

UNIT-I

1. ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE

Differential Equation, Order and Degree of Differential Equation, Solutions of Differential Equations, Kind of Solutions, Equitation of the First Order and First Degree, Equations in Which the Variables are Separable, Homogeneous Equations, Equations Reducible to a Homogeneous Form, Linear Equations, Solution of Linear Equations, Differential Equations Reducible to the Linear Form (Bernoulli's Equation), Exact differential equation, Integrating Factors, Some Rules for Finding Integrating Factors of Equation, Illustrative Examples, Exercise.

2. LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS

Linear Differential Equations, Solution of the Linear Equation with Constant Coefficients, Auxiliary Equations, Auxiliary equation Having Equal Roots, Auxiliary Equation Having Complex Roots, The differential equation of the type,

Particular Integral, To show that $\frac{1}{D-\alpha}Q = e^{\alpha x} \int e^{-\alpha x} Q dx$, To

evaluate $\frac{1}{f(D)}e^{ax}$, where, To evaluate

$\frac{1}{f(D)} \sin ax$, where $f(D) \equiv P_0 D^n + P_1 D^{n-1} + \dots + P_n$., To evaluate $\frac{1}{f(D)} x^m$, where m is a positive integer and, To evaluate $\frac{1}{f(D)} e^{ax} V$, where V is any function of x and, To Evaluate $\frac{1}{f(D)} e^{ax}$, when $f(D) = 0$., To evaluate $\frac{1}{f(D^2)} \sin ax$ or $\cos ax$, when $f(-a^2) = 0$., To Evaluate $\frac{1}{f(D)} x^V$ where V is any Function of x Except e^{ax} ., Miscellaneous Illustrative Examples, Illustrative Examples, Exercise.

3. SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS

Simultaneous Differential Equations, The Equations of the Type, The General Expression of Integrals, Geometrical Meaning of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Illustrative Examples, Exercise.

4. SECOND ORDER DIFFERENTIAL EQUATIONS

Linear Equations of Second Order, The Complete Solution in Terms of A Known Integral, Method of removal of the First Derivative (Reduction of Normal Form), Transformation of the Equation by Changing the Independent Variable, Operational Method, Selection of an Appropriate Method to Solve Linear Differential Equations of Second Order, Illustrative Examples, Exercise.

5. APPLICATIONS OF DIFFERENTIAL EQUATIONS

Physical Applications, Electrical Circuits, A Horizontal Elastic String, Vertical Elastic String, Mass on a Spring, Motion Under Inverse Square Law in A Straight Line, Particle Falling Under an Attraction Due to Earth, Forced Oscillations, Beam Clamped at One End and Loaded at the Other (Cantilever), Electrical Oscillations, Illustrative Examples, Exercise.

UNIT-II

6. SERIES SOLUTIONS OF LINEAR DIFFERENTIAL EQUATIONS

Introduction, Method of Frobenius, Roots of Indicial Equation Unequal, Differing by an Integer and Making a Coefficient of y Indeterminate, Roots of Indicial Equation Unequal, Differing by an Integer and Making a Coefficient of y Infinite, Illustrative Examples, Exercise

7. LEGENDRE'S POLYNOMIALS AND FUNCTIONS

Legendre's Equations (Definition), Legendre's Function of the First or Legendre's Polynomial Degree, General Solution of Legendre's Equation, Laplace's Second Integral for $P_n(x)$: When n is a Positive Integer, Orthogonal Properties of Legendre's Polynomials, Rodrigue's Formula, Even and Odd Functions, Illustrative Examples, Exercise.

8. BESSEL FUNCTIONS

Bessel's Equation, Solution of Bessel's Differential Equation, General Solution of Bessel's Equation, Integration of Bessel's Equation in Series for $n = 0$, Recurrence Formulae of $J_n(x)$, Show that when n is, Generating Function for $J_n(x)$, Trigonometric Expansions Involving Bessel's Function, Illustrative Example, Exercise.

UNIT-III

9. THE LAPLACE TRANSFORMS

Introduction, Piece-wise or Sectionally Continuous Functions, Functions of Exponential Order, Function of Class A, The Transform Concept, Laplace Transform (Definition), Notation, Existence of Laplace Transform, Laplace Transforms of Elementary Functions, Linearity Property of Laplace Transforms, First Translation or Shifting Property, Second Translation or Heaviside's Shifting Theorem, Change of Scale Property, Laplace Transforms of Derivatives, Laplace Transform of Tenth Order Derivative of $F(t)$, Derivative of Laplace Transforms, Laplace Transform of Integrals, Periodic Functions, Initial-value Theorem, Final Value Theorem, Laplace Transform of the Laplace Transform, Laplace Transform of Some Special Functions, Illustrative Examples, Exercise.

10. THE INVERSE LAPLACE TRANSFORM

Inverse Laplace Transform (Definition), Uniqueness of Inverse Laplace Transforms, Table of Inverse Laplace Transforms, Linearity Property, First Translation of Shifting Theorem, Second Translation or Shifting Theorem, Change of Scale Property, Use of Partial Fractions, Inverse Laplace Transform of Derivatives, Division by p , Multiplication by Power of s , Inverse Laplace Transform of Integrals, Convolution (Definition), Convolution Theorem, Table of Inverse Laplace Transform Theorems, The Heaviside Expansion Formula, Miscellaneous Illustrative Examples, Illustrative Examples, Exercise.

11. APPLICATION OF LAPLACE TRANSFORM TO SOLUTION OF DIFFERENTIAL EQUATIONS

Solution of Ordinary Differential Equation with Constant Coefficients, Solution of Ordinary Differential Equations with Variable Coefficients, Solution of Simultaneous Ordinary Differential Equations, Solution of Partial Differential Equations, Illustrative Examples, Exercise.

UNIT-IV

12. FOURIER'S SERIES

Periodic Functions, Fourier's Theorem, Limitations, Evaluation of Fourier Coefficients, A Fourier Theorem, Even and Odd Functions, Half-Range Series, Cosine Series, Sine Series, Change of Interval, Change of Period, Complex Form of Fourier Series, Properties of Fourier Series,

13. PARTIAL DIFFERENTIAL EQUATIONS OF THE FIRST ORDER

Introduction, Derivation of a Partial Differential Equation, The Complete and Particular Integrals, The Singular Integral, The General Integral, To Solve Lagrange's

Equation, Lagrange's Solution of the Linear Equation, Some Special Types of Equations, Standard I, Standard II, Standard III, Standard IV, General Method of Solution, Illustrative Examples, Exercise.

14. LINEAR PARTIAL DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS

Definitions, Notations, Solution Linear Partial Differential Equation, Linear Homogeneous Partial Differential Equation with Constant Coefficients, Non-Homogeneous Linear Partial Differential Equation with Constants Coefficients, Complementary Function of a Homogeneous Equation with Constant Coefficients, If the Auxiliary Equation has Equal Roots, The Particular Integral, Shorter Method for Finding Particular Integral, Particular Case when $F(a,b) = 0$, General Method for P.I. The Non-Homogeneous Equations with Constant Coefficients, The Particular Integral, Equations Reducible to Homogeneous Linear Form, Case When Linear Factors are not Possible, Illustrative Examples, Exercise.

UNIT-V

15. SEPARATION OF VARIABLE METHOD

Classification of Linear Partial Differential Equations of Second, Nature of the Differential Equation, Classification of the "PDF" of Second Order, Boundary Value Problem, Method of Separation of Variables or Product Method, The Principle of Superposition, Notations, Heat (Diffusion), Wave and Laplace Equations in Cartesian Co-ordinates, Solution of One-Dimensional Heat (Diffusion) Equations, Solution of the Two Dimensional Heat (Diffusion) Equation, Solution of Three Dimensional Heat (Diffusion) Equation, Solution of One-Dimensional Wave Equation, D'Alembert's Solution of Wave Equation, Solution of Two-Dimensional Wave Equation, Solution of Two-Dimensional Laplace's Equation, Solution of Three-Dimensional Laplace's Equation, Solution of the Two-Dimensional Laplace's Equation in Plane Polar Coordinates, Solution of Boundary Value Problems in Cylindrical Coordinates, Fourier-Bessel Series, Solution of Laplace's Equation in Cylindrical Coordinates, Solution of Heat (Diffusion) Equation, Solution of Wave Equations, Solution of Laplace's Equation in Spherical Coordinates, Solution of Heat (Diffusion) Equation in Spherical Polar Coordinates, Illustrative Examples, Exercise.

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