Department of PG Studies and Research in Mathematics& Computer Science

Programme Offered

- **M.Sc. Mathematics**
- **M.Sc. Computer Science**

M.Sc. Mathematics

PROGRAMME OBJECTIVES

The M.Sc. Mathematics programme's main objectives are

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PO-1. Critical Thinking: Identifying the assumptions that frame our actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO-2. Effective Communication: Read, Write, Speak and listen clearly in English and Hindi (Bilingual).

PO-3. Social Interaction: Provide a social exchange between two or more individuals.

PO-4. Effective Citizenship: Demonstrate social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO-5. Ethics: Recognize different value and moral systems and correlate them with present system.

PO-6. Environment & Sustainability: To understand the responsibility to conserve natural resources and protect global ecosystems to support health & wellbeing.

PO-7. Self-Directed & Life-long learning: It focuses on the process by which students take control of their own learning, in particular how they set their own learning goals, locate appropriate resources, decide on which learning methods to use and evaluate their progress.

PROGRAMME SPECIFIC OUTCOMES

On successful completion of the M.Sc. Mathematics programme a student will

PSO-1. Have a strong foundation in core areas of Mathematics, both pure and applied.

PSO-2. Be able to apply mathematical skills and logical reasoning for problem solving.

PSO-3. Communicate mathematical ideas effectively, in writing as well as orally.

PSO-4. Have sound knowledgeof mathematical modeling, programming and computational techniques as required for employment in industry.

SEMESTER I

PAPER 1 ADVANCED ABSTRACT ALGEBRA –I

Course Outcomes

CO-1. After studying this course, the student will be able to

CO-2. proveSchreier's refinement theorem and Jordan−Holder theorem and also to prove fundamentaltheorem of arithmetic using Jordan−Holder theorem.

CO-3. count the number of elements, subgroups and able to find the normalizer and centralizer in a group.

CO-4. identify and construct examples of fields, distinguish between algebraic and transcendental extensions, characterize normal extensions in terms of splitting fields and prove the existence of algebraic closure of a field.

CO-5. characterize perfect fields using separable extensions, construct examples of automorphism group of a field and Galois extensions as well as prove Artin's theorem and the fundamental theorem of Galois theory.

PAPER 2 COMPLEX ANALYSIS (MTC-102)

Course Outcomes

After studying this course, the student will be able to

CO-1. understand analytic function as a mapping on the plane, Mobius transformation and branch of logarithm.

CO-2. understand Cauchy's theorems and integral formulas on open subsets of the plane.

CO-3. understand how to count the number of zeros of analytic function, open mapping theorem and Goursattheorem as a converse of Cauchy's theorem.

CO-4. know about the kind of singularities of meromorphic functions which helps in residue theory andcontour integrations.

CO-5. handle integration of meromorphic function with zeros and poles leading to the argument principle andRouche's theorem.

PAPER 3 REAL ANALYSIS (MTC -103)

Course Outcomes

After studying this course the student will be able to

CO-1. to check whether the given function is inferable or not.

CO-2. check the convergence and uniform convergence of the given sequence or series of functions

CO-3. differentiate the functions of several variables and also compute the higher order derivatives of functionsof several variables

PAPER 4 TOPOLOGY (MTC -104)

Course Outcomes

After studying this course the student will be able to

CO-1. determine interior, closure, boundary, limit points of subsets projections, subspace topology, order topology, basisand subbasis of topological spaces.

CO-2. check whether a collection of subsets is a basis for a given topological spaces or not, and determine the topologygenerated by a given basis.

CO-3. identify the continuous maps between two spaces and maps from a space into product space and determinecommon topological property of given two spaces.

CO-4. determine the connectedness and path connectedness of the product of an arbitrary family of spaces.

CO-5. determine the metric topology, metriziable space, several standard metrics and the topology generated by them.

PAPER 5 C-Language

Course Outcomes

After studying this course the student will be able to

CO-1. read, understand and trace the execution of programs written in C language.
CO-2. write the C code for a given algorithm.
CO-3. write programs that perform operations using derived data types.
CO-4. solve an algebraic or transcendental equation using an appropriate numerical method.

PAPER 6 Numerical Analysis

Course Outcomes

After studying this course the student will be able to

CO-1. compute the piecewise, spline and bivariate interpolation and approximation by several methods
CO-2. solve the ordinary differential equations using extrapolation methods.
CO-3. solve the boundary value problems by shooting method.
CO-4. interpolate the function with two variables using finite difference and finite element methods.

SEMESTER II

Paper 1 Applied Functional Analysis

Course Outcomes

After studying this course the student will be able to

CO-1. identify the Hilbert space and perform the operations of Cartesian and Tensor products on it.
CO-2. Check the weak convergence, weak compactness and apply several theorems concerning the concept.
CO-3. identify spectrum, particularly point spectrum and resolvent of standard operators like shifts andmultiplication and to understand the spectral theorem for bounded linear operators.
CO-4. understand the basic properties of bounded linear operators on normed, Banach and Hilbert spaces andapply these properties to solve simple problems. Understand
CO-5. the concepts of compactness, self-adjointness and positivity of bounded linear operators.

Paper 2 Divergent Series

Course Outcomes

After studying this course the student will be able to

CO-1. understand the big O, little o and asymptotic relations.
CO-2. check for the regularity and consistency of the given method for summing the divergent series**.**
CO-3. check whether the given series is summable by Holder's method, Cesaro's method or by Abel'smethod and also establish the relation between Cesaro and Abel's summability.
CO-5. understand the Limitation theorem, Tauberian theorems and Littlewood's extension of Tauber'stheorem.

Paper 3 Theory of Linear operators

Course 4 Outcomes

After studying this course the student will be able to

CO-1. identify spectrum, particularly point spectrum and resolvent of standard operators like shifts andmultiplication and to understand the spectral theorem for bounded linear operators.
CO-2. understand the basic properties of bounded linear operators on normed, Banach and Hilbert spaces andapply these properties to solve simple problems.
CO-3. understand the concepts of compactness, self-adjointness and positivity of bounded linear operators.

Paper 4 Simplicial Homology Theory

Course Outcomes

After studying this course student will be able to

CO-1. identifyhyperplanes, simplexes and finite simplicial complexes as subsets of a Euclidean space.
CO-2. learn the idea of compact triangulable spaces as geometric carriers of finite simplicial complexes (polyhedra).
CO-3. learn the use of homological algebra to associate simplicial homology groups with triangulable spaces and illustrate it by computing simplicial homology groups of some well-known compact polyhedral.
CO-4. understand the topological invariance of simplicial homology groups (up to homotopy).
CO-5. prove important applications of simplicial homology theory like invariance of dimension, Euler'sformula, Lefschetz and Brouwer's fixed point theorems, etc.

Paper 5 Approximation Theory

Course Learning Outcomes

After studying this course the student will be able to

CO-1. deal with the linear operators and understand the properties of some specific linear operators asBernstein Polynomial, Fourier series operator.
CO-2. useBohman and Korovkin's theorem to check whether the given operator provides uniformapproximation or not.

CO-3. verify the existence of polynomial for best approximation, and study the characteristics of thepolynomial for best approximation.
CO-4. use the Chebyshev system, algebraic polynomials and trigonometric polynomials forinterpolation.

Paper 6 Operator Theory on Banach Algebra

Course Outcom

After studying this course the student will be able to

CO-1. useBanach algebra techniques to solve problems in mathematics, applied mathematics andmathematical physics.
CO-2. demonstrate understanding of the properties of bounded linear operators on Hilbert spaces.
CO-3. demonstrate understanding of compact and Fredholm operators.
CO-4. solve problems involving infinite matrices and concrete operators in function spaces

Paper 7 Special Functions

Course Outcomes

After studying this course the student will be able to

CO-1. understand integral calculus and special functions of various engineering problem and to knownthe application of some basic mathematical methods via all these special functions.
CO-2. explain the applications and the usefulness of these special functions.
CO-3. classify and explain the functions of different types of differential equations.
CO-4. understand purpose and functions of the gamma and beta functions, Fourier series andTransformation.
CO-5. use the gamma function, beta function and special functions to: evaluate different types of integralcalculus problems and Fourier series to solve differential equations.

Paper 8 Spherical Trigonometry and Astronomy

Course Outcomes

After studying this course the student will be able to

CO-1. to explain and learn fundamental of Spherical Trigonometry
CO-2. to explain properties of right-angle triangle and solution
CO-3. to explain relation between sides & angles of a Spherical triangle.
CO-4. to explain application of Spherical triangle & Examples.

Paper 9 MATLAB

Course Outcomes

After studying this course the student will be able to

CO-1. able to use Matlab for interactive computations.
CO-2. familiar with memory and file management in Matlab.

CO-3. able to generate plots and export this for use in reports and presentations.
CO-4. able to program scripts and functions using the Matlab development environment.
CO-5. able to use basic flow controls (if-else, for, while).

Paper 10 Linear Programming

Course Outcomes

After studying this course the student will be able to

CO-1. formulate and solve a linear programming problem.
CO-2. convert standard business problems into linear programming problems and can solve using simplex algorithm.
CO-3. formulate and solve transportation problems.
CO-4. formulate and solve the Assignment problem.

SEMESTER III

Paper 1 Algebraic Topology

Course Outcomes

After completing this course a student will be able to
CO-1. grasp the basics of Algebraic Topology.
CO-2. determine fundamental groups of some standard spaces like Euclidean paces and spheres.
CO-3. understand proofs of some beautiful results such as Fundamental theorem of Algebra, Monodromy theorem, Lifting theorem etc.

Paper 2 Fuzzy Sets and their Applications

Course Outcomes

After studying this course the student will be able to

CO-1. Construct fuzzy sets with the required membership function.
CO-2. Compute the α-cut and strong α-cut.
CO-3. perform the standard operations on fuzzy sets and study their properties.
CO-4. Apply the extension principle, perform the operation of arbitrary intersection and arbitrary union of fuzzysets
CO-5. Use the intuitionistic fuzzy sets when the condition of non-membership is given.

Paper 3 Infinite Matrix and Divergent Series

Course Outcomes

After studying this course the student will be able to

CO-1. solve all the problems concerning the matrices whatever the order of the matrix may be.
CO-2. find the reciprocal of the given matrix easily, and will be equipped with many other properties which easethe solution of matrices.

CO-3. do the analysis of the divergent series.

Paper 4 Spline Theory

Course Outcomes

After studying this course the student will be able to

CO-1. Find polynomial interpolation of the given data.
CO-2. Understand piecewise interpolation and broken line interpolation.
CO-3. find parabolic spline interpolation and know the existence and uniqueness of the parabolic splineinterpolation.
CO-4. Understand the basic properties and theory of B-splines and implement basic algorithms for B-splines.

Paper 5 Abstract Harmonic Analysis

Course Outcomes

After studying this course the student will

CO-1. be familiar with Banach algebras and their representations.
CO-2. have studied relations between representations of locally compact groupsand representations of group algebras.
CO-3. have studied representation theory of compact groups.
CO-4. know the notions of orthonormal basis of space of square integrable functionson compact groups.
CO-5. know positive definite functions, Bochner theorem, semi direct product of groupsand their representation.

Paper 6 Integration Theory

Course Outcomes

On completion of the course, the student should be able to

CO-1. use the concepts of measurable set and measurable function.
CO-2. state and explain the construction of the Lebesgue integral and use it.
CO-3. apply the theorems of monotone and dominated convergence and Fatou's lemma.
CO-4. describe the construction of product measure and to apply Fubini's theorem.
CO-5. state and explain properties of L^pspaces

Paper 7 Sobolev Spaces

Course Outcomes

After studying this course the student will be able to

CO-1. understand the use of distribution and test functions**.**
CO-2. compute the convolutions, Fourier transform and perform other computations using them
CO-3. apply the ReimannLebesgue theorem, Plancheral theorem, Holder’s inequality, Minkowski’s inequality insolving problems.

Paper 8 Wavelets Analysis

Course Outcomes

After studying this course the student will be able to

CO-1. explain the applications of wavelets in the construction of orthonormal bases by wavelets.
CO-2.understand approximation of functions (signal) by frame theory.
CO-3. understand the properties of various scaling functions and their wavelets.
CO-4. understand the properties of multiresolution analysis.
CO-5. construct the scaling functions using infinite product formula and iterative procedure.

Paper 9 Mathematical modeling

Course Outcomes

After studying this course the student will be able to

CO-1. create mathematical models of empirical or theoretical phenomena in domains such as the physical,natural, or social sciences;
CO-2. create variables and other abstractions to solve college-level mathematical problems in conjunction withpreviously-learned fundamental mathematical skills such as algebra;3.

CO-3. draw inferences from models using college-level mathematical techniques including problem solving,quantitative reasoning, and exploration using multiple representations such as equations, tables, and graphs

Paper 10 Elective Paper

Course Outcomes

After studying this course the student will be able to

CO-1. demonstrate understanding the random variable, expectation, variance and distributions.
CO-2. explain the large sample properties of sample mean.
CO-3. understand the concept of the sampling distribution of a statistic, and in particular describe the behavior of the sample mean.
CO-4. analyze the correlated data and fit the linear regression models.
CO-5. demonstrate understanding the estimation of mean and variance and respective one sample and two-sample hypothesis tests.

Paper 11 Operations Research

Course Outcomes

After studying this course the student will be able to

CO-1. formulate and solve problems as networks and graphs.
CO-2. construct linear integer programming models and discuss the solution techniques.

CO-3. set up decision models and use some solution methods for nonlinear optimization problems.
CO-4. propose the best strategy using decision making methods under uncertainty and game theory.
CO-5. solve multi-level decision problems using dynamic programming method.