M SC. MATHEMATICS

Programme Outcomes

After the successful completion of this course, the student will be able

- To motivate for research in mathematical sciences.
- To train computational scientists who can work on real life challenging problem
- To have an in-depth knowledge of a broad range of methods and techniques for analysing and solving problems within applicable fields.
- To have a Good theoretical insight and the ability to apply theory to the development of methods and techniques for solving a problem.
- To have an in-depth knowledge within a specific mathematical primary field.
- To tackle complex problems, reveal structures and clarify problems, discover suitable analytical and/or numerical methods and interpret solutions.
- To communicate clearly in writing and orally knowledge, ideas and conclusions about mathematics, including formulating complex mathematical arguments, using abstract mathematical thinking synthesising intuition about mathematical ideas and their applications.
- To demonstrate an advanced knowledge and fundamental understanding of a number of specialist mathematical topics, including the ability to solve problems related to those topics using appropriate tools and techniques.
- To produce a mature oral presentation of a non-trivial mathematical topic
- To apply rigorous, analytic, highly numerate approach to analyze, execute tasks and solve problems in daily life and at work.

Course Outcomes

Semester – 1

MT01C01 LINEAR ALGEBRA

Upon the completion of the course the students will be able to:

- Analyze finite and infinite dimensional vector spaces and subspaces over a field and their properties, including the basis structure of vector spaces,
- Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism,

- To describe the properties of determinants and its relation to matrix transpose,inverse etc
- Compute with the characteristic polynomial, eigenvectors, eigenvalues and Eigen spaces,
- Compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt orthogonalization
- Identify self-adjoint transformations and apply the spectral theorem and orthogonal decomposition of inner product spaces, the Jordan canonical form to solving systems of ordinary differential equations.

MT01C02 BASIC TOPOLOGY

Upon completion of this course, students should be able to:

- Define and illustrate the concept of topological spaces and continuous functions,
- Define and illustrate the concept of product topology and quotient topology,
- Prove a selection of theorems concerning topological spaces, continuous functions, product topologies, and quotient topologies,
- Define and illustrate the concepts of the separation axioms,
- Define connectedness and compactness, and prove a selection of related theorems, and
- Describe different examples distinguishing general, geometric, and algebraic topology.

MT01C03 MEASURE THEORY AND INTEGRATION

Upon completion of this course, students should be able to:

- To understand the fundamental concepts of Mathematical Analysis.
- To state some of the classical theorems in of Advanced Real Analysis.
- To be familiar with measurable sets and functions.
- To integrate a measurable function.
- To understand the properties of Classical Banach Spaces.

MT01C04 GRAPH THEORY

Upon completion of this course, students should be able to:

- Students will understand the language of graphs and trees.

- Students will understand the use of graphs as modes
- Students will understand various types of trees and methods for traversing trees
- Solve problems using basic graph theory
- Identify induced subgraphs, cliques, matchings, covers in graphs
- Determine whether graphs are Hamiltonian and/or Eulerian
- Solve problems involving vertex and edge connectivity, planarity and crossing numbers
- Solve problems involving vertex and edge coloring
- Model real world problems using graph theory

MT01C05 COMPLEX ANALYSIS

Upon completion of this course, students should be able to:

- Represent complex numbers algebraically and geometrically,
- Define and analyze limits and continuity for complex functions as well as consequences of continuity,
- 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,
- Analyze sequences and series of analytic functions and types of convergence,
- Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula, and
- Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.

SEMESTER 2

MT02C05 ABSTRACT ALGEBRA

Upon completion of this course, students should be able to:

- Demonstrate knowledge of group homomorphism, isomorphism and automorphisim.
- Derive and apply the First Isomorphism Theorem.
- Demonstrate knowledge of conjugates, the Class Equation and Sylow theorems.
- Derive and apply Sylow Theorems.

- Solvable groups and associated properties, finite abelian groups.
- Demonstrate knowledge of polynomial rings and associated properties.
- Derive and apply Gauss Lemma, Eisenstein criterion for irreducibility of rationals.
- Understand the characteristic of a field and the prime subfield.
- Understand Factorization and ideal theory in the polynomial ring; the structure of a primitive polynomials
- Understand Field extensions and characterization of finite normal extensions as splitting fields.
- Understand the structure and construction of finite fields.
- Understand radical field extensions.
- Understand Galois group and Galois theory.

MT02C07 ADVANCED TOPOLOGY

Upon completion of this course, students should be able to:

- Understand product topology
- Understand Tietze Characterisation of Normality.
- Able to Evaluate Functions in to Products
- Use The Urysohn Metrisation Theorem.
- Familiar with Nets and Filters
- Familiar with compactness
- Students will understand the concept of derivative in n dimensions and the implicit and inverse function theorems which give a bridge between suitably nondegenerate infinitesimal information about mappings and local information.
- They will understand the concept of manifold and see some examples such as matrix groups.

MT02C08 ADVANCED COMPLEX ANALYSIS

Upon successful completion of this course, the student will be able to:

- Manipulate complex numbers in various representations, define fundamental topological concepts in the context of the complex plane, and define and calculate limits and derivatives of functions of a complex variable.

- Use fundamental results, including: Cauchy's Theorem and Cauchy's Integral Formula, the Fundamental Theorem of Algebra, Morera's Theorem and Liouville's Theorem.
- Represent analytic functions as power series on their domains and verify that they are well-defined.
- Define a branch of the complex logarithm.Classify singularities and find Laurent series for meromorphic functions

MT02C09 PARTIAL DIFFERENTIAL EQUATIONS

Upon completion of this course, students should be able to:

- Classify PDE and transform into canonical form
- Solve linear PDE of both first and second order
- Derive heat and wave equations in 2D and 3D
- Apply technique of separation of variables to solve PDEs and analyse the behaviour of solutions in terms of eigen function expansion
- Find the solutions of PDE determined by conditions at the boundary of the spatial domain and initial conditions at time zero.

MT02C10 REAL ANALYSIS

On completion of this unit successful students will be able to:

- evaluate the limits of a wide class of real sequences;
- determine whether or not real series are convergent by comparison with standard series or using the Ratio Test;
- understand the concept of continuity and be familiar with the statements and some proofs of the standard results about continuous real functions;
- understand the concept of the differentiability of a real valued function and be familiar with the statements of the standard results about differentiable real functions.

MT03C11 MULTIVARIATE CALCULUS AND INTEGRAL TRANSFORMS

On completion of this unit successful students will be able to:

- Understand the basic results in the analysis of functions of several variables.
- Understand the fundamental transforms,convolutions.

- Recognise vector valued functions and relate directional derivatives and partial derivatives to total derivative.
- Understand implicit functions and extremum problems.
- Recognise primitive mappings and differential forms.

MT03C12 FUNCTIONAL ANALYSIS

On completion of this unit successful students will be able to:

- Discuss various problems in different space: vector space, inner product space and Hilbert Spaces.
- Explain the fundamental concepts of functional analysis.
- Understand the approximation of continuous functions.
- Understand concepts of Hilbert and Banach spaces with l2 and lp spaces serving as examples.
- Understand the definitions of linear functional and prove the Hahn-Banach theorem, open mapping theorem, uniform boundedness theorem, etc.
- Define linear operators, self adjoint, isometric and unitary operators on Hilbert spaces.

MT03C13 DIFFERENTIAL GEOMETRY

On satisfying the requirements 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
- Analyze and solve complex problems using appropriate techniques from differential geometry
- Apply problem-solving with differential geometry to diverse situations in physics, engineering or other mathematical contexts
- Apply differential geometry techniques to specific research problems in mathematics or other fields
- To obtain sound knowledge in understanding the basic concepts in geometry of curves and surfaces in Euclidean space, especially.

- To acquire mastery in solving typical problems associated with the theory.
- To gain sufficient knowledge for generalizing these concepts to higher dimensions.

MT03C14 NUMBER THEORY AND CRYPTOGRAPHY

On completion of this unit successful students will be able to:

- Learn the foundational Number Theory required for encryption and decryption.
- Encrypt and Decrypt message.
- Know the difference between private key and public key cryptographies.
- Understand a number of privacy mechanisms.

MT03C15 OPTIMIZATION TECHNIQUES

On completion of this unit successful students will be able to:

- Formulate optimization problems;
- Understand the importance of linear programming problems in which the variables are being restricted to integers;
- Solve integer programming problems as well as mixed integer linear programming problems;
- Apply the methods of optimization in real life situation.
- Identify strategic situations and represent them as games
- Solve simple games using various techniques
- Identify the methods and solve programming problems when the objective function or constraints are non linear.

Semester – 4

MT04C16 SPECTRAL THEORY

On satisfying the requirements of this course, students will have the knowledge and skills to:

- Explain the fundamental concepts of functional analysis and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of functional analysis techniques.
- Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from functional analysis.

- Apply problem-solving using functional analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts.

MT04E01ANALYTIC NUMBER THEORY

- The aim of this course is to study the prime numbers using the famous Riemann ζ-function. In particular, we will study the connection between the primes and the zeros of the ζ-function.
- In addition to the highlights mentioned above, students will gain experience with different types of Fourier transform.
- The course aims to introduce students to the theory of prime numbers, showing how the irregularities in this elusive sequence can be tamed by the power of complex analysis.
- Students will learn to handle multiplicative functions, to deal with Dirichlet series as functions of a complex variable, and to prove the Prime Number Theorem and simple variants.

MT04E05 MATHEMATICAL ECONOMICS

On completion of this unit successful students will be able to:

- Possess a solid grasp of essential mathematical tools required for the further studies in economic theory.
- Use and explain the underlying principles, terminology, methods, techniques and conventions used in the subject.
- Develop an understanding of optimization techniques used in economic theory.
- Encourage students to think about applying these mathematical tools in their own research, if necessary, with suitable modifications.
- Solve economic problems using the mathematical methods described in the course.
- Use the mathematical methods described in the course to analyze and solve problems in tutorials in a group discovery setting.

MT04E07 OPERATIONS RESEARCH

On completion of this unit successful students will be able to:

- To apply the notions of linear programming in solving transportation problems.
- To understand the theory of games for solving simple games.
- To acquire knowledge in formulating Tax planning problem and use goal

programming algorithms.

- To use linear programming in the formulation of shortest route problem and use algorithmic approach in solving various types of network problem.
- To know the use of dynamic programming in various applications.

MT04E14 CODING THEORY

After the completion of this course, students will able to

- Comprehend various error control code properties, error detection and correction.
- Understand various methods of generating and detecting different types of error correcting codes
- Understands the fundamentals of coding theory
- 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.
- Apply various algorithms and techniques for coding
- Understands binary symmetric channel

PROJECT

- Engage in the study or research of a topic that is beyond the regular math department offerings in both rigor and content, and
- Produce a document (paper or thesis) that exhibits both the background and the conclusions reached as a result such study or research