PROGRAMME: M Sc Mathematics

Programme Specific Outcomes (PSOs)

PSO	PSO Statement Upon completion of the M.Sc. Mathematics Degree Programme, the graduates will be able to:
PSO1	Understanding basic concepts to enhance the logical, reasoning, analytical and problem solving skills of students
PSO2	Analyze to improve the perspective of students on mathematics as per modern requirement
PSO3	Adapt a research culture in young minds
PSO4	Understanding the learning of mathematics becomes more alive, vibrant, relevant and meaningful; a programme that paves the way to seek and understand the world around them
PSO5	Motivate students to uphold scientific integrity and objectivity in professional endeavours

Course	Details
Year/ Semester	I/I
Type	Core Course (Theory)
Code	ME010101
Title	Abstract Algebra
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement
CO1	Understand the concepts of sets, binary operations, number system and permutation
CO2	Understand the basic concepts about Group, Ring and field and the basic properties of these algebraic structures
CO3	Construct Group table for finite groups.
CO4	Explain Group Homomorphism by using relationship between groups
CO5	Understand the basic information about Cyclic group, Alternate group, Permutation Group, Direct product of groups and Cosets

Course	Details
Year/ Semester	I/I
Type	Core Course (Theory)
Code	ME010102
Title	Linear Algebra
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the basic concepts of vector space, basis, dimension and computations concerning subspaces
CO2	Understand the concepts of linear transformation, linear functionals, dual of a functional and their role in studying matrices
CO3	Analyze the concepts of isomorphism in vector space and apply the definition in different areas of Mathematics
CO4	Describe about determinants and apply the result as permutation and uniqueness of determinants
CO5	Evaluate the characteristic polynomial, eigen values and vectors, annihilating polynomials and minimal polynomial

Course Outcomes (COs)

Course	Details
Year/ Semester	I/1
Type	Core Course (Theory)
Code	ME010103
Title	Basic Topology
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the concept of topological space with illustration. Identify the transition from metric space to topological space. Describe two general constructions for topological space
CO2	Explain the concepts closure, interior and boundary in topological space and the construction of a topological space using these operators. Study the continuity in topological space
CO3	Identify that homeomorphism is the basic equivalence relation by which objects are classified in topology.
CO4	Mention some general problems in topology and realise that quotient spaces as the solution to one of them
CO5	Describe topological spaces with special properties. Illustrate connectedness in topological space and also distinguish between connected spaces and disconnected spaces
CO6	Develop the knowledge of separation axioms with sufficient examples

Course Outcomes (COs)

Course	Details
Year/ Semester	I/1
Type	Core Course (Theory)
Code	ME010104
Title	Real Analysis
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	**CO Statement** Upon completion of this course, the students will be able to:
CO 1	Discuss and analyze functions of bounded variation and rectifiable curves.
CO 2	Understand the definition and properties of monotonic functions, functions of bounded Variation, total variation, additive property of total variation, functions of bounded variation expressed as the difference of increasing functions, continuous functions of bounded variation
CO 3	Develop an understanding of curves and paths, rectifiable path and arc length, additive and continuity properties of arc length, equivalence of paths and change of parameter
CO 4	Definition and existence of the Riemann-Stieltjes integral, properties of the integral, integration and differentiation, integration of vector valued functions.
CO 5	Identify Sequence and Series of Functions with illustrations
CO 6	Understand and analyze the definition Uniform convergence, study the relation between Uniform convergence and Continuity, Uniform convergence and Integration, Uniform convergence and Differentiation
CO 7	Understand Some Special Functions with properties- the exponential functions, logarithmic functions and trigonometric functions

Course Outcomes (COs)

Course	Details
Year/ Semester	I/1
Type	Core Course (Theory)
Code	ME010105
Title	Graph Theory
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand basic concepts of Graphs and directed graphs
CO2	Analyse some operations on graphs
CO3	Understand vertex connectivity and edge connectivity
CO4	Apply algorithms to find minimum weight spanning trees and
CO5	Describe Eulerian and Hamiltonian graphs
CO6	Apply graph colouring in various real-life situations
CO7	Understand the difference between planar and nonplanar graphs

Core Course

Course Outcomes (COs)

Course	Details
Year/ Semester	I/II
Type	Core Course (Theory)
Code	ME010201
Title	Advanced Abstract Algebra
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the definitions extension fields, algebraic extensions, Geometric Constructions Finite fields
CO2	Discuss and analyze unique factorization domains and Euclidean domains with examples
CO3	Explain Gaussian integers and multiplicative norm on an integral domain with properties
CO4	Understand the definition automorphism of fields and demonstrate Splitting fields
CO5	Analyze , derive and apply the conjugation isomorphism theorem and the isomorphism extension theorem
CO6	Discuss and derive Galois Theory with Illustrations

Core Course

Course Outcomes (COs)

Course	Details
Year/ Semester	I/II
Type	Core Course (Theory)
Code	ME010202
Title	Advanced Topology
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the concept of compactness, the connection between compactness and separation axioms.
CO2	Explain the importance of Urysohn's lemma and Tietze characterization of normality with its derivation
CO3	Extend the study to the products of arbitrary families of topological spaces. Understand product topology and related theorems
CO4	Develop the knowledge of evaluating functions into products. Describing evaluation function and its major properties
CO5	Understand and derive the classical theorems - Tychonoff embedding theorem and Urysohn's metrization theorem in general topology
CO6	Study on the concept of a net, as a generalization of a sequence and explain its convergence. Get a knowledge of homotopy of paths

Course Outcomes (COs)

Course	Details
Year/ Semester	I/II
Type	Core Course (Theory)
Code	ME010203
Title	Numerical Analysis with Python
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Summarise the basic knowledge about Python, use IDLE to develop programmes
CO2	Acquire object oriented skills in python. Create simple python programme for solving mathematical problems
CO3	Define symbols and symbolic operators and using sympy solve problems on factor finding, summing a series and solving inequalities.
CO4	Understanding curve fitting, polynomial interpolation, Lagranges method, Newtons method and its limitations
CO5	Explain the numerical method for finding the roots of equation by using bisection and Newton Raphson method
CO6	Create programmes for curve fitting, interpolation, roots of mathematical equations using python programming
CO7	Create python programmes on numerical integration

Course Outcomes (COs)

Course	Details
Year/ Semester	I/II
Type	Core Course (Theory)
Code	ME010204
Title	Complex Analysis
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand spherical representation and stereographic projection
CO2	Analyse different types of linear transformations in complex plane
CO3	Understand the fundamental theorems in complex integration
CO4	Apply fundamental theorems to evaluate complex integration
CO5	Describe local properties of analytic functions

Course	Details
Year/ Semester	I/II
Type	Core Course (Theory)
Code	ME010205
Title	MEASURE THEORY AND INTEGRATION
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the basic concepts of Real Analysis
CO2	Define Sigma algebra of sets
CO3	Understand the basic concepts of Lebesgue measure and Measurable functions
CO4	State some theorems on Measure theory
CO5	Understand the properties of General Measure space
CO6	Explain product measure and properties

Course Outcomes (COs)

Course	Details
Year/ Semester	II/III
Type	Core Course (Theory)
Code	ME010301
Title	Advanced Complex Analysis
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand basic properties of harmonic functions
CO2	Describe Dirichlet's problem
CO3	Analyse general properties of sequences of analytic functions
CO4	Understand partial fractions and factorization
CO5	Describe Riemann Zeta function
CO6	Understand normality, compactness and Reimann Mapping Theorem

Core Courses

Course	Details
Year/ Semester	II/III
Type	Core Course (Theory)
Code	ME010302
Title	Partial Differential Equation
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Study the method of finding the orthogonal trajectories of a system of curves on a surface
CO2	Explain pfaffian differential forms, its equations and related theorems. Solve problems of pfaffian differential equations in two and three variables
CO3	Solve linear and nonlinear PDE of first order. Using the theory of linear PDE, determine the systems of surfaces orthogonal to a given system of surfaces
CO4	Understand compatible system of first order PDE and find their solutions. Explain Charpit's method and solve related problems
CO5	Illustrate Jacobi's method. Describe the origin of second order PDE and find the solution of such problems
CO6	Find the solution of second order PDE using the method of separation of variables. Illustrate Monge's method

M.Sc. Courses

Course	Details
Year/ Semester	II/III
Type	Core Course (Theory)
Code	ME010303
Title	Multivariate Calculus and Integral Transforms
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand Different forms of Fourier series, integral transforms and convolutions
CO2	Discuss and derive the Weirstrass theorem, the Fourier integral theorem and the convolution theorem for Fourier transforms
CO3	Explain the relation between directional derivatives and continuity, the total derivative in terms of partial derivatives
CO4	Discuss the matrix of a linear function and The Jacobian matrix, Implicit functions and extremum problems
CO5	Analyze and derive a sufficient condition for differentiability, equality of mixed partial derivatives, the inverse function theorem and the implicit function theorem
CO6	Understand and analyze the extrema of real valued functions of one variable and generalise it to functions of several variables
CO7	Understand primitive mappings, partitions of unity and effect of change of variables on a multiple integral

Core Course

Course Outcomes (COs)

Course	Details
Year/ Semester	II/III
Type	Core Course (Theory)
Code	ME010304
Title	Functional Analysis
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the meaning of functions and functionals with example. A background in linear algebra and ordinary calculus, is sufficient as a prerequisite
CO2	Analyse different spaced like metric space, normed space and inner product space and the relevance of this in subspace, compactness etc
CO3	Understand the concepts of orthogonal complement, direct sum, orthonormal and the comparison with Linear Algebra
CO4	Understand the better feeling for the difficulties encouraged in the transition from a Hilbert space to general Banach Space.
CO5	Describe the Hilbert adjoint operator and was suggested by problems in matrices and linear differential and integral equations.
CO6	Define three important class of equation, self-adjoint, unitary and normal operators which play a key role in various applications.

M.Sc. Courses

Course	**Details**
Year/ Semester	II/III
Type	Core Course (Theory)
Code	ME010305
Title	OPTIMIZATION TECHNIQUE
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	**CO Statement** Upon completion of this course, the students will be able to:
CO1	Formulate Optimization problems
CO2	Solve linear programming problem using various methods
CO3	Solve integer programming problem.
CO4	Explain 0-1 variables and goal programming
CO5	Explain minimum path problem and maximum flow problem
CO6	Understand basic concepts of non linear programming and Identify the methods and solve programming problems when the objective function or constraints are non linear.

Course Outcomes (COs)

Course	Details
Year/ Semester	II/IV
Type	Core Course (Theory)
Code	ME010401
Title	Spectral Theory
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Explain the fundamentals of functional analysis which originate from classical analysis
CO2	Understand the concepts behind the category theory. Define uniform boundedness theorem, Baire's theorem and application in Fourier series.
CO3	Understand the three types of convergence in operator which turn out to be of theoretical as well as practical value
CO4	Understand the concepts of resolvent set and spectrum of operators, their properties and define the spectral mapping theorem. Explain the use of complex analysis in spectral theory
CO5	Define the compact linear operator on normed space and their spectrum which play a central role in the theory of integral equations and various problems of mathematical physics.
CO6	Understand the spectral theory of bounded self-adjoint linear operators, its properties, positive operators and projection operators

Course Outcomes (COs)

Course	Details
Year/ Semester	II/IV
Type	Core Course (Theory)
Code	ME010402
Title	Analytic Number Theory
Credits	4
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the definitions Arithmetic Functions, Dirichlet Multiplication, Dirichlet inverses and convolutions, Generalized convolutions with basic arithmetical funtions like $\mu(n)$, $\varphi(n)$, $\Lambda(n)$, $\lambda(n)$, $\sigma(n)$ and $d(n)$.
CO2	Discuss and derive the relation connecting μ and φ , the Möbius inversion formula with generalization
CO3	Identify Multiplicative functions and completely Multiplicative functions with their inverses
CO4	Understand and compute Average order of Arithmetical functions and apply it to the distribution of lattice points visible from the origin
CO5	Understand and apply partial sums of a Dirichlet product to $\mu(n)$ and of $\Lambda(n)$.
CO6	Discuss ,derive and apply the Relation connecting Chebyshev's functions $\vartheta(x)$ and $\pi(x)$, Some equivalent forms of the prime number theorem, Inequalities for $\pi(n)$ and Pn and Shapiro's tauberian theorem
CO7	Understand the definitions and basic properties of congruences, Residue classes and complete residue system, Linear congruences, Reduced residue system and Polynomial congruences modulo p

Course Outcomes (COs)

Course	Details
Year/ Semester	II/IV
Type	Core Course (Theory)
Code	ME800401
Title	Differential Geometry
Credits	3
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the importance of level sets and graph of a function. Find and sketch level curves and graph of certain functions and explain its geometrical interpretation.
CO2	Illustrate vector fields and its applications in other fields. Establish existence and uniqueness theorem for integral curves. Study the relation connecting level set and tangent space
CO3	Describe n- surface with illustration and derive Lagrange multiplier theorem. Study vector field on n- surface and its orientation. Understand gauss map. Find the spherical image of the compact connected oriented n- surface
CO4	Develop a knowledge of geodesic in an n- surface with examples. Discuss the concept parallel transport and derive the property that the parallel transport is invariant under isometrics
CO5	Describe Weingarten map with two major properties and its geometrical interpretation
CO6	Find the curvature of plane curves and verify that the parametrization of plane curves can be used to evaluate integrals over the curve. Discuss differential 1-forms and their integrals
CO7	Study on normal curvature, gauss Kronecker curvature and principal curvature with illustration

Courses Outcome (CO)

Course	Details
Year/ Semester	II/IV
Type	Core Course (Theory)
Code	ME800402
Title	ALGORITHMIC GRAPH THEORY
Credits	3
Hrs/ week	5
Total Hrs	90

CO No.	CO Statement Upon completion of this course, the students will be able to:
CO1	Understand the basic concepts of graphs
CO2	Discuss various types of graphs
CO3	Explain different graph algorithms
CO4	Find complexity of various algorithms
CO5	Define trees, distance, and matchings
CO6	Explain networks

Course Outcomes (COs)

Course	Details
Year/ Semester	II/IV
Type	Core Course (Theory)
Code	ME800403
Title	Combinatorics
Credits	3
Hrs/ week	5
Total Hrs	90

CO No.	**CO Statement** Upon completion of this course, the students will be able to:
CO1	Understand the concepts of permutation and combination
CO2	Apply injection and bijection principle for solving problems
CO3	Evaluate arrangements and selections with repetitions
CO4	Apply Pigeonhole principle for solving problems
CO5	Describe Ramset numbers and bounds for Ramsey numbers
CO6	Apply generalised principle of inclusion and exclusion for solving problems
CO7	Understand derangements