

68. MATHEMATICS**DIFFERENTIAL CALCULUS: (15 Marks)**

Successive Differentiation - Expansions of Functions- Mean value theorems. Indeterminate forms - Curvature and Evolutes. Partial differentiation - Homogeneous functions - Total derivative. Maxima and Minima of functions of two variables - Lagrange's Method of multipliers - Asymptotes - Envelopes.

DIFFERENTIAL EQUATIONS: (20 Marks)

Differential Equations of first order and first degree: Exact differential equations - Integrating Factors - Change in variables - Total Differential Equations - Simultaneous

Total Differential equations - Equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. Differential Equations

first order but not first degree: Equations solvable for y - Equations solvable for x - Equations that do not contain x (or y) - Clairaut's Equation.

Higher order linear differential equations: Solution of homogeneous linear differential equations with constant coefficients - Solution of non-homogeneous differential equations $P(D)y = Q(x)$ with constant coefficients by means of polynomial operators when $Q(x) = be^{ax}, b \sin ax / b \cos ax, bx^k, Ve^{ax}$. Method of undetermined coefficients - Method of variation of parameters - Linear differential equations with non constant coefficients - The Cauchy- Euler Equation.

Partial Differential equations: Formation and solution- Equations easily integrable - Linear equations of first order - Non linear equations of first order - Charpit's method - Homogeneous linear partial differential equations with constant coefficient - Non homogeneous linear partial differential equations - Separation of variables.

REAL ANALYSIS: (18 Marks)

Sequences: Limits of Sequences - A Discussion about Proofs - Limit Theorems for Sequences - Monotone Sequences and Cauchy Sequences. Subsequences - Lim sup's and Lim inf's - Series - Alternating Series and Integral Tests. **Sequences and Series of Functions:** Power Series - Uniform Convergence - More on Uniform Convergence - Differentiation and Integration of Power Series.

Integration: The Riemann Integral - Properties of Riemann Integral - Fundamental Theorem of Calculus.

ALGEBRA: (17 Marks)

Groups: Definition and Examples of Groups- Elementary Properties of Groups - Finite Groups; Subgroups -Terminology and Notation -Subgroup Tests - Examples of Subgroups **Cyclic Groups:**Properties of Cyclic Groups - Classification of Subgroups Cyclic Groups - **Permutation Groups:** Definition and Notation - Cycle Notation - Properties of Permutations - A Check Digit Scheme Based on D_5 . **Isomorphisms:** Motivation - Definition and Examples - Cayley's Theorem Properties of Isomorphisms - Automorphisms - Cosets and Lagrange's Theorem Properties of Cosets 138 - Lagrange's Theorem and Consequences - An Application of Cosets to Permutation Groups - The Rotation Group of a Cube and a Soccer Ball - Normal Subgroups and Factor Groups ; Normal Subgroups - Factor Groups - Applications of Factor Groups - Group Homomorphisms - Definition and Examples - Properties of Homomorphisms - The First

Isomorphism Theorem.

Introduction to Rings: Motivation and Definition - Examples of Rings - Properties of Rings – Subrings - **Integral Domains:** Definition and Examples –Characteristics of a Ring - Ideals and Factor Rings; Ideals - Factor Rings - Prime Ideals and Maximal Ideals.

Ring Homomorphisms: Definition and Examples - Properties of Ring – Homomorphisms - The Field of Quotients Polynomial Rings: Notation and Terminology.

LINEAR ALGEBRA: (15 Marks)

Vector Spaces: Vector Spaces and Subspaces - Null Spaces, Column Spaces, and Linear Transformations - Linearly Independent Sets; Bases - Coordinate Systems - The Dimension of a Vector Space.

Rank-Change of Basis - Eigen values and Eigenvectors - The Characteristic Equation.

Diagonalization - Eigenvectors and Linear Transformations - Complex Eigenvalues - Applications to Differential Equations - **Orthogonality and Least Squares:** Inner Product, Length, and Orthogonality - Orthogonal Sets.

NUMERICAL ANALYSIS: (15 Marks)

Solutions of Equations in One Variable: The Bisection Method - Fixed-Point Iteration - Newton's Method and Its Extensions - Error Analysis for Iterative Methods - Accelerating Convergence - Zeros of Polynomials and Müller's Method - Survey of Methods and Software.

Interpolation and Polynomial Approximation: Interpolation and the Lagrange Polynomial - Data Approximation and Neville's Method - Divided Differences - Hermite Interpolation - Cubic Spline Interpolation.

Numerical Differentiation and Integration: Numerical Differentiation - Richardson's Extrapolation - Elements of Numerical Integration - Composite Numerical Integration – Romberg Integration - Adaptive Quadrature Methods - Gaussian Quadrature.

Texts:

- Shanti Narayan and Mittal, Differential Calculus
- Zafar Ahsan, Differential Equations and Their Applications
- Kenneth A Ross, Elementary Analysis-The Theory of Calculus
- Joseph A Gallian, Contemporary Abstract algebra (9th edition)
- David C Lay, Linear Algebra and its Applications 4e
- Richard L. Burden and J. Douglas Faires, Numerical Analysis (9e)