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 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.

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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.

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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.

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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.

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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.

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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, for solving nonlinear partial differential equations, Linear Partial Differential Equations with constant coefficients, Homogeneous Partial Differential Equations with constant coefficients. (0.9, 0.10, 0.11, 1.6, 1.7 of [1])

Unit- II

Classification of second order Partial Differential Equations, Canonical forms, Canonical form for hyperbolic, parabolic and elliptic equations, Adjoint operators, Riemann's method.(1.2, 1.3, 1.4, 1.5 of [1])

Unit- III

Fourier Series, Ellipitic Differntial Equation: Separation of variables, with Examples, Solution of Laplace equation, Dirichlet problem and Neumann problem. (2.5, 2.6, 2.7, 2.8, 2.9, 2.10 [2])

Unit- IV

Parabolic Differential Equations: Separation of variables method, Solution of Diffusion equation in cylindrical and spherical coordinates. Hyperbolic Differential Equations: D'Alembert's solution of wave equation, solution of one dimensional wave equation - separation of variables. (3.5, 3.6, 3.7, 3.8, 4.4, 4.5 of [1])

Text Book:

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

- **Fourier Analysis** by Murray R Spiegel, Schamum outline series, Mc.Graw-Hill.

References:

1. **Elements of Partial Differential Equations** by Ian Sneddon, Mc.Graw-Hill International Edition.

2. **Partial Differential Equations** by Lawrece C. Evans, American Mathematical Society.

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<div align="center">**M.Sc. Applied Mathematics**</div>

M 403   **Semester-IV**

<div align="center">## Paper-III: Numerical Analysis</div>

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.*

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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).

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