Programme Outcomes, Programme Specific Outcomes and Course Outcomes For PG Programmes

Program Name: M.Sc. Mathematics

Program Outcomes

1. To develop and conduct continuing education programs for Mathematics graduates with a view to update their fundamental knowledge base and problem solving capabilities in the various areas of Mathematics.
2. Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.
3. To inculcate the curiosity for mathematics in students and to prepare them for future research.
4. Develop, design and implement research projects competently and independently.
5. Identify and define emerging problems related to one's area of interest.

Program Specific Outcomes

1. Apply the knowledge of mathematical concepts in interdisciplinary fields. Upon completion of the program, students will be able to demonstrate critical
2. Understanding at an advanced level with up-to-date knowledge in research methodology of his/her field of interests.
3. Students will be completely prepared to take up PhD and continue his/her research.
4. Qualify Competitive Exams like NET/GATE/SET/GRE etc.

M.Sc I Year Semester I Subjects:

Course Outcomes:

M101 Abstract Algebra:

The course will enable the students to:

- Recognize the mathematical objects called groups.
- Link the fundamental concepts of groups and symmetries of geometrical objects.
- Explain the significance of the notions of cosets, normal subgroups, and factor groups.
- Analyze consequences of Lagrange's theorem.
- Learn about structure preserving maps between groups and their consequences.
- Ability to understand a large class of commutative rings by regarding them as quotients of polynomial rings by suitable ideals.

M102 Mathematical Analysis

This course will enable the students to:

- Understand many properties of the real line $\mathbb{R}$ and learn to define sequence in terms of functions from $\mathbb{R}$ to a subset of $\mathbb{R}$.
- Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
- Apply the ratio, root, and alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.
- Learn some of the properties of Riemann integrable functions, and the applications of the fundamental theorems of integration.

M103 Ordinary and partial Differential equations

This course will enable the students to:

- Understand the genesis of ordinary differential equations.
- Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
- Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.
- Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
- Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.
- Apply a range of techniques to solve first & second order partial differential equations.
- Model physical phenomena using partial differential equations such as the heat and wave equations.

M104 Elementary Number Theory

This course will enable the students to:

- Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences.
- Learn about number theoretic functions, modular arithmetic and their applications.
- Familiarise with modular arithmetic and find primitive roots of prime and composite numbers.
- Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture.
- Apply public crypto systems, in particular, RSA.

M105 Discrete Mathematics

This course will enable the students to:

- Learn about partially ordered sets, lattices and their types.
- Understand Boolean algebra and Boolean functions, logic gates, switching circuits and their applications.
- Solve real-life problems using finite-state and Turing machines.
- Assimilate various graph theoretic concepts and familiarize with their applications.

M.Sc I Year Semester II Subjects:

M201 Galois Theory

This course will enable the students to:

- Construction of minimal polynomials, splitting fields, finite fields etc.
- Verify/identify normal fields, separable fields.
- Construction of algebraic numbers geometrically using straightedge and compass only.
- Formulation of Galois groups and Galois field extensions

M202 Lebesgue measure & Integration

This course will enable the students to:

- Concepts of simple functions
- Integration of functions on arbitrary measure space
- Regular only measure and metric outer measure
- Generalization of classical Lebesgue integral on real sets
- Integration of bounded functions on sets of finite measure

M203 Complex Analysis

This course will enable the students to:

- Visualize complex numbers as points of $\mathbb{R}$ and stereographic projection of complex plane on the Riemann sphere.
- Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy Riemann equations.
- Learn the role of Cauchy Goursat theorem and Cauchy integral formula in evaluation of contour integrals.
- Apply Liouville's theorem in fundamental theorem of algebra.

- Understand the convergence, term by term integration and differentiation of a power series.
- Learn Taylor and Laurent series expansions of analytic functions, classify the nature of singularity, poles and residues and application of Cauchy Residue theorem.

M204 Topology

This course will enable the students to:

- Define topological spaces, product topology, metric topology, quotient space.
- Discuss the continuous functions, connected space, compact space, complete metric space, related theorems on Baire space.
- Describe closed sets and limit points, components and path components.
- Prove Urysohn's lemma, Urysohn's metrization theorem, Nagata-Snirnov metrization theorem, Ascoli's theorem.
- Understand the separation axiom, a space filling curve.

M205 Theory of Ordinary Differential Equations

This course will enable the students to:

- Power series solutions.
- Properties of Bessel functions and Legendre polynomials.
- Existence and uniqueness of initial value problems.
- Picard's and Peano's theorems, Gronwall's inequality.
- Maximal interval of existence, continuous dependence.
  Higher order linear equations and linear systems, fundamental solutions, Wronskian, matrix exponential equations.
- Boundary value problems for second order equations, Green functions, eigen value problems.

M.Sc II Year Semester III Subjects:

M301 Functional Analysis

This course will enable the students to:

- To learn to recognize the fundamental properties of normed spaces and of the transformations between them.
- Understand the notions of dot product and Hilbert space and apply the spectral theorem to the resolution of integral equations.
- Corelate Functional Analysis to problems arising in Partial Differential Equations, Measure Theory and other branches of Mathematics.

M302 General Measure & Integration

This course will enable the students to:

- Concepts of measure spaces and measurable spaces.
- Borel -algebra.
- Cantor ternary set.
- Completion of measure spaces.

M303 Linear Algebra

This course will enable the students to:

- Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.
- Relate matrices and linear transformations; compute Eigen values and Eigen vectors of linear transformations.
- Learn properties of inner product spaces and determine orthogonality in inner product spaces.
- Realise importance of adjoint of a linear transformation and its canonical form.

M304 (A) Operations Research

This course will enable the students to:

- Analyze and solve linear programming models of real life situations.
- Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.
- Understand the theory of the simplex method.
- Know about the relationships between the primal and dual problems, and to understand sensitivity analysis.
- Learn about the applications to transportation, assignment and two-person zero-sum game problems.

M305 (B) Numerical Analysis

This course will enable the students to:

- Obtain numerical solutions of algebraic and transcendental equations.
- Find numerical solutions of system of linear equations and check the accuracy of the solutions.
- Learn about various interpolating and extrapolating methods.
- Solve initial and boundary value problems in differential equations using numerical methods.
- Apply various numerical methods in real life problems.

M.Sc II Year Semester IV Subjects:

M401 Integral equations & calculus of Variations

This course will enable the students to:

- Apply a range of techniques to solve first & second order partial differential equations.
- Model physical phenomena using partial differential equations such as the heat and wave equations.
- Understand problems, methods and techniques of calculus of variations.

M402 Elementary operator theory

This course will enable the students to:

- Equivalent norms on a vector spaces define the same topology.

- On a finite dimensional vector space any two norms are equivalent.

- Using topology to work with infinite dimensional vector spaces.
- Viewing C[a,b] with sup norm and integration norm respectively as

- Banach space and incomplete norm linear space.
- Comparing the differences between finite and infinite dimensional spaces.
- Comparing the differences between Banach and Hilbert spaces.
- Analyzing the structure of the spectrum of certain operators.

M403 Analytic Number Theory

This course will enable the students to:

- The student masters the basic concepts of analytic number theory, including selected arithmetic and multiplicative functions, Abel summation and Möbius inversion, the Mellin transformation and Perron's formula, Dirichlet series and Euler products, Dirichlet characters.
- The students knows both the additive and the multiplicative definition of the Riemanns zeta function, the functional equation and the basic of the zeta function and the gamma function.
- The student has an overview of and can formulate the central results and open problems of the subject, including the prime number theorem and the Riemann hypothesis.

M404 (A) Integral Transforms

This course will enable the students to:

- Obtain solution of a boundary value problem using integral equations.
- Obtain minimum surface of revolution from a variational formulation.
- Solution of Wave, Heat and Laplace equations using integral transform technique.

M405 (A) Fluid Mechanics

This course will enable the students to:

- Identify and obtain the values of fluid properties and relationship between them and understand the principles of continuity, momentum, and energy as applied to fluid motions.
- Recognize these principles written in form of mathematical equations.
- Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.