M. Sc. Mathematics
Semester wise Syllabus

Total Marks : 2500
Each Paper : 100 marks theory + 25 marks sessional
Periods Allotted per week per paper : 05 Hrs.

M. Sc. Semester – I

Compulsory Papers

1. Paper I Algebra-I
2. Paper II Real Analysis-I
3. Paper III Topology-I
4. Paper IV Liner Algebra and differential equations

Optional Papers (Any One)

5. Paper V Numerical Analysis
6. Paper VI Integral Equations
7. Paper VII Fuzzy Mathematics-I

M. Sc. Semester-II

Compulsory Papers

1. Paper I Algebra-II
2. Paper II Real Analysis-II
3. Paper III Topology-II
4. Paper IV Differential geometry

Optional Papers (Any One)

5. Paper V Classical Mechanics
6. Paper VI Mathematical Methods
7. Paper VII Fuzzy Mathematics-II

Detailed Syllabus

Semester-I

Paper-I
Algebra-I

Unit 1: Permutation Group. Group of Symmetry. Dihedral group. Commutator group. Isomorphism Theorems. Automorphisms. Characteristic subgroup. Conjugacy and G- Sets.

Unit 2: Normal Series. Solvable groups. Nilpotent groups. Cyclic decomposition of permutation group. Alternating groups. Simplicity of $A_{n.}$

Unit 3: Direct product, semi-direct product of groups. Sylows theorems. Groups of order p^2 and pq.

Unit 4: Ideals and Homomorphisms. Sum and direct sum of ideals. Maximal and prime ideals. Nilpotent and Nil ideals. Modules Submodules. Direct sums. R-homomorphisms and quotient modules. Completely reducible modules. Free modules.

Text Book:
Basic Abstract Algebra : Bhattacharya, Jain and Nagpal, Second Edition, Cambridge University Press.

Reference Books :
1. Topics in Algebra, I. N. Herstein, Second Edition, John Wiley.
2. Abstract Algebra : David S. Dummit and Richard M. Foote, John Wiley.

Paper-II
Real Analysis-I

Unit 1: Uniform convergence. Uniform convergence and continuity. Uniform convergence and integration. Uniform convergence and differentiation. Equicontinuous families of functions. The Stone- Weierstrass theorm.

Unit 2: Differentiation. The Contraction Principle. The Inverse Function Theorem. The Implicit Function Theorem. The Rank theorem. Partitions of unity.

Unit 3: The space of tangent vectors at a point of R^n. Another definition of $T_a(R^n)$. Vector fields on open subsets of R^n. Topological manifolds. Differentiable manifolds. Real Projective space. Grassman manifolds. Differentiable functions and mappings.

Unit 4: Rank of a mapping. Immersion. Sub manifolds. Lie groups. Lie groups. Examples of lie groups.

Text Books:

1. Principal of Mathematical Analysis (Third Edition) : Walter Rudin
   Mc GRAW – Hill Book Company.
2. An Introduction to Differentiable Manifolds and Riemannian Geometry : W. Boothby, Academic Press, 1975.

Reference Books:

1. Methods of Real Analysis : R. R. Goldberg, John Wiley.
2. Calculus of Several Variables : C Goffman, Harper and Row.

Paper-III

Topology-I

Unit 1: Countable and Uncountable sets. Examples and related Theorems. Cardinal Numbers and related Theorems. Topological Space and Examples.

Unit 2: Open sets and limit points. Derived Sets. Closed sets and closure operators. Interior, Exterior and boundary operators. Neighbourhoods, bases and relative topologies.

Unit 3: Connected sets and components. Compact and countably compact spaces. Contiuous functions, and homeomorphisms.

Unit 4: T_0- and T_1- spaces, T_2- spaces and sequences. Axioms of countability. Separability. Regular and normal spaces.

Text Book:

Foundations of General Topology: W. J. Pervin, Academic press, 1964.

Reference Books:

1. Topology: J. R. Munkres, (second edition), Prentice Hall of India, 2002.
2. Introduction to Topology and Modern Analysis: G. F. Simmons, Mc Graw Hill 1963.
3. General Topology: J. L. Kelley, Van Nostrand, 1995.
4. Introduction to general Topology: K. D. Joshi, Wiley Eastern Ltd. 1983.

Paper-IV

Linear Algebra and differential equations

Unit 1: Matrices and operators, Subspaces, Bases and Dimension, Determinants, trace, and Rank. Direct sum decomposition. Real Eigen Values. Differential equations with Real Distinct Eigen values. Complex Eigen values.

Unit 2: Complex vector spaces. Real operators with complex Eigen values. Application of complex linear algebra to differential equations. Review of topology in R^n. New norms for old. Exponential of operators.

Unit 3: Homogeneous liner systems. A non-homogeneous equation. Higher order systems. The primary decomposition. The S+N decompositions. Nilpotent canonical forms.

Unit 4: Jordan and real canonical forms. Canonical forms and differential equations. Higher order linear equations on functions spaces. Sinks and sources. Hyperbolic flows. Generic properties of operators. Significance of genericity.

Text Book :
Differential equations, dynamical system and linear algebra: M. W. Hirsch and S. Smale, Academic Press, 1975.

Reference Book:
Dynamical systems: V. I. Arnold, Springer Verlag, 1992.

Paper-V

Numerical Analysis

(Optional)

Unit 1: Simple enclosure methods, Secant method, Newton's method, general theory for one point iteration methods. Aitken extrapolation for linearly convergent sequences, Error tests, Numerical evaluation of multiple roots, roots of polynomials, Mullers method, Non-liner systems of equations, Newton's method for non-linear systems.

Unit 2: Polynomial interpolation theory, Newton's divided differences, finite difference and table oriented interpolation formulas. Forward-differences. Hermite interpolation.

Unit 3: The Weierstrass theorem and Taylor's theorem. The minimax approximation problem, the least square apporoximation problem, orthogonal polynomial, economization of Taylor series, minimax approximation.

Unit 4: The trapezoidal rule and Simpson's rule, Newton-Cotes integration formulas.

Text Book:
An Introduction to Numerical Analysis : Kendal E. Atkinson, Johan Wiley and sons, lnc.

Paper-VI

Integral Equations

(Optional)

Unit 1: Preliminary concepts of integral equations. Some problems which give rise to integral equations. Conversion of ordinary differential equations into integral equations. Classification of linear integral equations. Integro-differential equations.

Unit 2: Fredholm equations. Degenerate kernels. Hermitian and symmetric kernels. The Hilbert-Schmidt theorem. Hermitization and symmetrization of kernels. Solutions of integral equations with Green's function type kernels.

Unit 3: Types of Voltera equations. Resolvent kernel of Voltera equations, Convolution type kernels. Some miscellaneous types of Voltera equations. Non-linear Voltera equations. Fourier integral equations. Laplace integral equations.

Unit 4: Hilbert transform. Finite Hilbert transform. Miscellaneous integral transform. Approximate methods of solutions for linear integral equations. Approximate evaluation of Eigen values and Eigen functions.

Text Book :

Integral Equations: A short course: LI. G. Chambers: International text book company Ltd, 1976.

Paper-VII

Fuzzy Mathematics-I

(Optional)

Unit 1. Crisp Sets. Fuzzy Sets. Fuzzy sets versus Crisp sets Operations of Fuzzy sets.

Unit 2: Fuzzy Arithmetic.

Unit 3: Fuzzy relations.

Unit 4: Fuzzy relation equations.

Text Book :

Fuzzy Sets and Fuzzy Logic, theory and applications. George J. Klir and Bo Yuan, Prentice Hall.

Semester II
Paper I
Algebra-II

Unit 1: Unique factorization domains. Principal Ideal domains. Euclidean domains. Polynomial rings over unique factorization domains.

Unit 2: Irreducible polynomials and Eisenstein criterion. Adjunction of roots. Algebraic extensions. Algebraically closed fields. Splitting fields. Normal extensions. Multiple roots.

Unit 3: Finite fields. Separable extensions. Automorphism groups, and fixed fields. Fundamental theorem of Galois theory. Fundamental theorem of algebra.

Unit 4: Roots of unity and Cyclotomic polynomials. Cyclic extensions. Polynomials solvable by radicals. Ruler and compass contractions.

Text Book:
Basic Abstract Algebra: Bhattacharya, Jain Nagpaul; Second Edition, Cambridge University Press.

Reference Books:
1. Topics in Algebra, I. N. Herstein, Second Edition, John Wiley.
2. Abstract Algebra, David S. Dummit and Richard M. Foote, John Wiley.

Paper II
Real Analysis-II

Unit 1: Outer measure. Measurable sets and Lebesgue measure. A non-measurable set, Measurable functions, Littlewood's three principles.

Unit 2: The Riemann integral. Lebesgue integral of a bounded function over a set of finite measure. Integral of a non-negative function. General Lebsgue integral. Convergence in measure. Differentiation of monotone functions. Functions of bounded variation. Differentiation of an integral.

Unit 3: Absolute continuity. Convex functions. L^p- spaces. Holder and Minkowski inequality. Riesz-Fischer theorem. Approximation in L^p. Bounded linear functional on L^p- spaces.

Unit 4: Compact metric spaces. Baire category theorem. Arzela Ascoli theorem. Locally compact spaces. Sigma compact spaces.

Text Book:
Real Analysis, H. L. Royden, Third edition, Prentice Hall, 1988.

Reference Books:
1. Measure theory and Integration, G. de Barra Wiley Eastern Limited, 1981.
2. An introduction to Measure & Integration, Inder K. Rana, Narosa Publishing House.

Paper-III
Topology-II

Unit 1: Urysohn's lemma. Tietze extension theorem. Completely regular spaces. Completely normal spaces. Compactness for metric spaces. Properties of metric spaces.

Unit 2: Quotient topology. Nets and filters.

Unit 3: Product topology: Finite products, products invariant properties, metric products. Tichonov topology, Tichonov theorem.

Unit 4: Locally finite topological spaces. Paracompact spaces, Urysohn's metrization theorem.

Text Book:

1. Foundation of General Topology: W. J. Pervin, Academic press, 1964.
2. Introduction to general Topology: K. D. Joshi, Wiley Eastern Ltd. 1983

Reference Books:

1. Topology: J. R. Munkres, second edition, Prentice Hall of India, 2002.
2. Introduction to topology and modern analysis : G. F. Simmons, Mc Graw Hill 1963.
3. General Topology: J. L. Kelley, Van Nostrand, 1995.

Paper-IV
Differential Geometry

Unit 1: Definition of surface. Curves on a surface. Surfaces of revolution. Helicoids. Metric. Direction coefficients. Families of curves. Isometric correspondence. Intrinsic properties. Geodesics. Canonical geodesic equations.

Unit 2: Normal property of geodesics. Existence theorems. Geodesic parallels. Geodesic curvature. Gauss Bonnet theorem. Gaussian curvature. Surfaces of constant curvature. Conformal mapping. Geodesic mapping.

Unit 3: Second fundamental form. Principal curvatures. Lines of curvature. Developables. Developables associated with space curves. Developables associated with curves on surfaces. Minimal surfaces and ruled surfaces. Fundamental equations of Surface theory. Parallel surfaces.

Unit 4: Compact surfaces whose points are umbilics. Hilbert's lemma. Compact surfaces of constant Gaussian or mean curvature. Complete surfaces. Characterisation of complete surfaces. Hilbert's theorem. Conjugate points on geodesics. Intrinsically defined surfaces. Triangulation. Two dimensional Riemannian manifolds. Problem of metrization. Problem of continuation.

Text Book:

An introduction to Differential Geometry: T. J. Wilmore; Oxford University Press.

Reference Book:

Geometry of curves and surfaces: do Carmo, Academic Press

Paper-V
Classical Mechanics
(Optional)

Unit 1: Variational Principal and Lagrange's equations; Hamilton's Principle, some techniques of calculus of variations, Derivation of Lagrange equations from Hamilton's principle. Extension of principle to nonholonomic systems. Conservation theorems and symmetry properties.

Unit 2: Legendre transformations and the Hamilton equation of motion. Cyclic coordinates and conservation theorems. Routh's procedure and oscillations about steady motion, The Hamiltonian formulation of relativistic mechanics, The Principal of least action.

Unit 3: The equations of canonical transformation. Examples of canonical transformation. The symplectic approach th\o canonical transformations. Poisson brackets and other canonical invariants.

Unit4: Equations of motion. Infinitesimal canonical transformations and conservation theorem in the Poisson bracket formulation, the anguler momentum, Poisson bracket relations, symmetry groups of mechanical systems. Liouville's theorem.

Text Book :

Classical Mechanics: By H. Goldstein, Second Edition Narosa publishing house, New Delhi.

Reference:

1. Lectures in Analytic Mechanics: F. Gantmacher, MIR Publishers, Moscow, 1975
2. Classical Mechanics: Narayan Chandra Rana and Pramod Sharad Chandra Jog, Tata Mc Graw hill.

Paper-VI
Mathematical Methods
(Optional)

Unit 1: Fourier integral theorem. Fourier transform. Fourier cosine and sine transform. The convolution integral. Multiple Fourier transform. Solution of partial differential equations by means of Fourier transform.

Unit 2: Calculations of the Laplace transform of some elementary functions. Laplace transform of derivatives. The convolution of two functions. Inverse formula for the Laplace transform. Solutions of ordinary differential equations by Laplace transform.

Unit 3: Finite Fourier transform. Finite Sturm – Liouville transforms. Generalized finite Fourier transform.

Unit 4: Finite Hankel transform. Finite Legendre transform. Finite Mellin transform.

Text Book:

The use of integral transforms: I N. Sneddon, Tata Mc Graw Hill Publishing Company Ltd.

Reference Books: Modern Mathematics For Engineers: Edwin F Beckenbach, Second series, Mc Graw Hill Book Company.

Paper-VII
Fuzzy Mathematics-II
(Optional)

Unit 1: Possibility theory

Unit 2: Fuzzy Logic

Unit 3: Constructing Fuzzy sets and operations on Fuzzy sets. Approximate reasoning.

Unit 4: Fuzzy System. Pattern Recognition.

Text Book:
Fuzzy Sets and Fuzzy Logic, theory and applications. George J. Klir and Bo Yuan, Prentice Hall, India.