understand the fundamental theorem for space curves. 6.To get introduced to the concept of a parameterized surface with the help of examples. 7.To understand geodesics as distance minimizing curves on surfaces. 8. To find geodesics on various surfaces
	M-EC-02	Partial Differential Equations	CO2	Use knowledge of partial differential equations (PDEs), modelling, the general structure of solutions, and analytic and numerical methods for solutions. 2.Understand analogies between mathematical descriptions of different (wave) phenomena in physics and engineering. 3.Classify PDEs, apply analytical methods, and physically interpret the solutions. 4.Solve practical PDE problems with finite difference methods, implemented in code, and analyze the consistency, stability and convergence properties of such numerical methods. 5.Interpret solutions in a physical context, such as identifying travelling waves, standing waves, and shock waves. 6.Apply problem-solving using concepts and techniques from PDE's and Fourier analysis applied to diverse situations in physics, engineering, financial mathematics and in other mathematical contexts.

	M-EC-03	Fluid Mechanics	C O3	Describe the physical properties of a fluid. 2.Calculate the pressure distribution of incompressible fluids 3.Describe the principles of motion of fluids 4.Identify the derivation of basic equations of fluid mechanics and apply 5.Use the dimensional analysis and derive the dimensionless numbers
	M-EC-04	Graph Theory	CO4	1. Know some important classes of graph theoretic problems; 2. Be able to formulate and prove central theorems about trees, connectivity, colouring and planar graphs; 3. Apply the concepts of graph connectivity at appropriate points of graph theory and 4. Be able to describe and apply some basic algorithms for graphs; 5. Be able to use graph theory as a modelling tool. 6. Apply domination theory in installing common facility in appropriate points in Town planning
	M-AC-05	Numerical Analysis-II	C O5	1. Make use of numerical techniques to find the derivative at a point and evaluate definite integrals 2. Demonstrate and match mathematical preliminaries to solve ordinary differential equations 3. Illustrate the numerical solutions of boundary value problems 4. Study of single step and multistep methods.

	OE-	Operations Research with MATLAB programming	C O6	**1.** Understand the concept of Graphs and Level sets-Vector fields. **2.** Analyze Graphical Method, Use of Artificial variables and Inverting a Matrix using Simplex method. **3.** Apply Duality to solve problems in Linear Programming. **4.** Understand Test the optimality for Degeneracy by using Transportation Algorithms (MODI method). **5.** Study Assignment Problem and its applications.
			C O7	
IV	M-EC-05	Measure and Integration	C O1	1. Study about measurable sets , functions and outer measure. 2. Analyse about measurable functions, convergency of measures. 3. Analyse about Lebesque integrals, Riemann integrals and properties. 4. Applications of vitali covering lemma, Riesz – Fischer Theorem. 5. Applications of measure theory in probability concepts.
	M-EC-06	Mathematical Methods	C O2	1. Applications of transforms and integral equations. 2. Study about calculus of variations. 3. Applications of asymptotic and perturbation methods.

				4. Study about first order and second order ODE.
	M-EC-07	Optimization Techniques	C O3	1. Formulate mathematical LPP models and find their solutions . 2. Translate LPP using duality principle and find their solutions. 3. Recall and apply simplex method and its extensions . 4. Recognize, solve and interpret transportation and assignment problems . 5. Recall some basic principles of optimization techniques and solve shortest path problems, Maximal flow problems. 6. Interpret the principle of non-linear problems.
			C O4	
			C O5	
			CO6	