PROF. G. RAM REDDY CENTRE FOR DISTANCE EDUCATION

DEPARTMENT OF MATHEMATICS

OSMANIA UNIVERSITY

M.Sc. Mathematics Syllabus

Semester – I & II

(Choice Based Credit System)
(w.e.f. the academic year 2023-2024)

M.Sc. Mathematics Course Structure

(Choice Based Credit System)
(w.e.f. the academic year 2023-2024)

SEMESTER – I

Subjects	Code	Paper Title	THPW	Credits	IA	ESE	Total
Core	M 101	**Abstract Algebra**	5	5	30	70	100
Core	M 102	**Mathematical Analysis**	5	5	30	70	100
Core	M 103	**Ordinary Differential Equations**	5	5	30	70	100
Core	M 104	**Elementary Number Theory**	5	5	30	70	100
			20	20			400

SEMESTER – II

Subjects	Code	Paper Title	THPW	Credits	IA	ESE	Total
Core	M 201	**Galois Theory**	5	5	30	70	100
Core	M 202	**Lebesgue measure and Integration**	5	5	30	70	100
Core	M 203	**Complex Analysis**	5	5	30	70	100
Core	M 204	**Integral Equations and Calculus of Variations**	5	5	30	70	100
			20	20			400

THPW = Teaching Hours Per Week.
IA = Internal Assessment (IA Test 20 Marks + Assignment 10 Marks).
ESE = End-Semester Examination.
End-Semester Examination Duration - 3 Hrs.

M. Sc. Mathematics

M 101 **Semester-I**

Paper-I: Abstract Algebra

Unit- I
Automorphisms - Conjugacy and G - sets - Normal series - Solvable groups - Nilpotent groups.
(Page No. 104 to 128)

Unit- II
Structure theorems of groups: Direct products - Finitely generated abelian groups - Invariants of a finite abelian group - Sylow theorems - Groups of orders p^2, pq.
(Page No. 138 to 155)

Unit- III
Ideals and homomorphisms - Sum and direct sum of ideals, Maximal and Prime ideals - Nilpotent and nil ideals - Zorn's lemma.
(Page No. 179 to 211).

Unit- IV
Unique factorization domains - Principal ideal domains - Euclidean domains - Polynomial rings over UFD - Rings of Fractions.
(Page No. 212 to 228)

Text Book:

- **Basic Abstract Algebra** by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul. Second Edition

References:

1. **Topics in Algebra** by I.N. Herstein.
2. **Elements of Modern Algebra** by Gibert and Gilbert.
3. **Abstract Algebra** by Jeffrey Bergen.
4. **Basic Abstract Algebra** by Robert B Ash.

M. Sc. Mathematics

M 102 **Semester-I**

Paper - II: Mathematical Analysis

Unit- I
Metric spaces - Compact sets - Perfect sets - Connected sets.
(Page No. 30-46)

Unit- II
Limits of functions - Continuous functions - Continuity and compactness, Continuity and connectedness - Discontinuities - Monotonic functions, Differentiation.
(Page No. 83-102)

Unit- III
Riemann - Steiltjes integral - Definition and Existence of the Integral - Properties of the integral – Integration and differentiation, Integration of vector valued functions - Rectifiable curves.
(Page No. 120-133 & 135-142)

Unit- IV
Sequences and Series of Functions: Uniform convergence - Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation – The Stone-Weierstrass theorem.
(Page No. 143-154, 159-161, 165-171 & 220-222)

Text Book:

- **Principles of Mathematical Analysis** (3rd Edition) By Walter Rudin, *McGraw-Hill International Edition.*

References:

1. **The Real Numbers** by John Stillwel.
2. **Real Analysis** by Barry Simon.
3. **Mathematical Analysis** Vol - I by D J H Garling.
4. **Measure and Integral** by Richard L.Wheeden and Antoni Zygmund.

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M 103 **Semester-I**

Paper - III: Ordinary Differential Equations

Unit- I

Existence and Uniqueness of Solutions: Preliminaries – Successive approximations – Picard's theorem – Some examples – Continuation and dependence on initial conditions – Existence of solutions in the large – Existence and uniqueness of solutions of systems.

Unit- II

Linear Differential Equations of Higher Order: Introduction – Higher order linear differential equations – A Mathematical model – Linear dependence and Wronskian – Homogeneous linear equations with constant coefficients – Equations with variable coefficients – Method of variation of parameters – Some standard methods –Laplace transforms.

Unit- III

Solutions in Power Series : Introduction – Second order linear equations with ordinary points – Legendre equation and Legendre Polynomials – Second order equations with regular singular points – Bessel functions.

Unit- IV

Oscillations of Second Order Equations: Introduction – Sturm's comparision theorem – Sturm's separation theorem-Elementary linear oscillations – Comparision theorem of Hille – Wintner – Oscillations of $x'' + a(t)x = 0$, Boundary value problems: Sturm – Liouville problem.

Text Book:

- **Ordinary Differential Equations** by S.G. Deo, V. Raghavendra , Rasmita Kar and V. Lakshmikantham , Third Edition, *McGraw-Hill Education(India)Private Limited, New Delhi.*

References:

1. **Differential Equations with Applications with Historical Notes** by George F.Simmons, *Second Edition.*
2. **Ordinary Differential Equations** by Earl A Coddington.

M. Sc. Mathematics

M 104 **Semester-I**

Paper - IV: Elementary Number Theory

Unit- I

The Fundamental Theorem of Arithmetic: Divisibility- GCD- Prime numbers, Fundamental theorem of arithmetic- the series of reciprocal of the primes- The Euclidean algorithm.
(Page No. 13 - 23)

Unit- II

Arithmetical Functions and Dirichlet Multiplication: The functions $\phi(n)$, $\mu(n)$ and a relation connecting them- Product formula for $\phi(n)$ - Dirichlet product- Dirichlet inverse and Mobius inversion formula -The Mangoldt function $\wedge(n)$- Multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function- Liouville's function $\lambda(n)$- The divisor functions $\sigma_\alpha(n)$.
(Page No. 24-39 & 46-51)

Unit- III

Congruences: Properties of congruences- Residue classes and complete residue system- Linear congruences-Reduced residue systems and Euler-Fermat theorem- Polynomial congruence modulo p - Lagrange's theorem- Application of Lagrange's theorem- Chinese remainder theorem and its applications.
(Page No. 106-120 & 126-128)

Unit- IV

Quadratic Residues and The Quadratic Reciprocity Law: Quadratic residues- Legendre's symbol and its properties- Evaluation of $(-1|p)$ and $(2|p)$ - Gauss' lemma- The quadratic reciprocity law and its applications-The Jacobi symbol.
(Page No. 178-190 & 201-203)

Text Book:

- **Introduction to Analytic Number Theory** by Tom M. Apostol. *Narosa publishing house*

References:

1. **Number Theory** by Joseph H. Silverman.
2. **Theory of Numbers** by K.Ramchandra.
3. **Elementary Number Theory** by James K Strayer.
4. **Elementary Number Theory** by James Tattusall.

M. Sc. Mathematics

M 201 **Semester-II**

Paper - I: Galois Theory

Unit- I

Algebraic extensions of fields: Irreducible polynomials and Eisenstein criterion - Adjunction of roots - Algebraic extensions - Algebraically closed fields.
(Page No. 281- 299).

Unit- II

Normal and separable extensions: Splitting fields - Normal extensions - Multiple roots - Finite fields - Separable extensions.
(Page No. 300 - 321).

Unit- III

Galois theory: Automorphism groups and fixed fields - Fundamental theorem of Galois theory - Fundamental theorem of Algebra.
(Page No. 322 - 339).

Unit- IV

Applications of Galois theory to classical problems: Roots of unity and cyclotomic polynomials - Cyclic extensions - Polynomials solvable by radicals – Symmetric functions-Ruler and Compass constructions.
(Page No. 340 - 364).

Text Book:

- **Basic Abstract Algebra** by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul. *Second Edition*

References:

1. **Topics in Algebra** by I.N. Herstein.
2. **Elements of Modern Algebra** by Gibert and Gilbert.
3. **Abstract Algebra** by Jeffrey Bergen.
4. **Basic Abstract Algebra** by Robert B Ash.

M 202 **Semester-II**

Paper - II: Lebesgue Measure and Integration

Unit- I

Algebra of sets - Borel sets - Outer measure - Measurable sets and Lebesgue measure - A non - measurable set - Measurable functions – Littlewood's three principles.

Unit- II

The Riemann integral - The Lebesgue integral of a bounded function over a set of finite measure - The integral of a non - negative function - The general Lebesgue integral.

Unit- III

Convergence in measure - Differentiation of monotone functions - Functions of bounded variation.

Unit- IV

Differentiation of an integral - Absolute continuity - The L_p - spaces - The Minkowski and Holder inequalities - Convergence and completeness.

Text Book:

- **Real Analysis** (3rd Edition)(Chapters 3, 4, 5) by H. L. Royden, *Prentice-Hall India.*

References:

1. **Lebesgue measure and Integration** by G.de Barra.
2. **Measure and Integral** by Richard L.Wheeden, Anotoni Zygmund.

M. Sc. Mathematics

M 203 **Semester-II**

Paper III: Complex Analysis

Unit- I

Regions in the Complex Plane - Functions of a Complex Variable - Limits - Continuity - Derivatives - Cauchy – Riemann Equations - Sufficient Conditions for Differentiability - Analytic Functions - Harmonic Functions - Reflection Principle - The Exponential Function - The Logarithmic Function - Complex Exponents- Trigonometric functions- Hyperbolic functions .

Unit- II

Derivatives of Functions $w(t)$ - Definite Integrals of Functions $w(t)$ - Contours - Contour Integrals - Some Examples - Upper Bounds for Moduli of Contour Integrals – Anti derivatives - Cauchy – Goursat Theorem - Simply Connected Domains - Multiply Connected Domains - Cauchy Integral Formula - An Extension of the Cauchy Integral Formula - Liouville's Theorem and the Fundamental Theorem of Algebra - Maximum Modulus Principle.

Unit- III

Convergence of Sequences - Convergence of Series - Taylor Series - Laurent Series - Absolute and Uniform Convergence of Power Series - Isolated Singular Points - Residues - Cauchy's Residue Theorem - Residue at Infinity - The Three Types of Isolated Singular Points - Residues at Poles - Examples - Zeros of Analytic Functions - Zeros and Poles - Behavior of Functions Near Isolated Singular Points.

Unit- IV

Evaluation of Improper Integrals - Improper Integrals from Fourier Analysis - Jordan's Lemma - Definite Integrals Involving Sines and Cosines - Argument Principle - Rouche's Theorem - Linear Transformations - The Transformation $w = 1/z$ - Mappings by $1/z$ - Linear Fractional Transformations - An Implicit Form.

Text Book:

- **Complex Variables with Applications** by James Ward Brown and Ruel V Charcill. *McGraw- Hill International Edition.*

References:

1. **Complex Analysis** by Dennis G. Gill.
2. **Complex Analysis** by Steven G. Krantz.
3. **Complex Variables with Applications** by S. Ponnusamy, Herb Silverman.
4. **Complex Analysis** by Joseph Bak, Donald J. Newman.

M 204 **Semester-II**

Paper - IV: Integral Equations and Calculus of Variations

Unit- I

Volterra Integral Equations: Basic concepts - Relationship between Linear differential equations and Volterra Integral equations - Resolvent Kernel of Volterra Integral equation. Differentiation of some resolvent kernels - Solution of Integral equation by Resolvent Kernel - The method of successive approximations - Convolution type equations - Solution of Integro-differential equations with the aid of the Laplace Transformation – Volterra integral equation of the first kind-Euler integrals-Abel's problem-Abel's integral equation and its generalizations.

Unit- II

Fredholm Integral Equations : Fredholm integral equations of the second kind – Fundamentals – The Method of Fredholm Determinants - Iterated Kernels constructing the Resolvent Kernel with the aid of Iterated Kernels - Integral equations with Degenerated Kernels. Hammerstein type equation – Characteristic numbers and Eigen function and its properties.

Green's function :Construction of Green's function for ordinary differential equations-Special case of Green's function –Using Green's function in the solution of boundary value problem.

CALCULS OF VARIATIONS:

Unit- III

Introduction – The Method of Variations in Problems with fixed Boundaries: Definitions of Functionals –Variation and Its properties - Euler's'equation- Fundamental Lemma of Calculus of Variation – The problem of minimum surface of revolution - Minimum Energy Problem Brachistochrone Problem - Variational problems involving Several functions - Functional dependent on higher order derivatives - Euler Poisson equation.

Unit- IV

Functional dependent on the functions of several independent variables - Euler's equations in two dependent variables – Variational problems in parametric form-Applications of Calculus of Variation-Hamilton's principle - Lagrange's Equation,Hamilton's equations.

Text Book:

- **Problems and Exercises in Integral Equations** by M.KRASNOV, A.KISELEV, G.MAKARENKO, (1971).
- **Integral Equations** by S.Swarup, (2008).
- **Differential Equations and The Calculus of Variations** by L.ELSGOLTS, MIR Publishers, MOSCOW.

PROF. G. RAM REDDY CENTRE FOR DISTANCE EDUCATION

DEPARTMENT OF MATHEMATICS

OSMANIA UNIVERSITY

M.Sc. Mathematics Syllabus

Semester – III & IV

(Choice Based Credit System)
(w.e.f. the academic year 2024-2025)

M.Sc. Mathematics Course Structure

(Choice Based Credit System)
(w.e.f. the academic year 2024-2025)

SEMESTER – III

Subjects	Code	Paper Title	THPW	Credits	IA	ESE	Total
Core	M 301	**Topology**	5	5	30	70	100
Core	M 302	**Linear Algebra**	5	5	30	70	100
Core	M 303	**Operations Research**	5	5	30	70	100
Core	M 304	**Mechanics**	5	5	30	70	100
			20	20			400

SEMESTER – IV

Subjects	Code	Paper Title	THPW	Credits	IA	ESE	Total
Core	M 401	**Functional Analysis**	5	5	30	70	100
Core	M 402	**Partial Differential Equations**	5	5	30	70	100
Core	M 403	**Numerical Analysis**	5	5	30	70	100
Core	M 404	**Mathematical Statistics**	5	5	30	70	100
			20	20			400

THPW = Teaching Hours Per Week.
IA = Internal Assessment (IA Test 20 Marks + Assignment 10 Marks).
ESE = End-Semester Examination.
End-Semester Examination Duration - 3 Hrs.

M. Sc. Mathematics

M 301 **Semester-III**

Paper-I: Topology

Unit- I
Topological Spaces: The Definition and examples - Elementary concepts - Open bases and open subbases- Weak topologies.
(Page No. 91-106)

Unit- II
Compactness: Compact spaces - Products of spaces - Tychonoff's theorem and locally compact spaces - Compactness for metric spaces - Ascoli's theorem.
(Page No. 110-128)

Unit- III
Separation: T_1 - spaces and Hausdorff spaces - Completely regular spaces and normal spaces - Urysohn's lemma and the Tietze extension theorem - The Urysohn imbedding theorem.
(Page No. 129-141)

Unit- IV
Connectedness: Connected spaces - The components of a spaces - Totally disconnected spaces - Locally connected spaces.
(Page No. 142-152)

Text Book:

- **Introduction to Topology and Modern Analysis** By G.F. Simmon's. *Tata Mc Graw Hill Edition.*

References:

1. **Introductory Topology** by Mohammed H. Mortad.
2. **Explorations in Topology** by David Gay.
3. **Encyclopedia of General Topology** by Hart, Nagata, Vanghan.
4. **Elementary Topology** by Michael C. Gemignani.

M. Sc. Mathematics

M 302 **Semester-III**

Paper-II: Linear Algebra

Unit- I

Elementary Canonical forms - Introduction,Characteristic Values,Annihilating Polynomials, Invariant Sub-spaces, Simultaneous Triangulation and Simultaneous Diagonalization (Ch6, Sec6.1 - 6.5).

Unit- II

Direct sum Decomposition, Invariant Direct sums, The Primary Decomposition Theorem (Ch6, Sec 6.6 - 6.8). The Rational and Jordan Forms: Cyclic Subspaces and Annihilators (Ch7, Sec 7.1)

Unit- III

Cyclic Decompositions and the Rational Form, The Jordan Form, Computation of Invariant Factors, Semi Simple Operators (Ch7, Sec 7.2 - 7.5)

Unit- IV

Bilinear Forms: Bilinear Forms, Symmetric Bilinear Forms, Skew-Symmetric Bilinear Forms,Groups Preserving Bilinear Forms (Ch10, Sec 10.1 - 10.4)

Text Book:

- **Linear Algebra** by Kenneth Hoffman and Ray Kunze,(2e), PHI.

References:

1. **Advanced Linear Algebra** by Steven Roman(3e).
2. **Linear Algebra** by David C Lay.
3. **Linear Algebra** by Kuldeep Singh.

M. Sc. Mathematics

M 303 **Semester-III**

Paper-III: Operations Research

Unit- I

Formulation of Linear Programming problems, Graphical solution of Linear Programming problem,Convex set,General formulation of Linear Programming problems, Standard and Matrix forms of Linear Programming problems,Simplex Method, Two-phase method, Big-M method, Method to resolve degeneracy in Linear Programming problem, Alternative optimal solutions.

Unit- II

Solution of simultaneous equations by Simplex Method, Inverse of a Matrix by Simplex Method,Revised Simplex Method,Concept of Duality in Linear Programming, Comparison of solutions of the Dualanditsprimal

Unit- III

Mathematical formulation of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, North West corner rule, Lowest cost entry method, Vogel's approximation method, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem, Method to resolve degeneracy, Unbalanced transportation problem. Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure

Unit- IV

Concept of Dynamic programming, Bellman's principle of optimality, characteristics of Dynamic programming problem,Backward and Forward recursive approach,Minimum path problem,Single Additive constraint and Multiplicatively separable return, Single Additive constraint and Additively separable return, Single Multiplicatively constraint and Additively separable return.

Text Book:

- **Operations Research** by S.D.Sharma, 18th Revised Edition 2017, KedarNath Ram Nath Publications.

References:

1. **Operations Research – An Introduction** by Hamdy A. Taha, 10th Edition.
2. **Linear Programming** by G.Hadley.

M. Sc. Mathematics

M 304 **Semester-III**

Paper-IV: Mechanics

Unit- I

Dynamics of systems of Particles: Introduction - Centre of Mass and Linear Momentum of a system - Angular momentum and Kinetic Energy of a system, Centre of mass of Rigid body, symmetry considerations(Solid hemisphere,Hemispherical shell,Semicircle, Semicircular lamina), Rotation of a Rigid body about a fixed axis, Moment of Inertia, calculation of moment of Inertia, Perpendicular axis theorem for plane lamina,Parallel axis theorem for any rigid body, Radius of Gyration. (7.1, 7.2, 8.1, 8.2, 8.3 of [1])

Unit- II

Physical pendulum - Angular momentum Laminar Motion of a Rigid body in Laminar motion. Body rolling down an inclined plane. Motion of Rigid bodies in three dimension – Rotation of rigid body about an arbitrary axis,moments and products of inertia. (8.4, 8.5, 8.6, 9.1 of [1])

Unit- III

Angular momentum vector, Rotational kinetic energy of a rigid body, principles axes of a rigid body, Determination of the other two principal axes when one is known, Determining principal axes by diagonalizing the moment of inertia matrix, Dynamics of a particle in a rotating coordinate system. Euler's equation of motion of a Rigid body , Free rotation of a rigid body, Free rotation of a rigid body. (9.2, 5.2, 9.3, 9.4 of [1])

Unit- IV

Hamilton's variational principle-An example,Generalized Coordinates, Lagrange's Equations of motion for conservative systems, applications of Lagrange's equations, Generalized momenta,Ignorable coordinates, D'Alembert Principle-Generalised forces, Hamilton function - Hamilton's Equations. (10.1, 10.2, 10.4, 10.5, 10.6, 10.8, 10.9 of [1])

Text Book:

- **Analytical Mechanics** by G.R.Fowles G.L Cassiday, Cengage Learning , 7th edition.

References:

1. **Classical Mechanics** by Herbert Goldstein, Charles P.Poole and JhonSafko, Pearson pub.
2. **Principles Of Mechanics** by Synge J. L. and B.A. Griffith, McGraw Hill, 3rd edition.

M. Sc. Mathematics

M 401 **Semester-IV**

Paper-I: Functional Analysis

Unit- I

Normed Spaces - Banach Spaces - Further properties of normed spaces - Finite dimensional normed spaces and sub spaces - compactness and finite dimension - linear operators - Bounded and continuous linear operators. [2.2, 2.3, 2.4, 2.5, 2.6 *and* 2.7].

Unit- II

Linear functional – normed spaces of operators – Dual space – Inner product space-Hilbert Space – Further Properties of Inner product Spaces – Orthogonal complements and direct sums – Orthogonal sets and sequences. [2.8, 2.10, 3.1, 3.2, 3.3 *and* 3.4]

Unit- III

Series related to Orthonormal Sequences and sets – Total Orthonormal sets and sequences – Representation of Functions on Hilbert spaces – Hilbert – Adjoint Operator-Self-Adjoint,unitary and normal operators. [3.5, 3.6, 3.8, 3.9 *and* 3.10]

Unit- IV

Hahn-Banach Theorem - Hahn-Banach Theorem for Complex Vector Spaces and Normed Spaces –Adjoint Operator- Reflexive Spaces- Category Theorem - Uniform Boundedness Theorem - Open Mapping Theorem - Closed Linear Operators – Closed Graph Theorem.
[4.2, 4.3, 4.5, 4.6, 4.7, 4.12 *and* 4.13]

Text Book:

- **Introductory Functional Analysis with Applications** by Erwin Kreyszig, John Wiley and sons, NewYork.

References:

1. **Functional Analysis** by B.V.Limaye 2nd Edition..
2. **Introduction to Topology and Modern Analysis** by G.F.Sinmmons. Mc.Graw-Hill International Edition.

M. Sc. Mathematics

M 402 **Semester-IV**

Paper-II: Partial Differential Equations

Unit- I

First order Nonlinear Equations, Cauchy's method of Characteristics, compatible systems of first order equations, Charpit's method, Special types of first order equations.

Unit- II

Higher order Linear Partial Differential Equations with constant coefficients, Homogeneous Partial Differential Equations with constant coefficients, Classification of second order Partial Differential Equations, Canonical forms, Canonical form for hyperbolic, parabolic and elliptic equations.

Unit- III

Fourier Transforms : Fourier Integral Representations, Fourier Transforms Pairs, Fourier Transform of Elementary Functions, Properties of Fourier Transform, Convolution theorem, Parseval's Relation,Transform of Dirac Delta Function, Finite Fourier Transforms.

Unit- IV

Solution of diffusion, wave and Laplace equations by using Fourier transforms and Separation of Variables Methods, D'Alembert's solution of wave equation, Dirichlet problem and Neumann problem.

Text Book:

- **Introdction to Partial Differential Equations** by K. Shankar Rao, PHI, Third Edition.

References:

1. **Elements of Partial Differential Equations** by Ian Sneddon, Mc.Graw-Hill International Edition.
2. **Partial Differential Equations** by Lawrence C. Evans, American Mathematical Society.

M.Sc. Applied Mathematics

M 403 **Semester-IV**

Paper-III: Numerical Analysis

Unit- I

Transcendental and Polynomial Equations: Introduction, Bisection Method - Iteration Methods Based on First Degree Equation: Secant Method, RegulaFalsi Method, Newton-Raphson Method - Iteration Methods Based on Second Degree Equation: Muller's Method, Chebyshev Method, Multipoint Iteration Methods, Rate of convergence - Iteration Methods.

Unit- II

System of Linear Algebraic Equations: Introduction - Direct Methods: Gauss Elimination Method, Gauss Jordan Elimination Method, Triangularization Method, Cholesky Method, Partition Method - Iteration Methods: Jacobi Iteration Method, Gauss Seidel Iteration Method, SOR Method, Convergence Analysis for iterative Methods.

Unit- III

Interpolation and Approximation: Interpolation: Introduction - Lagrange and Newton Interpolations, Finite Difference Operators - Interpolating Polynomials using Finite Differences - Hermite Interpolations, Piecewise and Spline Interpolations. Approximation: Least Squares Approximation.
Differentiation : Methods based on interpolation, Methods based on finite differences.

Unit- IV

Numerical Integration: Methods Based on Interpolation: Newton- Cotes Methods - Methods Based on Undetermined Coefficients: Guass- Legendre Integration Methods - Composite Integration Methods.
Numerical Solution of ODEs: Introduction - Numerical Methods: Euler Methods-Mid point Method Single Step Methods: Taylor series method, Runge-Kutta Method (2nd and 4th orders). Multistep Methods: Adams Bashforth Method - Adams Moulton Method, Milne-Simpson Method - Predictor Corrector Methods.

Text Book:

- **Numerical Methods for Scientific and Engineering computation** by M.K. Jain, S.R.K. Iyengar, R.K. Jain, 7th Edition, *New Age International Publishers,2019.*

M. Sc. Mathematics

M 404 **Semester-IV**

Paper-IV: Mathematical Statistics

Unit- I

Probability: Sample space and events of an experiment, Properties of Probability experiments, Equally likely out comes, Conditional probability and independence, Bayes' Theorem. **Discrete Random Variables**: Random variables, Expected value, Properties of expected values, variance of random variables, Properties of variances, Binomial random variables and its Expected value and variance, Hyper-geometric random variables, Poisson random variables.[ch4, 5]

Unit- II

Normal Random Variables: Continuous random variables, Normal random variables, Probabilities associated with a standard Normal random variable, Finding Normal probabilities. Problems on related. **Distributions of Sampling Statistics**: Sample Mean, Central Limit Theorem, Distribution of the sample mean, Sample size needed, Sampling proportions from a finite population; Probabilities associated with sample proportions. **Estimation** : Point estimator of a population mean, population proportion, Estimating a population variance,.(Ch.6, 7, 8)

Unit- III

Testing Statistical Hypotheses: Hypothesis tests and Significance levels, Tests concerning the mean of a Normal population: Case of known variance, One-sided tests; the t-test for the mean of a Normal population: Case of unknown variance, Hypothesis Tests Concerning Population Proportions. Two-Sided Tests of p. **Hypothesis Tests Concerning Two Populations**:Testing equality of means of two Normal populations: Case of known and unknown variances and large Sample sizes, Testing equality of means: Small - sample tests when the unknown population variances are equal, Paired-sample t-test, Testing equality of population proportions. Problems on related.(Ch.9, 10)

Unit- IV

Chi-Squared Goodness of Fit Tests: Chi-Squared Goodness of fit Tests, Testing for independence in Populations classified according to two characteristics, Testing for independence in contingency tables with fixed marginal totals. Analysis of Variance: Introduction,One-factor and two factor Analysis of Variances, Parameter estimation, Degrees of freedom, Testing hypotheses.(ch11, 12)

Text Book:

- **Introductory Statistics** by Sheldon M.Ross(2010), Academic Press, Elsevier, 3rd Edition.(chapters 4 to 12).

References:

1. **Introduction to Probability Models** by Sheldon M.Ross(2010), Academic Press, Elsevier, 10th Edition. (chapters 4 to 13).