

## 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  $P dx + Q dy + R dz = 0$ . 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

$Q(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_0$ ,  $b \sin ax$ ,  $b \cos ax$ ,  $b x^k$ ,  $V e^{ax}$ . 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 -  $\limsup$ 's and  $\liminf$ '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 CPGET-2020 Syllabus

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)