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1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Table 1: Programme Educational Objectives of M.SC MATHEMATICS	
PEO1	Have significant opportunities in various service domains at National and International levels like banking, insurance, government jobs, consultancy, teaching, defense, industry, research and entrepreneurial pursuit.
PEO2	Have leadership quality to handle all kind of circumstances in diversities by providing interdisciplinary and multidisciplinary learning environment.
PEO3	Inculcate value system while working in a team assigned with a important targets they will contribute through their critical thinking and mathematical competence holding the ethical values.
PEO4	Achieve peer recognition as an individual or as a team member having specialized knowledge and expertise to investigate, formulate, analyze and implement on the problems of pure, applied and computational mathematics to compete at global level.
PEO5	Have continuous learning attitude to adopt new skills and techniques to overcome the problems related with new technologies.

2. PROGRAMME SPECIFIC OUTCOMES (PSOs)

Table 2: Programme Specific Outcomes of M.SC MATHEMATICS	
PSO1	Understand the mathematical concepts and applications in the field of algebra, analysis, computational techniques, optimization, differential equations, engineering and actuarial science.
PSO2	Adopt changing scientific environment in the process of sustainable development by using mathematical tools.
PSO3	Handle the advanced techniques in algebra, analysis, computational techniques, optimization, differential equations, engineering, finance and actuarial science to analyze and design algorithms solving variety of problems related to real life problems.
PSO4	Have necessary skills and expertise in the field of research and developments through seminar and dissertation.

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3. PROGRAMME OUTCOMES (POs)

Table 3: Programme Outcomes of M.SC MATHEMATICS

PO1	**KNOWLEDGE DOMAIN:** Demonstrate an understanding of the basic concepts in mathematics, statistics, operations research and their importance in the solution of some real- world problems
PO2	**PROBLEM ANALYSIS:** Analyze and solve the well-defined problems in mathematics statistics, and operations research. Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decision. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.
PO3	**PRESENTATION AND INTERPRETATION OF DATA:** Demonstrate the ability to manipulate and visualize data and to compute standard statistical summaries.
PO4	**ETHICS:** Analyze relevant academic, professional and research ethical problems and commit to professional ethics and responsibilities with applicable norms of the data analysis and research practices.
PO5	**MODERN TOOL USAGE:** Learn, select, and apply appropriate methods and procedures, resources and computing tool such as LATEX, MATLAB etc with an understanding of the limitations.
PO6	**COMMUNICATION:** Effectively communicate about their field of expertise on their activities, with their peer and society at large. Such as, being able to comprehend and write effective reports and design documentation, make effective presentations.
PO7	**PROJECT MANAGEMENT:** Apply Knowledge and understanding of principles of mathematics and statistics effectively as an individual, and as a member or leader in diverse teams to manage projects in multidisciplinary environment.
PO8	**INDIVIDUAL AND TEAM WORK:** Work effectively as an individual, as a member or leader of various teams, and in multi-disciplinary settings.
PO9	**DESIGN/DEVELOPMENT OF SOLUTIONS:** Model the real-world problems in to mathematical equations and draw the inferences by finding appropriate solutions.
PO10	**LIFE-LONG LEARNING:** Continue to acquire mathematical knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematics.

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4. COURSE OUTCOMES (COs)

Table 4: Courses Outcomes of M.SC MATHEMATICS	
COURSE 1: ALGEBRA - I	
CO1	Students will have a working knowledge of important mathematical concepts in abstract algebra such as definition of a group, order of a finite group and order of an element.
CO2	Students will be knowledgeable of different types of subgroups such as normal subgroups, cyclic subgroups and understand the structure and characteristics of these subgroups.
CO3	Students will be introduced to and have knowledge of many mathematical concepts studied in abstract mathematics such as permutation groups, factor groups and Abelian groups.
CO4	Students will see and understand the connection and transition between previously studied mathematics and more advanced mathematics. The students will actively participate in the transition of important concepts such homomorphisms & isomorphisms from discrete mathematics to advanced abstract mathematics.
CO5	Students will gain experience and confidence in proving theorems. A blended teaching method will be used requiring the students to prove theorems give the student the experience, knowledge, and confidence to move forward in the study of mathematics.
COURSE 2: LINEAR ALGEBRA	
CO1	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.
CO2	Use visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions, especially in R^2 and R^3, as well as conceptually extend these results to higher dimensions.
CO3	Use technology, where appropriate, to enhance and facilitate mathematical understanding, as well as an aid in solving problems and presenting solutions
CO4	Communicate and understand mathematical statements, ideas and results, both verbally and in writing, with the correct use of mathematical definitions, terminology and symbolism
CO5	Critically Analyse and construct mathematical arguments that relate to the study of introductory linear algebra.
COURSE 3: REAL ANALYSIS I	

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO1	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
CO2	Comprehend regions arguments developing the theory underpinning real analysis.
CO3	Demonstrate an understanding of limits ad how that are used in sequences, series and differentiation.
CO4	Construct rigorous mathematical proofs of basic results in real analysis.
CO5	Appreciate how abstract ideas and regions methods in mathematical analysis can be applied to important practical problems.
COURSE 4: DISCRETE MATHEMATICS	
CO1	Be familiar with fundamental mathematical concepts and terminology of discrete mathematics and discrete structures.
CO2	Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
CO3	Understand graph, subgraphs, connected and disconnected graphs etc.
CO4	Solve problems involving vertex,edge connectivity and planarity
CO5	Know the theory of Computation and Finite Automata
COURSE 5: NUMBER THEORY	
CO1	Prove results involving divisibility and greatest common divisors.
CO2	Solve systems of linear congruences.
CO3	Find integral solutions to specified linear Diophantine Equations
CO4	Apply Euler-Fermat's Theorem to prove relations involving prime numbers.
CO5	Apply the Wilson's theorem.

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
COURSE 6: ALGEBRA II	
CO1	Explain the fundamental concepts of field extensions and Galois theory and their role in modern mathematics and applied contexts.
CO2	Demonstrate accurate and efficient use of field extensions and Galois theory.
CO3	Demonstrate capacity for mathematical reasoning through analysing, proving and explaining concepts from field extensions and Galois theory.
CO4	Apply problem-solving using field extensions and Galois theory applied to diverse situations in physics, engineering and other mathematical contexts.
CO5	Analyse and construct geometric numbers,
COURSE 7: REAL ANALYSIS II	
CO1	Understand the fundamentals of measure theory and be acquainted with the proofs of the fundamental theorems underlying the theory of integration
CO2	Understanding of how these underpin the use of mathematical concepts such as volume, area, and integration.
CO3	Develop a perspective on the broader impact of measure theory in ergodic theory and have the ability to pursue further studies in this and related area.
CO4	Explain the concept of length, area, volume using Lebesgue's theory.
CO5	Apply the general principles of measure theory and integration in such concrete subjects as the theory of probability or financial mathematics.
COURSE 8: TOPOLOGY	
CO1	Demonstrate knowledge and understanding of concepts such as open and closed sets, interior, closure and boundary.
CO2	Create new topological spaces by using subspace, product and quotient topologies.
CO3	Use continuous functions and homeomorphisms to understand structure of topological spaces.
CO4	Demonstrate knowledge and understanding of metric spaces.

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO5	Apply theoretical concepts in topology to understand real world applications
COURSE 9: ODE AND CALCULUS OF VARIATIONS	
CO1	Identify, analyse and subsequently solve physical situations whose behaviour can be described by ordinary differential equations
CO2	Competence in solving applied problems which are linear and nonlinear form
CO3	Solve the problems choosing the most suitable method
CO4	determine the solution of differential equations with initial and boundary value problems
CO5	enhance and develop the ability of using the language of mathematics in analysing the real-world problems of sciences and engineering.
COURSE 10: OPERATIONS RESEARCH	
CO1	Formulate some real life problems into Linear programming problem.
CO2	Use the simplex method to find an optimal vector for the standard linear programming problem and the corresponding dual problem
CO3	Prove the optimality condition for feasible vectors for Linear programming problem and Dual Linear programming problem.
CO4	Find optimal solution of transportation problem and assignment problem
CO5	Formulate and solution of linear programming model of two person zero sum game
COURSE 11: PROGRAMMING WITH SCILAB (PCC)	
CO1	Install and learn basics of Scilab Language
CO2	Using functions, loops and conditional statements
CO3	Handling Complex numbers, Polynomials, Vectors, Matrices

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO4	Handling Graphics and plots
CO5	Solutions to ODEs
COURSE12:SCIENTIFIC PROGRAMMING WITH PYTHON(PCC)	
CO1	To learn basics of the Python Language
CO2	To use control statements, functions and modules
CO3	To use data structures like lists, tuples, sequences
CO4	To use graphs and plots
CO5	To find solutions to ODEs and Numerical Analysis problems
COURSE 13: MULTIVARIABLE CALCULUS AND GEOMETRY	
CO1	Manipulate vectors to perform geometrical calculations in three dimensions
CO2	Understand the basic concepts and know the basic techniques of differential and integral calculus of functions of several variables.
CO3	Apply the theory to calculate the gradients, directional derivatives, arc length of curves, area of surfaces, and volume of solids.
CO4	Solve problems involving maxima and minima, line integral and surface integral, and vector calculus.
CO5	Develop mathematical maturity to undertake higher level studies in mathematics and related fields.
COURSE 14: COMPLEX ANALYSIS	
CO1	Perform basic algebraic manipulation with complex numbers.
CO2	Understand the geometric interpretation of complex numbers.

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO3	Know methods of finding the nth roots of complex numbers and the solutions of simple polynomial equations.
CO4	Compute definite integrals using residue calculus.
CO5	Appreciate the existence of special functions and their use in a range of contexts.
COURSE 15: FUNCTIONAL ANALYSIS	
CO1	Be familiar with the completeness in normed linear spaces
CO2	Understand the concepts of bounded linear transformation, equivalent formulation of continuity and spaces of bounded linear transformations.
CO3	Describe the solvability of linear equations in Banach Spaces, weak and strong convergence and their equivalence in finite dimensional space.
CO4	Learn the properties of compact operators.
CO5	Understand uniform boundedness principle and its consequences
COURSE 16: PDE AND INTEGRAL EQUATIONS	
CO1	Apply a range of techniques to find solutions of standard Partial Differential Equations (PDE)
CO2	Understand basic properties of standard PDE's.
CO3	Demonstrate accurate and efficient use of Fourier analysis techniques and their applications in the theory of PDE's.
CO4	Demonstrate capacity to model physical phenomena using PDE's (in particular using the heat and wave equations).
CO5	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.
COURSE 17: CODING THEORY	

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO1	Understand and apply the techniques of error detection and correction, to prove the properties of the codes studied.
CO2	Demonstrate the familiarity with issues arising from the applications of these coding.
CO3	Apply their knowledge to invent new coding algorithms.
CO4	Analyse the performance of error control codes Apply convolution codes for performance analysis & cyclic codes for error detection and correction
CO5	Design BCH code for Channel performance improvement against burst errors.
COURSE 18: CRYPTOGRAPHY	
CO1	Understand various Cryptographic Techniques
CO2	Apply various public key cryptography techniques
CO3	Implement Hashing and Digital Signature techniques
CO4	To be able to secure a message over insecure channel by various means
CO5	To learn about how to maintain the Confidentiality, Integrity and Availability of a data
COURSE 19:MEASURE AND INTEGRATION	
CO1	Define and understand basic notions in abstract integration theory, integration theory on topological spaces and the n-dimensional space.
CO2	Describe and apply the notion of measurable functions and sets and use Lebesgue monotone and dominated convergence theorems and Fatous' Lemma.
CO3	Describe the construction of and apply the Lebesgue integral,
CO4	describe the construction of product measures and use Fubini's theorem.
CO5	Describe the notion of absolute continuity and singularities of measures.

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
COURSE 20: PROBABILITY THEORY	
CO1	Understand the axiomatic formulation of modern probability theory and consider random variables as an internal requirement for the analysis of random phenomena.
CO2	Characterize probability models and function of random variables based on single and multiples random variables
CO3	Evaluate and apply moments and characteristic functions and understand the concept of inequalities and probabilistic limits.
CO4	Understand the concept of random processes and determine covariance and spectral density of stationary random processes.
CO5	Demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models.
COURSE 21: ADVANCED FUNCTIONAL ANALYSIS	
CO1	Formulate and prove theorems concerning analytic functions
CO2	Use and analyse conformal maps
CO3	Discuss the theory of analytic continuation
CO4	Properties of solutions to complex differential equations
CO5	Evaluate complex integrals by using Cauchy-Goursat Integral Theorem
COURSE 22 :ADVANCED COMPLEX ANALYSIS	
CO1	Formulate and prove theorems concerning analytic functions
CO2	Use and analyse conformal maps
CO3	Discuss the theory of analytic continuation
CO4	Properties of solutions to complex differential equations

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO5	Evaluate complex integrals by using Cauchy-Goursat Integral Theorem
COURSE 23: ALGEBRAIC NUMBER THEORY	
CO1	Define the key notions of algebraic number theory and outline their interrelation.
CO2	The concept (definition and significance) of algebraic numbers and algebraic integers
CO3	Understand the fundamental theorems of the course and apply them in specific cases.
CO4	Explain the concept of "geometry of numbers" according to Minkowski.
CO5	The definition of the Class Group.
COURSE 24: ALGEBRAIC TOPOLOGY	
CO1	Explain the fundamental concepts of algebraic topology and their role in modern mathematics and applied contexts.
CO2	Demonstrate accurate and efficient use of algebraic topology techniques.
CO3	Demonstrate capacity for mathematical reasoning through analysing, proving and explaining concepts from algebraic topology.
CO4	Apply problem-solving using algebraic topology techniques applied to diverse situations in physics, engineering and other mathematical contexts.
CO5	find algebraic invariants that classify topological spaces up to homeomorphism, though usually most classify up to homotopy equivalence,,
COURSE 25: COMMUTATIVE ALGEBRA	
CO1	Knows basic definitions concerning elements in rings, classes of rings, and ideals in commutative rings.
CO2	Know constructions like tensor product and localization, and the basic theory for this.
CO3	Know basic theory for noetherian rings and Hilbert basis theorem

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO4	Have insight in the correspondence between ideals in polynomial rings, and the corresponding geometric objects: affine varieties.
CO5	Know the theory of Gröbner bases and Buchberger's algorithm
COURSE 26: DIFFERENTIAL GEOMETRY	
CO1	Analyse the equivalence of two curves by applying some theorems.
CO2	Express definition and parametrization of surfaces.
CO3	Explain differential maps between surfaces and find derivatives of such maps.
CO4	List topological aspects of surfaces
CO5	Give examples of manifolds and investigate their properties.
COURSE 27: FLUID DYNAMICS	
CO1	Describe the motion of fluids.
CO2	Identify derivation of basic equations of fluid mechanics and apply
CO3	Make dimensional analysis and similitude.
CO4	Apply the similitude concept and set up the relation between a model and a prototype.
CO5	Identify how to derive basic equations and know the related assumptions.
COURSE 28: GRAPH THEORY	
CO1	Solve problems using basic graph theory
CO2	Identify induced subgraphs, cliques, matchings, covers in graphs
CO3	Solve problems involving vertex and edge connectivity, planarity and crossing numbers

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Table 4: Courses Outcomes of M.SC MATHEMATICS	
CO4	Determine whether graphs are Hamiltonian and/or Eulerian
CO5	Model real world problems using graph theory
COURSE 29: REPRESENTATION THEORY	
CO1	Give an account of important concepts and definitions in representation theory for finite groups
CO2	Exemplify and interpret important concepts in specific cases
CO3	Formulate important results and theorems
CO4	Describe the main features of the proofs of important theorems
CO5	Use the theory, methods and techniques of the course to solve mathematical problems.
COURSE 30: WAVELET THEORY	
CO1	To understand basic properties of Discrete Fourier Transforms
CO2	To understand the Fast Fourier Transforms
CO3	To apply Wavelets on Z_N
CO4	To apply Fourier Transform and convolution
CO5	To apply Multi-resolution analysis using wavelets