DEPARTMENT OF MATHEMATICS

PROGRAMME : M. Sc. MATHEMATICS

A. PROGRAMME OUTCOMES (PO)

- The knowledge theory and methods in mathematics will be acquired by the students. They will also be acquainted with the methods in Mathematical research. They will also acquire knowledge of the application of these methods to scientific as well as business problems.
- Acquire the skills using computer calculations in scientific investigations. They also be able to plan and perform calculations using mathematical models.
- Acquire proficiency in solving scientific problems by using theory, numerical simulations and experiments. They will be able to develop new variants of the acquired methods if required.
- Contribute to new scientific research or new applications of research.
- Select, interpret and critically evaluate information from different sources- books, scientific reports, internet, journals etc.
- Encourage students to engage in lifelong learning and research.
- Helps students to engage with current research and new developments in the subject.

B. PROGRAMME SPECIFIC OUTCOMES (PSO)

- They will be able to explain the core ideas and techniques of Mathematics.
- They will be able to recognise the power of abstractness and generalisation.
- They will be able to carry out research with independent judgement.
- They will be able to set up mathematical models of real world problems and obtain solutions through structured and analytic approaches.
- They will be able to carry out objective analysis and prediction of quantitative information.
- They will be able to communicate effectively about the subject using ICT.
- They will be able to work independently and collaborate effectively in team work.
- They will be able to self-evaluate and continuously engaged in life long learning.

C. COURSE OUTCOMES (CO)

FIRST SEMESTER

MM 211 – LINEAR ALGEBRA

Upon successful completion of the course students will;

- Acquire knowledge about vector spaces, subspaces, bases and dimensions.
- Understand linear maps, their algebras, matrix of linear maps.
- Find the Eigen values and Eigen vectors of linear transformations.
- Study operators on real and complex vector spaces, determinant of an operator.
- Thoroughly know Cayley-Hamilton Theorem for operators on real spaces.

MM212 – REAL ANALYSIS – I

Upon successful completion of the course students will;

- Learn about the functions of bounded variation and rectifiable curve.

- Understand the concept of Riemann-Stieltjes integral.
- Understand the concept of uniform convergence of sequence of functions.
- Acquire knowledge about continuity, partial derivative, directional derivative, limits and differentiability of functions of several variables.

MM213 – DIFFERENTIAL EQUATION

Upon successful completion of the course students will;

- Acquire the knowledge of the existence of series solutions of differential equation.
- Acquire the knowledge of special functions like Legendre polynomial, Bessel's function, Gamma function and their properties.
- Acquire the knowledge of finding the solution of first order partial differential equations by different methods.
- Acquire the knowledge of finding the solution of second order partial differential equations.
- Acquire the knowledge of finding the solution of one dimensional wave equations.

MM 214 – TOPOLOGY – I

Upon successful completion of the course students will;

- Demonstrate knowledge and understanding of metric spaces.
- Understand terms, definitions and theorems related to Topology.
- Demonstrate knowledge and understanding of concepts such as open and closed sets, interior, closure and boundary.
- Use continuous functions and homeomorphisms to understand structure of topological spaces.
- Conceive the concept of connectedness and compactness and understand theorems related to them.

SECOND SEMESTER

MM 221 – ABSTRACT ALGEBRA

Upon successful completion of the course students will;

- Acquire knowledge about important Mathematical concepts in Abstract Algebra such as groups, rings, integral domains and fields.
- Learn application of Algebra on irreducible polynomials.
- Apply Sylow Theorem in the study of simple groups.
- Understand the application of algebra in finding the roots of polynomials.
- Conceive the concept of field extensions and discuss Galois Theory.
- Study the solvability of polynomials by radicals, insolvability of quintic.

MM 222 – REAL ANALYSIS – II

Upon successful completion of the course students will;

- Acquire basic concepts from Measure Theory including sigma algebra, outer measure, measurable sets, measurable functions, the Lebesgue integral etc.
- Get an overview of the central results of the theory of Lebesgue integration.
- Be familiar with the concept of convex functions , the space LP(μ) and inequalities including Jensen's inequality, Holder's inequality, Minkowski's inequality.
- Be able to understand the meaning of decomposition theorems and express given signed measure as a difference of two measures.

MM 223 - TOPOLOGY – II

Upon successful completion of the course students will;

- Create new topological spaces by using product and quotient topologies.
- Understand separation properties and study various theorems related to them.
- Conceive the concept of nets and filters and understand nets as generalised sequence.
- Know the fundamental concept of Algebraic topology.
- Understand the concept of fundamental group and acquire the ability to find the fundamental groups of various topological spaces.
- Demonstrate capacity for fundamental reasoning through analysing, proving and explaining concepts from Algebraic Topology.

MM 224 – SCIENTIFIC PROGRAMMING WITH PYTHON

Upon successful completion of the course students will;

- Acquire the knowledge of defining functions and imposing functions from modules in Python.
- Acquire the knowledge of creating graphs in Python.
- Acquire the knowledge of solving calculus problems using functions in Python.
- Acquire the knowledge of solving numerical integration problems and finding the roots of the equation by numerical methods using Python programs.

THIRD SEMESTER

MM 231 – COMPLEX ANALYSIS – I

After completing the course students should be able to understand and apply the following concepts related to complex functions.

- Power series of complex functions.
- Complex integration to understand analytic functions in a better way.
- Properties of Möbius transformations briefly and complex numbers as points on a sphere.

MM 232 – FUNCTIONAL ANALYSIS –I

- Understand the basic idea on normed space through examples and study various properties and characterisations of normed space. Also understand the idea of continuity of linear maps between normed spaces.
- Understand two fundamental results in functional analysis – Hahn-Banach Theorem and Hahn- Banach Separation Theorem and its consequences.
- Understand the idea of Banach Space (complete normed space.) through examples and its various properties.
- Understand the ,most important results in functional analysis, viz. the uniform boundedness principle the Closed Graph Theorem, The Open Mapping Theorem and the bounded inverse Theorem. It illustrates the interplay between the algebraic structure and the distance structure.
- Understand the notion of spectrum of an operator and their various properties.

MM 233 – OPERATIONS RESEARCH (ELECTIVE)

Upon successful completion of the course students will;

- Study scientific approach to problem solving.

- Use quantitative methods and techniques for effective decision making.
- Understand the formulation of Mathematical models for decision and control problem to deal with the situations arising out of risk and uncertainty.

MM 234 – GRAPH THEORY (ELECTIVE)

Upon successful completion of the course students will;

- Understand the relation between graphs and groups.
- Provide the idea of cut vertex, blocks, connectivity, Euler graph and Hamiltonian graph and learn to identify them.
- Conceive the concept of strong digraph, tournament, matching, factorisation and their properties.
- Demonstrate the method for finding Ramsey number of graphs.
- Acquire the knowledge of locating number and its various properties.
- Demonstrate the relationship between peripheral vertex, eccentric vertex, boundary vertex, complete vertex, interior vertex.

FOURTH SEMESTER

MM 241 – COMPLEX ANALYSIS – II

Through this course understand the topology of the complex plane and proofs of some landmark theorems which are geometric in nature.

- Demonstration of compactness and convergence in the space of analytic functions and Riemann Mapping Theorem.
- Clear understanding of Weierstass factorisation Theorem, Gamma function, Riemann Zeta function, Runge's Theorem, simple connectedness and MittagLeffler's Theorem.
- Study the notion of analytic continuation; begins with Schwarz Reflection Principle and ends in Monodromy Theorem.
- Get a closer understanding of Harmonic functions and its basic properties, solution of Dirichlet's problem and Harnack's Theorem.

MM 242 – FUNCTIONAL ANALYSIS – II

Through this course understand the following :

- The idea of compact operators and the spectral theorem for compact operators.
- The notion of inner product space and learn its various properties.
- The orthogonality of two vectors in an inner product space and its various properties.
- The technique of finding best approximations like the optimisations subject to certain constraints.
- The Projection Theorem and Riesz Representation Theorem and is consequences.
- Spectral Theorem for compact self adjoint operators.

MM 243- FIELD THEORY (ELECTIVE)

Upon successful completion of the course students will;

- Explain the concept of solvable group and acquire the knowledge of properties of solvable group.
- Be introduced the concept of irreducible polynomial and demonstrate the creation of a field containing the roots of irreducible polynomial.
- Conceive the idea of splitting field of a polynomial and understand its relationship with dimension of vector space.

- Introduce the concept of separable extension, algebraic extension, Galois group, Galois field.
- Recognise the properties of set of all roots of unity and introduce the concept of primitive element and its properties.
- Demonstrate the one-to–one correspondence between the intermediate fields and subgroups of the Galois group for a given field extension which is finite and Galois.

MM 244 - ANALYTIC NUMBER THEORY (ELECTIVE)

Upon successful completion of the course students will;

- Review some basic concepts and results of number theory such as divisibility, greatest common divisor, prime numbers, Euclidean algorithm etc.
- Study arithmetical functions and its applications.
- Learn the application of congruence, quadratic residues and primitive roots for solving numerical problems.

PROGRAMME : B. Sc. MATHEMATICS

A. PROGRAMME OUTCOMES (PO)

- Acquire domain knowledge
- Develop skills of critical thinking, reasoning, analytic and problem solving.
- Demonstrate empathetic social concern and equity.
- Build up scientific integrity and objectivity in professional endeavours.
- Student become capable to recognize different value systems including your own, and accept responsibility for them.
- Students will acquire the knowledge theory and methods in mathematics including some from the research frontier of the field as well as knowledge of the application of these models and methods to problems pertaining to other scientific areas and to the business world.
- Strengthen communication skill.
- Imbibe human values, inclusiveness attitude and socio- cultural sensitivity.
- Build up the ability of lifelong learning.
- Develop the skills to teach Mathematics at the secondary level.

B. PROGRAMME SPECIFIC OUTCOMES (PSO)

- To provide logic frame work in all areas of basic Mathematics.
- To attain foundation in basic Mathematics.
- To learn powerful tools for tackling topics in calculus.
- To learn powerful tools for tackling topics in theory of equations.
- To learn powerful tools for tackling topics in geometry.
- To get an introduction to almost All areas of Mathematics.

C. COURSE OUTCOMES (CO)

FIRST SEMESTER

MM 1141 : METHODS OF MATHEMATICS

Upon successful completion of this course students will :

- Understand the various methods of differential calculus and its properties such as extremum problems, Rolle's Theorem, Mean Value Theorem and its consequences.

- Understand the various methods of integral calculus, its properties through area, volume, length related concepts.
- Acquire the skill of problem solving.

SECOND SEMESTER

MM 1221 :FOUNDATIONS OF MATHEMATICS

Upon successful completion of this course students will :

- Begin the rigorous study of Mathematics, understand the concept of sets and functions.
- Realize the logical aspects such as connectives, truth tables, conditional statements and understand the usage of various quantifiers like universal and extential quantifiers in statements.
- Understand the fundamental concepts of Cartesian system and polar coordinate system and the relation between them.
- Understand the fundamental concepts of three – dimensional rectangular coordinate system and basic facts of quadric surfaces, cylindrical coordinate system, spherical coordinate system.
- Acquire the skill of problem solving.

THIRD SEMESTER

MM 1341 :ELEMENTARY NUMBER THEORY AND CALCULUS - I

Upon successful completion of this course students will :

- Acquire the knowledge of algebraic structures through congruence classes.
- Acquire the skill in differentiating and integrating vector valued functions.
- Analyze vector functions to find derivatives, tangent lines, integrals, arc length and curvature .
- Apply the knowledge to explain various physical phenomenon.
- Acquire the skill of problem solving.

FOURTH SEMESTER

MM 1441 :ELEMENTARY NUMBER THEORY AND CALCULUS - II

Upon successful completion of this course students will :

- Conceive the concept of irreducibility of polynomials in different rings and the Fundamental Theorem of Algebra.
- Acquire knowledge in the calculus of functions of two variables and three variables.
- Visualisation of functions of several variables.
- Acquire the skill of problem solving.

FIFTH SEMESTER

MM 1541 :REAL ANALYSIS - I

Upon successful completion of this course students will :

- Understand the notion of real numbers and ideas of limits in a formal manner.

- Conceive the concept of limits of sequences and series, limit of functions.
- Produce rigorous proofs of results that arise in the context of real analysis.
- Acquire skill in plotting softwares such as geogebra to plot various functions.

MM 1542 :COMPLEX ANALYSIS – I

Upon successful completion of this course students will :

- Understand the basic properties of complex numbers.
- Understand the definition of complex functions, power series representation of complex functions.
- Develops a knowledge about analytic functions and Cauchy- Riemann equations.
- Extend the knowledge of notions of differentiation and integration of complex functions.

MM 1543 : DIFFERENTIAL EQUATIONS

Upon successful completion of this course students will :

- Know how differential equations arise in various physical problems.
- Solve differential equations of first order and exact differential equations.
- Solve linear differential equations of second order.
- Acquire the skill of problem solving.

MM 1544 : VECTOR ANALYSIS

Upon successful completion of this course students will :

- Develop the notion directional derivatives.
- Develop knowledge about vector field and its divergence and curl.
- Conceive the idea of line integrals and conservative vector fields.
- Use Green's Theorem to find the work done by a force along a closed curve.
- Demonstrate Gauss' Theorem and Stoke'sThorem.
- Acquire the skill of problem solving.

MM 1545 : ABSTRACT ALGEBRA – I

Upon successful completion of this course students will :

- Acquire the knowledge of binary structures such as groups, subgroups, cyclic groups by using the skill of binary operations.
- Understand various properties of above said binary structures and its characterisations.
- Acquire the skill of problem solving.

MM 1551.1 : OPEN COURSE – OPERATIONS RESEARCH

Upon successful completion of this course students will :

- Acquire skills to formulate Linear Programming Problem and solve them using graphical method and simplex method.
- Understand variety of problems such as Assignment Problem, Transportation Problem etc.
- Acquire the knowledge to CPM and PERT techniques to plan, schedule and control project activities.

SIXTH SEMESTER

MM 1641 : REAL ANALYSIS - II

Upon successful completion of this course students will :

- Identify the continuity and discontinuity of various functions.
- Understand differentiation from a conceptual point of view.
- Develops knowledge about Riemann integration and applies into problems.
- Acquire the skill of problem solving.

MM 1642 :LINEAR ALGEBRA

Upon successful completion of this course students will :

- Understand the algebraic and geometric representation of vectors in Euclidean n-space.
- Learn to solve system of linear equations using the language of matrices.
- Conceive the concept of linear transformations, eigen values, eigen vectors and diagonalisations.

MM 1643 : COMPLEX ANALYSIS - II

Upon successful completion of this course students will :

- Represent functions as Power and Laurent series and classify isolated singular points.
- Critically evaluate application of Residue Theorem in the evaluation of some integrals.
- Evaluate improper integrals in various situations.
- Acquire the skill of problem solving.

MM 1644 : ABSTRACT ALGEBRA – II

Upon successful completion of this course students will :

- Familiar with the concept of homomorphism of groups and factor groups.
- Review the concept of rings and understand the concept of factor rings.
- Use the knowledge to solve different problems.

MM 1645 : COMPUTER PROGRAMMING

Upon successful completion of this course students will :

- Acquire the skill of document preparation in computers using the LATEX type setting program and also the basics of computer programming using Python.
- Develop the skill for writing the elementary programs by using Python code.

MM 1661.1 : GRAPH THEORY (ELECTIVE)

Upon successful completion of this course students will :

- Build an awareness of some of the fundamental concepts in Graph Theory.
- Study the Konigsberg Bridge Problem, The Chinese Postman Problem, and the Teleprinter's Problem and their graph models and solutions.
- Learn about trees and its properties.
- Understand the concept of planar and non- planar graphs.