

MATHEMATICS

UNIT – I

Elementary set theory, finite, countable and uncountable sets, Real number system, supremum, infimum, Sequences and series, convergence, limsup, liminf, Bolzano Weierstrass theorem, Heine Borel theorem, Continuity, uniform continuity, differentiability, mean value theorem, Sequences and series of functions, uniform convergence, Riemann sums and Riemann integral, Improper Integrals, Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue, measure, Lebesgue integral, Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, Metric spaces, compactness, connectedness. Normed Linear Spaces. Spaces of Continuous functions as examples.

Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations, Algebra of matrices, rank and determinant of matrices, linear equations, Eigenvalues and eigenvectors, Cayley-Hamilton theorem, Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms, Inner product spaces, orthonormal basis, Quadratic forms, reduction and classification of quadratic forms.

UNIT – II

Algebra of complex numbers, the complex plane, polynomials, Power series, transcendental functions such as exponential, trigonometric and hyperbolic, functions, Analytic functions, Cauchy-Riemann equations, Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem, Taylor series, Laurent series, calculus of residues.

Permutations, combinations, pigeon-hole principle, inclusion-exclusion, principle, derangements, Fundamental theorem of arithmetic, divisibility in \mathbb{Z} , congruences, Chinese Remainder Theorem, Euler's ϕ -function, primitive roots, Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems, Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain, Polynomial rings and irreducibility criteria, Fields, finite fields, field extensions.

UNIT – III

Existence and Uniqueness of solutions of initial value problems for first order ordinary, differential equations, singular solutions of first order ODEs, system of first order ODEs, General theory of homogenous and non-homogeneous linear ODEs, variation of, parameters, Sturm-Liouville boundary value problem, Green's function. Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs, Classification of second order PDEs, General solution of higher order PDEs with, constant coefficients, Method of separation of variables for Laplace.

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson, method, Rate of convergence, Solution of systems of linear algebraic equations using, Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – IV

Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case).

Standard discrete and continuous univariate distributions. Sampling distributions. Standard errors and asymptotic distributions, distribution of order statistics and range. Methods of

estimation. Properties of estimators. Confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, Likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Best linear unbiased estimators, tests for linear hypotheses and confidence intervals. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized, randomized blocks and Latin-square designs. Connected, complete and orthogonal block designs, BIBD. 2 K factorial experiments: confounding and construction.

Linear programming problem. Simplex methods, duality. Elementary queuing and inventory models.

UNIT – V

Programming and programming language concepts, Operating systems, process management, memory management, UNIX, Shell programming, system administration, software engineering, System investigations, Programming in PASCAL – control structure, array and records, subprograms, pointers, files and sets

C Programming, Data types, operator and expressions, Decision Structure, Control structure, Union and Bit fields

System analysis, feasibility study, System design and control, Quality assurance, MIS, building a management information system, Introductory Multimedia, Microprocessor and assembly language programming, data processing through COBOL.

Database management systems, concepts, models and implementation, file organization, conventional DBMS. RDBMS and DDBMS. Relational model, SQL, Distributed databases, Object Oriented DBMS Relational Model, Client / Server Database.