2.6 Student Performance and Learning Outcomes

2.6.1 Program outcomes, program specific outcomes and course outcomes

Sr. No.	Program	Program Objectives	Program Specific Objectives
1	MSc Mathematics	**PO1**: Promotion of self study **PO2**: Promotion of thinking **PO3**: Confidence **PO4**: Creativity **PO5**: Problem Solving **PO6**: Understanding Concepts **PO7**: Development of Writing, Listening and Teaching Skills **PO8**: Group Discussion (Skill of Team work, interpersonal skills) **PO9**: Social Values: Unity in Diversity **PO10**: Learning Values from Teachers	**PSO1**: To produce research scholars who can provide the leadership in mathematics and its applications. **PSO2**: The student desiring to become a teacher shuld be expose to historical aspects of development of some important concepts of mathematics and technique of teaching mathematics through problem seminars.

Courses Offered

Sr. No.	Course	Course Outcomes
1	MSc I (Sem I) Advanced Calculus	Upon successful completion of this course, students will be able to : • Understand topics derivative of scalar fields & vector fields , Line integral , Multiple integral and Surface integral. • Compute the physical terms like work done , mass ,center of mass , and weight of the body. • Teach how to find the area & volume of objects of irregular shape. • Learns dealing with function of more than one variable.

		• Use differentiation for multivariate functions to find relative extrema of the functions.
2	MSc I (Sem I) Group Theory	A student who has studied and learned the material should be able to: • Incorporate equivalence relations into group theoretic structures, particularly factor groups. • Determine subgroups and determine whether given subsets of a group are subgroups. • Use the Fundamental Theorem of Cyclic Groups to classify and determine subgroup structure of non-cyclic groups. • Construct and manipulate group homomorphisms and isomorphisms. • Recognize and interpret theorems to prove properties about specific algebraic structure. • Use the skills of proof by contradiction, proof by contraposition, proof of set equality, and proof using both forms mathematical induction. • Define and test a potential isomorphism for being well-defined, a homomorphism, one-to-one and onto. • Use definitions of one-to-one, onto, well-defined, homomorphism, isomorphism and others to characterize a given map. • Create factor groups using normal subgroups or the First Isomorphism Theorem and interpret elements of factor groups accurately. • Demonstrate understanding of permutations and symmetries in a group theoretic context–articularly the significance of Cayley's Theorem. • Recognize and use the Sylow Theorems to characterize certain finite groups.
3	MSc I (Sem I) Numerical Analysis	After studying this course, Student should be able to: • Effectively express the concepts and results of Number Theory. • Construct mathematical proofs of statements and find counterexamples to false statements in Number Theory. • Collect and use numerical data to form conjectures about the integers. • Understand the logic and methods behind the major proofs in Number Theory. • Work effectively as part of a group to solve challenging problems in Number Theory.
4	MSc I (Sem I) Ordinary Differential Equations	After studying this course, Student should be able to: • Find general solutions to first-order, second-order, and higher-order homogeneous and nonhomogeneous differential equations by manual and technology-based methods. • Identify and apply initial and boundary values to find particular solutions to first-order, second-order, and higher order homogeneous and non-homogeneous differential equations by manual and technology-based methods, and analyze and interpret the results. • Select and apply appropriate methods to solve differential equations; these methods will include, but are not limited to, undetermined

		coefficients, variation of parameters, eigenvalues and eigenvectors, LaPlace and inverse LaPlace transforms. • Select and apply series techniques to solve differential equations; these techniques will include but are not limited to Taylor series. • Select and apply numerical analysis techniques to solve differential equations; these techniques will include but are not limited to Euler, Improved Euler, and Runge-Kutta.
5	MSc I (Sem II) Complex Analysis	On completion of this unit successful students will be able to: • Understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations; • Evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem; • Compute the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculating residues; • Use the Cauchy Residue Theorem to evaluate integrals and sum series.
6	MSc I (Sem II) Topology	On completion of this unit successful students will be able to: • Understand terms, definitions and theorems related to topology. • Demonstrate knowledge and understanding of concepts such as connectedness and compactness. • Apply theoretical concepts in topology to understand real world applications. The aim of the course is to provide for the students an introduction to theory of metric and topological spaces with emphasis on those topics that are important to higher mathematics. • focuse on the basic notions of metric and topological spaces, properties of continuous mappings selected types of topological spaces (compact and connected spaces) and basic theorems on topological spaces.
7	MSc I (Sem II) Rings and Modules	Upon successful completion of this course, students will be able • To write precise and accurate mathematical objects in ring theory • For checking the irreducibility of higher degree polynomials over rings. • To understand the concepts like ideals and quotient rings. • To understand the generalization of vector spaces over fields to modules over rings • To write about ring theory in a coherent , grammatically correct and technically accurate manner.
8	MSc I (Sem II) Linear Algebra	Upon successful completion of this course, students will be able : • Define and compute eigenvectors and eigenvalues. • Define a vector space and state its properties. • Compute the linear span of a set of vectors. • Determine the linear independence or dependence of a set of vectors. • Determine a basis of a vector space. • Explain the ideas of linear independence, spanning set, basis, and dimension. • Define and identify linear transformations.

		- Define and compute the characteristic polynomial of a matrix. - State the spectral theorem. - Define the notion of length for abstract vectors in abstract vector spaces. - Define and identify orthogonal vectors. - Define and identify orthogonal and orthonormal subsets of $R^{n.}$ - Perform range-nullspace decompositions. - Perform orthogonal decomposition of space. - Perform singular-value decomposition. - Diagonalizing systems with repeated eigenvalues, Algebraic and geometric multiplicity of eigenvalues, Introduction to the Jordan form. - Use the Gram-Schmidt process.
9	MSc I (Sem II) Partial Differential Equations	Upon successful completion of this course, students will be able to : - Explain clearly concepts and theory of basic methods for solving partial differential equations. - Recognize the types of second-order partial differential equations as typified by classical equations of mathematical physics, such as the wave equation, heat-diffusion equation and Laplace equation. - Apply eigenfunction expansion methods to solve nonhomogeneous versions of heat-diffusion and wave equations. - Recognize the concept of a Green function and its applications in solving non-homogeneous problems and elementary boundary value problems - Create and formulate mathematical models for a range of scientific and engineering problems involving partial differential equations.
10	MSc II (Sem III) Combinatorics	Upon successful completion of this course : - It increases the logical thinking of the students. - It teaches how to reason and model combinatorically. - Students are able to use generating functions to solve a variety of combinatorial problems - Students are able to use addition and multiplication principle. - Students can understand the logical structure of programms. - It develops proficiency in solving discrete math problems
11	MSc II (Sem III) Field Theory	Upon successful completion of this course, students will be able to : - Understand the fundamental concepts of field extensions and Galois theory and their role in modern mathematics and applied contexts - Understand accurate and efficient use of field extensions and Galois theory - Understand capacity for mathematical reasoning through analyzing, proving and explaining concepts from field extensions and Galois theory. - Apply problem- insightful solutions to several classical problems, of

		which the most notable is the *problem of solvability by radicals*: which polynomial equation in one variable can be solved by means of radicals, i.e. via root extraction in addition to the usual rational operations of addition, subtraction, multiplication and division? • Understand why geometric constructions: squaring a circle, doubling a cube and trisecting angle are impossible by using compass and scale.
12	MSc II (Sem III) Functional Analysis	• Students will appreciate the role of completeness through the Baire category theorem and its consequences for operators on Banach spaces. • They will have a demonstrable knowledge of the properties of a Hilbert space, including orthogonal complements, orthonormal sets, complete orthonormal sets together with related identities and inequalities. • They will be familiar with the theory of linear operators on a Hilbert space, including adjoint operators, self-adjoint and unitary operators with their spectra. • They will know the L_2L2-theory of Fourier series and be aware of the classical theory of Fourier series and other orthogonal expansions. • Understanding meaning and relations between main terms of measure and integral theory as well of functional analysis, formulating and proving of statements. • Identification of a problem and, using functional relations between objects of algebra, mathematical analysis, probability theory, geometry, complex-variable functions and so one, as well applying various methods from such branches, solution this problem.
13	MSc II (Sem III) Graph Theory	The students who succeeded in this course; • Algorithms to find the components of a graph and the strongly connected components of a digraph. • Algorithms to construct breadth first search and depth first search spanning trees of a connected graph. • The algorithms of Prim and Kruskal to find a minimum weight spanning tree in a connected graph. • Morav´ek's algorithm to find a longest path spanning tree in an acyclic directed network. • The max flow/min cut algorithm for finding a maximum (s,t)-flow in a network. • Algorithms for finding a maximum matching and a maximum weight matching in a bipartite graph. • Algorithms for finding an Euler trail in a graph or digraph and for solving the Chinese Postman Problem.
14	MSc II (Sem III) Applied Mathematics (Linear Integral	The students who succeeded in this course; • Will be able to classify integral equations. • Will be able to apply functional analytic methods on operators and integral equations.

	Equations)	• Will be able to describe definitions and relations in the theory of integral equations. • Will be able to analyse the methods such as integral transforms, Green's function, the concept of resolvent, uniqueness theorems, Fredholm theory. • Will be able to apply the theory of integral equations to other disciplines like applied mathematics, science and engineering.
15	MSc II (Sem IV) Number Theory	Upon successful completion of this course, students : • Effectively express the concepts and results of Number Theory. • Construct mathematical proofs of statements and find counterexamples to false statements in Number Theory. • Collect and use numerical data to form conjectures about the integers. • Understand the logic and methods behind the major proofs in Number Theory. • Work effectively as part of a group to solve challenging problems in Number Theory
16	MSc II (Sem IV) Differential Geometry	Upon successful completion of this course, students : • Will have the knowledge and skills to explain the concepts and language of differential geometry and its role in modern mathematics • Can apply differential geometry techniques to specific research problems in mathematics or other fields • Will be able to compute quantities of geometric interest such as integral curves, geodesics, orientation . • Can understand the topic curvature which helps student for understanding the shape of curve and surfaces. • Can understand the concept of parallel transport of vectors.
17	MSc II (Sem IV) Fourier Analysis and Boundary Value Problems	Upon successful completion of this course, students will be able : • To understand the Fourier series representation of periodic functions. • To provide standard method for solving differential equations. • To demonstrate how differential equation can be useful in many types of problems likes heat equations ,wave equations. • To understand how the wave and diffusion partial differential equations can be used to model certain systems. • To determine appropriate simple boundary and initial conditions for such models.
18	MSc II (Sem IV) Lattice Theory	Upon successful completion of this course, students will be able : • Recognize lattices, complete ordered sets and their varieties, • Know the standard tools of lattice theory, • Know the main representation theorems of lattices,, • To make use all the above both inside the theory and applications.
19	MSc II (Sem IV) Applied Mathematics (Coding Theory)	Upon successful completion of this course : • Knowledge. The student has knowledge of properties of and algorithms for coding and decoding of linear block codes, cyclic codes and convolution codes. The student has an overview of arithmetic in finite

		fields, linear algebra over finite fields, and rings of power series. • Skills. The student masters arithmetic in finite fields and linear algebra over finite fields. The student is able to apply various algorithms and techniques for coding and decoding. • Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them. • Describe the real life applications based on the fundamental theory. • Calculate entropy, channel capacity, bit error rate, code rate, steady-state probability and so on.