



Unit I

**Syllabus :** Exact differential equations, Equations reducible to exact form. Linear differential equations, Equations reducible to linear form, Bernoulli's equation.

## Chapter 1 : Differential Equations

1-11 to 1-79

- |        |   |      |
|--------|---|------|
| 1.1    | Introduction .....  | 1-1  |
| 1.2    | Differential Equations.....   | 1-1  |
| 1.2.1  | Order and Degree of a Differential Equation .....   | 1-1  |
| 1.3    | Formation of a Differential Equation.....   | 1-2  |
| 1.4    | Solved Examples on Formation of<br>Differential Equation .....                                    | 1-2  |
| 1.5    | Differential Equation of the First Order and<br>First Degree .....                                | 1-9  |
| 1.6    | Variable Separable Form .....   | 1-10 |
| 1.6.1  | Solved Examples on Variable Separable Form.....   | 1-10 |
| 1.7    | Differential Equations Reducible to Variable<br>Separable Form by using Substitution.....         | 1-14 |
| 1.7.1  | Solved Examples on V.S. Form Using<br>Substitutions .....   | 1-14 |
| 1.8    | Homogeneous Differential Equations .....  | 1-22 |
| 1.8.1  | Solved Examples on Homogeneous<br>Differential Equations.....                                     | 1-23 |
| 1.9    | Non-Homogeneous Differential Equations .....  | 1-27 |
| 1.9.1  | Solved Examples on Non-Homogeneous Differential<br>Equations.....                                 | 1-29 |
| 1.10   | Linear Differential Equations of First Order .....  | 1-35 |
| 1.10.1 | Solved Examples on Linear Differential<br>Equations.....  | 1-36 |
| 1.11   | Equations Reducible to Linear Differential Equations<br>OR Bernoulli's Differential Equation..... | 1-41 |
| 1.11.1 | Solved Examples on Equations Reducible to<br>Linear Form.....                                     | 1-42 |
| 1.12   | Exact Differential Equations .....  | 1-54 |
| 1.12.1 | Solved Examples on Exact Differential<br>Equations.....   | 1-55 |
| 1.13   | Non-Exact Differential Equations Reducible to<br>Exact Form .....                                 | 1-60 |
| 1.13.1 | Solved Examples on Non-Exact Differential<br>Equations.....                                       | 1-61 |
| 1.14   | Transformation to Polar Co-ordinates .....  | 1-74 |
| 1.14.1 | Solved Examples on Transformation to<br>Polar Co-ordinates .....                                  | 1-75 |

UNIT II

**Syllabus :** Applications of Differential Equations to Orthogonal Trajectories, Newton's Law of Cooling, Kirchhoff's Law of Electrical Circuits, Rectilinear Motion, Simple Harmonic Motion, One dimensional Conduction of Heat.

## **Chapter 2 : Applications of Differential Equations**

2-1 to 2-54

- |       |   |      |
|-------|---|------|
| 2.1   | Newton's Law of Cooling.....  | 2-1  |
| 2.2   | One Dimensional Conduction of Heat or<br>Heat Flow .....                                  | 2-7  |
| 2.2.1 | Fourier's Law of Heat Conduction .....  | 2-7  |
| 2.3   | Simple Electric Circuits .....  | 2-15 |
| 2.3.1 | Introduction.....   | 2-15 |
| 2.3.2 | Differential Equations for Electrical Circuit .....                                       | 2-15 |
| 2.4   | Orthogonal Trajectories.....  | 2-29 |
| 2.4.1 | Introduction.....   | 2-29 |
| 2.4.2 | Working Rule to find orthogonal Trajectories of<br>Cartesian (x, y) co-ordinates.....     | 2-29 |
| 2.4.3 | Working Rule to Find Orthogonal Trajectories of<br>Polar (r, $\theta$ ) Co-ordinates..... | 2-29 |
| 2.5   | Rectilinear Motion.....   | 2-34 |
| 2.6   | Simple Harmonic Motion .....  | 2-49 |
| 2.7   | Solved Examples on Simple Harmonic Motion.....  | 2-50 |

UNIT II

**Syllabus :** A Reduction Formulae, Beta and Gamma functions, Differentiation Under Integral Sign and Error functions.

**Chapter 3 : Reduction Formulae, Gamma and Beta Function**      **3-1 to 3-10**

3-1 to 3-57

- |       |   |      |
|-------|---|------|
| 3.1   | Introduction.....   | 3-1  |
| 3.2   | Reduction Formulae.....   | 3-1  |
| 3.2.1 | Reduction Formulae of Some Standard Functions....   | 3-1  |
| 3.2.2 | Conversion Formulae.....  | 3-3  |
| 3.3   | Type 1 : Solved Examples Based on Substitution<br>and Properties of Definite Integrals..... | 3-5  |
| 3.4   | Type 2 : Solved Examples on Relation Connecting<br>$I_n$ , $I_{n-1}$ , $I_{n-2}$ .....      | 3-13 |
| 3.5   | Gamma Functions .....   | 3-28 |
| 3.5.1 | Properties of Gamma Functions.....  | 3-29 |
| 3.6   | Solved Examples of the type $\int_0^{\infty} e^{-ax^n} dx$ .....                            | 3-30 |



3.7      Solved Examples of the type $\int_0^1 \log\left(\frac{1}{x}\right) dx$ and $\int_0^1 \log(x) dx$ ..... 3-35
---

3.8      Solved Examples of the type $\int_0^\infty \frac{dx}{a^x}$ ..... 3-39
--

3.9      Beta Functions ..... 3-42
------------------------------------

3.9.1    Properties of Beta Functions ..... 3-42
--

3.10     Solved Examples on Beta Functions ..... 3-42
---

**Chapter 4 : Differentiation Under the Integral Sign (DUIS) and Error Functions 4-1 to 4-18**

4.1      Introduction to DUIS ..... 4-1
---

4.1.2    Rule - I : Integral with Constant Limits ..... 4-1
---

4.2      Solved Examples on DUIS Rule - I ..... 4-1
---

4.3      Rule - II : Integral with Limits as Functions of the Parameter ..... 4-10
--

4.4      Solved Examples Rule - II of DUIS ..... 4-10
---

4.5      Error Functions ..... 4-12
-------------------------------------

4.5.1    Properties of Error Functions ..... 4-13
---

4.6      Solved Examples on Error Functions ..... 4-13
--

**UNIT IV**

<b>Syllabus :</b> Tracing of Curves - Cartesian, Polar and Parametric curves, Rectification of curves.
--

**Chapter 5 : Curve Tracing 5-1 to 5-45**

5.1      Introduction ..... 5-1
---------------------------------

5.2      Curves given by Cartesian Equations ..... 5-1
--

5.3      Type 1 : Solved Examples on Curves given by Cartesian Curves : (Explicit Relations) ..... 5-3
--

5.4      Type 2 : Solved Examples on Curves given by Cartesian Co-ordinates : (Implicit Relations) ..... 5-19
---

5.5      Curves given by Polar Co-ordinates ..... 5-24
--

5.6      Type 3: Solved Examples on Curves given by Polar Co-ordinates ..... 5-25
---

5.7      Curves given by Polar Co-ordinates of the type $r = a \sin n\theta$ or $r = a \cos n\theta$ (Rose Curves) ..... 5-33
---

5.8      Type 4 : Solved Examples on Rose Curves ..... 5-33
---

5.9      Curves given by Parametric Equations ..... 5-39
--

5.10     Type 5 : Solved Examples on Curves given by Parametric Equations ..... 5-40
--

**Chapter 6 : Rectification of Curves 6-1 to 6-13**

6.1      Introduction ..... 6-1
---------------------------------

6.2      Solved Example on Rectification of Curves ..... 6-1
--

**UNIT V**

<b>Syllabus :</b> Cartesian, Spherical polar and Cylindrical coordinate systems, Sphere, Cone and Cylinder.
---

**Chapter 7 : Sphere**

**7-1 to 7-27**

7.1      Definition of Sphere ..... 7-1
---

7.2      Equation of Sphere in Different Forms ..... 7-1
--

7.3      Type 1 : Solved Examples on Different Forms of Sphere and Concept of Locus ..... 7-1
---

7.4      Equation of the Tangent Plane ..... 7-11
---

7.5      Type 2 : Solved Examples on Tangent Plane ..... 7-12
---

7.6      Section of a Sphere by a Plane ..... 7-17
--

7.7      Type 2 : Solved Examples on Circle ..... 7-17
--

**Chapter 8 : Cone and Cylinder**

**8-1 to 8-40**

8.1      A Cone ..... 8-1
---------------------------

8.1.1    Oblique Circular Cone ..... 8-1
--

8.1.2    Right Circular Cone ..... 8-1
--

8.1.3    Angle between Two Lines ..... 8-2
--

8.2      Solved Examples on Right Circular Cone ..... 8-2
---

8.3      Cylinder ..... 8-23
------------------------------

8.3.1    Right Circular Cylinder ..... 8-23
---

8.3.2    Projection of segment of a Line ..... 8-23
---

8.4      Solved Examples on Cylinder ..... 8-23
---

**UNIT VI**

<b>Syllabus :</b> Double and Triple integrations, Change of order of integration, Applications to find Area, Volume, Mass, Centre of Gravity and Moment of Inertia.
---

**Chapter 9 : Double Integration and Area**

**8-1 to 8-47**

9.1      Introduction ..... 9-1
---------------------------------

9.2      Double Integration ..... 9-1
---------------------------------------

9.3      Type 1 : Solved Examples on Direct Evaluation of Double Integrals ..... 9-1
--

9.4      Type 2 : Double Integration When Limits of Integration are not Provided ..... 9-5
--

9.4.1    Strip ..... 9-5
--------------------------

9.4.2    Vertical Strip ..... 9-5
-----------------------------------

9.4.3    Horizontal Strip ..... 9-5
-------------------------------------

9.5      Solved Examples on Double Integration When Limits of Integration are not Provided ..... 9-5
--

9.6      Conversion of Cartesian (x, y) Double Integral to Polar (r, θ) Double Integral ..... 9-17
--

