

**UNIT I**

**Chapter 1 : Matrices 1-1 to 1-47**

1.1	Introduction.....	1-1
1.2	Definition of a Matrix.....	1-1
1.3	Types of Matrices .....	1-1
1.3.1	Row matrix or Row Vector.....	1-1
1.3.2	Column Matrix or Column Vector .....	1-2
1.3.3	Rectangular Matrix .....	1-2
1.3.4	Square Matrix .....	1-2
1.3.5	Diagonal Matrix.....	1-2
1.3.6	Trace of Matrix.....	1-2
1.3.7	Determinant of the Matrix .....	1-2
1.3.8	Singular Matrix and Non Singular Matrix.....	1-2
1.3.9	Null Matrix or Zero Matrix .....	1-3
1.3.10	Unit (Identity) Matrix .....	1-3
1.3.11	Scalar Matrix.....	1-3
1.3.12	Transpose of a Matrix.....	1-3
1.3.13	Upper Triangular Matrix.....	1-3
1.3.14	Lower Triangular Matrix.....	1-3
1.3.15	Triangular Matrix.....	1-3
1.3.16	Conjugate of a Matrix .....	1-3
1.3.17	Transposed Conjugate of a Matrix .....	1-4
1.3.18	Symmetric Matrix.....	1-4
1.3.19	Skew-Symmetric Matrix.....	1-4
1.3.20	Hermitian Matrix .....	1-5
1.3.21	Skew – Hermitian .....	1-5
1.4	Operations of Matrices .....	1-5
1.4.1	Equality of Two Matrices .....	1-5
1.4.2	Addition of Matrices.....	1-5
1.4.3	Subtraction of Matrices.....	1-5
1.4.4	Scalar Multiplication .....	1-6
1.4.5	Multiplication of Matrices OR Product of Two Matrices .....	1-6
1.4.6	Power of Matrix.....	1-6
✓	<b>Syllabus Topic</b> : Properties of Matrices.....	1-6
1.5	Properties of Matrices.....	1-6
✓	<b>Syllabus Topic</b> : Inverse of Matrix .....	1-9
1.6	Inverse of A Matrix.....	1-9
1.6.1	Minor of an Element of Determinant.....	1-9
1.6.2	Cofactor of an Element.....	1-9
1.6.3	Adjoint of a Matrix.....	1-9
1.7	Orthogonal Transformation .....	1-11
1.8	Unitary Matrix .....	1-12
✓	<b>Syllabus Topic</b> : Elementary Transformation .....	1-13
1.9	Elementary Transformations .....	1-13
1.9.1	Equivalent Matrix.....	1-13
1.10	Elementary Matrices.....	1-13
✓	<b>Syllabus Topic</b> : Rank of Matrix.....	1-14
1.11	Rank of Matrix .....	1-14
✓	<b>Syllabus Topic</b> : Echelon or Normal Matrix .....	1-14
1.12	Echelon form of Matrix.....	1-14
1.13	Normal Form or First Canonical Form of a Matrix.....	1-15
1.13.1	Definition.....	1-15
1.13.2	Steps to Find Normal Form of a Matrix .....	1-15
1.14	Reduction of a Matrix A to Normal form PAQ .....	1-19

✓	<b>Syllabus Topic</b> : Linear Equation .....	1-24
1.15	Linear Equations .....	1-24
1.16	Homogeneous Linear Equations .....	1-31
✓	<b>Syllabus Topic</b> : Linear Dependence and Linear independence of vectors.....	1-38
1.17	Vectors.....	1-38
✓	<b>Syllabus Topic</b> : Characteristic Values and Characteristic Vectors.....	1-43
1.18	Eigen values and Eigen Vectors.....	1-43
✓	<b>Syllabus Topic</b> : Cayley - Hamilton Theorem .....	1-45
1.19	Cayley - Hamilton Theorem .....	1-45
✓	<b>Syllabus Topic</b> : Reduction of Matrix to a Diagonal Matrix.....	1-46
1.20	Reduction of Matrix to a Diagonal Matrix.....	1-46
✓	<b>Syllabus Topic</b> : Similarity of Matrices .....	1-47
1.21	Similarity of Matrices.....	1-47

**Chapter 2 : Complex Numbers 2-1 to 2-31**

✓	<b>Syllabus Topic</b> : Complex Number .....	2-1
2.1	Standard Form of Complex Number.....	2-1
2.1.1	Conjugate of a Complex Number .....	2-2
2.1.2	Algebra of Complex Numbers.....	2-2
✓	<b>Syllabus Topic</b> : Equality of Complex Number .....	2-4
2.2	Equality of Complex Numbers .....	2-4
✓	<b>Syllabus Topic</b> : Graphical Representation of Complex Number (Argand's Diagram).....	2-5
2.3	Graphical Representation of Complex Number (Argand's Diagram).....	2-5
✓	<b>Syllabus Topic</b> : Mathematical Operation with Complex Numbers and their Representation on Argand's Diagram .....	2-5
2.3.1	Mathematical Operation with Complex Numbers and their Representation on Argand's Diagram.....	2-5
✓	<b>Syllabus Topic</b> : Polar Form of the Complex Number.....	2-6
2.4	Polar Form of the Complex Number.....	2-6
✓	<b>Syllabus Topic</b> : Polar Form of $x + iy$ for Different Sign of $x, y$ .....	2-8
2.4.1	Polar Form of $x + iy$ for Different Signs of $x, y$ .....	2-8
2.4.2	Multiplication of Complex Numbers in Polar Form .....	2-11
2.4.3	Division of Complex Numbers In Polar Form.....	2-11
✓	<b>Syllabus Topic</b> : Exponential Form of Complex Number.....	2-12
2.5	Exponential Form of the Complex Number.....	2-12
2.6	Complex Numbers as Vectors .....	2-12
2.7	De-Moivre's Theorem .....	2-14
2.7.1	De-Moivre's Theorem and its Corollaries .....	2-15
2.7.2	Expression of $\sin n\theta, \cos n\theta$ in Powers of $\sin \theta, \cos \theta$ .....	2-19
2.7.3	Expansion of $\sin n\theta, \cos n\theta$ in Terms of sines and cosines of Multiples of $\theta$ .....	2-20
2.8	Roots of the Complex Numbers.....	2-20

✓	<b>Syllabus Topic</b> : Circular Functions of Complex Angles.....	2-22
2.9	Circular Functions of Complex Numbers.....	2-22
✓	<b>Syllabus Topic</b> : Definition of Hyperbolic Function.....	2-24
2.10	Hyperbolic Functions.....	2-24
✓	<b>Syllabus Topic</b> : Relation between Circular and Hyperbolic Function.....	2-24
2.10.1	Relation between Circular and Hyperbolic Functions.....	2-24
✓	<b>Syllabus Topic</b> : Differentiations and Integration.....	2-25
2.10.2	Differentiation and Integration of Hyperbolic Functions.....	2-25
✓	<b>Syllabus Topic</b> : Graphs of Hyperbolic Function.....	2-25
2.10.3	Graphs of Hyperbolic Functions.....	2-25
✓	<b>Syllabus Topic</b> : Inverse Hyperbolic Function.....	2-27
2.10.4	Inverse Hyperbolic Functions.....	2-27
✓	<b>Syllabus Topic</b> : Logarithms of complex quality, $j(=i)$ as an operator (Electrical Circuits).....	2-29
2.11	Logarithms of Complex Number.....	2-29

**UNIT II**

**Chapter 3 : Equation of the First Order and of the First Degree 3-1 to 3-14**

✓	<b>Syllabus Topic</b> : Separation of Variables.....	3-1
3.1	Separation of Variables.....	3-1
✓	<b>Syllabus Topic</b> : Equations Homogeneous in x and y.....	3-2
3.2	Equations Homogeneous in x and y.....	3-2
✓	<b>Syllabus Topic</b> : Non Homogeneous Linear Differential Equations.....	3-4
3.3	Non - Homogeneous Linear Differential Equations.....	3-4
✓	<b>Syllabus Topic</b> : Exact Differential Equations.....	3-6
3.4	Exact Differential Equations.....	3-6
✓	<b>Syllabus Topic</b> : Integrating Factor (I.F).....	3-7
3.5	Integrating Factor (I.F).....	3-7
✓	<b>Syllabus Topic</b> : Linear Equations.....	3-11
3.6	Linear Equations.....	3-11
✓	<b>Syllabus Topic</b> : Equation Reducible to this Form (Bernoulli's Differential Equation).....	3-13
3.6.1	Equation Reducible to this Form (Bernoulli's Differential Equation).....	3-13

**Chapter 4 : Differential Equation of the First Order of a Degree Higher than the First 4-1 to 4-8**

✓	<b>Syllabus Topic</b> : Introduction.....	4-1
4.1	Introduction.....	4-1
✓	<b>Syllabus Topic</b> : Solvable for p (or the Methods of Factors).....	4-1
4.2	Equation Solvable for p.....	4-1
✓	<b>Syllabus Topic</b> : Solve for x.....	4-4
4.3	Equations Solvable for x.....	4-4
✓	<b>Syllabus Topic</b> : Solve for y.....	4-5
4.4	Equations Solvable for y.....	4-5
✓	<b>Syllabus Topic</b> : Clairaut's Form of Equation.....	4-6
4.5	Clairaut's Equation.....	4-6

✓	<b>Syllabus Topic</b> : Methods of Substitution.....	4-7
4.6	Equation Reducible to Clairaut's form.....	4-7

**Chapter 5 : Linear Differential Equations with Constant Coefficients 5-1 to 5-28**

✓	<b>Syllabus Topic</b> : Introduction.....	5-1
5.1	Introduction.....	5-1
✓	<b>Syllabus Topic</b> : Differential Operator.....	5-2
5.2	The Differential Operator.....	5-2
5.2.1	Complete (General) Solution of the Differential Equation (D.E.).....	5-2
✓	<b>Syllabus Topic</b> : Linear Differential Equation $f(D)y = 0, f(D)y = x$ .....	5-2
5.3	Linear Differential Equation.....	5-2
5.3.1	Linear Differential Equations with Constant Coefficients.....	5-2
✓	<b>Syllabus Topic</b> : The Complimentary Function (C.F.).....	5-4
5.4	Method to find Complimentary Function (C.F.).....	5-4
✓	<b>Syllabus Topic</b> : The Inverse Operator and the Symbolic Expiration for the a Particular Integral $1/f(D)X$ ;.....	5-5
5.5	Methods to find Particular Integral (P.I.).....	5-5
5.5.1	Particular Integral (P.I.).....	5-5
✓	<b>Syllabus Topic</b> : General Method.....	5-5
5.5.2	General Method to find Particular Integral (P.I.).....	5-5
✓	<b>Syllabus Topic</b> : Particular Integral : Short Methods..	5-7
5.5.3	Short Methods to find P.I. (Particular Integral).....	5-7
✓	<b>Syllabus Topic</b> : Particular Integral : Other Method.	5-18
5.6	Method of variation of parameters.....	5-18
5.6.1	Method (A).....	5-18
5.6.2	Method (B).....	5-18
5.6.3	Solved Problems.....	5-19
5.7	Differential Equation of the Form $\frac{d^2y}{dx^2} = f(x)$ .....	5-19
5.7.1	Differential Equation of the form $\frac{d^2x}{dt^2} = f(y)$ .....	5-20
✓	<b>Syllabus Topic</b> : Differential Equations Reducible to the Linear Differential Equations with Constant Coefficients.....	5-21
5.8	Equations Reducible to Linear Differential Equations with Constant Coefficients.....	5-21
5.8.1	Cauchy's or Euler's Homogeneous Linear Differential Equations.....	5-21
5.8.2	Legendre's Linear Differential Equation.....	5-23
5.8.3	Simultaneous Linear Equations with Constant Coefficients.....	5-25

**UNIT III**

**Chapter 6 : The Laplace Transform 6-1 to 6-17**

✓	<b>Syllabus Topic</b> : Introduction.....	6-1
6.1	Introduction.....	6-1
6.1.1	Prerequisite.....	6-1
✓	<b>Syllabus Topic</b> : Definition of the Laplace Transform.....	6-1
6.2	Definition of Laplace Transform.....	6-1
6.2.1	Existence Condition.....	6-2
✓	<b>Syllabus Topic</b> : Table of Elementary Laplace Transform.....	6-2



✓	<b>Syllabus Topic</b> : Theorems on Important Properties of Laplace Transformation, First Shifting Theorem, Second Shifting Theorem, The Convolution Theorem .....6-4
6.4	Properties of Laplace Transform .....6-4
✓	<b>Syllabus Topic</b> : Laplace Transform of an Integral .....6-14
6.5	Evaluation of Integrals by using Laplace Transform .....6-14
✓	<b>Syllabus Topic</b> : Laplace Transform of Derivatives .....6-15
6.6	Laplace Transform of derivatives .....6-15
6.6.1	Laplace Transform of the Differential Equation .....6-15

### Chapter 7 : Inverse Laplace Transform 7-1 to 7-17

7.1	Inverse Laplace Transforms .....7-1
✓	<b>Syllabus Topic</b> : Shifting Theorem .....7-1
7.2	Shifting Theorem .....7-1
✓	<b>Syllabus Topic</b> : Partial Fraction Methods .....7-4
7.3	Partial Fraction Methods .....7-4
✓	<b>Syllabus Topic</b> : Use of Convolution Theorem .....7-7
7.4	Convolution Theorem .....7-7
✓	<b>Syllabus Topic</b> : Laplace Transform of Special Functions, Periodic Function, Heaviside Unit Step Function, Dirac – delta Function (Unit Impulse Function) .....7-9
7.5	Laplace Transform of Special Functions .....7-9
✓	<b>Syllabus Topic</b> : Solution of Ordinary Linear Differential Equation with Constant Coefficients, Solution of Simultaneous Ordinary Differential Equation .....7-12
7.6	Solution to the Differential Equation using Laplace Transform Method .....7-12

### UNIT IV

### Chapter 8 : Multiple Integrals 8-1 to 8-21

8.1	Introduction .....8-1
✓	<b>Syllabus Topic</b> : Double Integral .....8-1
8.2	Definition .....8-1
8.2.1	Solved Examples on Double Integrals .....8-1
✓	<b>Syllabus Topic</b> : Change of the Order of Integration .....8-3
8.3	Evaluation of Double Integral by Changing the Order of Integration .....8-3
✓	<b>Syllabus Topic</b> : Double Integral in Polar Co-Ordinates .....8-8
8.4	Double Integral in Polar Co-Ordinates .....8-8
8.4.1	Evaluation of Double Integral .....8-8

✓	<b>Syllabus Topic</b> : Triple Integrals .....8-17
8.5	Triple Integrals .....8-17
8.5.1	Solved Examples .....8-18

### Chapter 9 : Applications of Integration 9-1 to 9-12

9.1	Introduction .....9-1
✓	<b>Syllabus Topic</b> : Area .....9-1
9.2	Area Enclosed by Plane Curves .....9-1
9.2.1	Areas of Cartesian Curves .....9-1
9.2.2	Areas of Polar Curves .....9-2
✓	<b>Syllabus Topic</b> : Volume of Solids .....9-8
9.3	Volumes of Solids .....9-8

### UNIT V

### Chapter 10 : Beta and Gamma Functions 10-1 to 10-17

10.1	Introduction .....10-1
✓	<b>Syllabus Topic</b> : Definition, Properties and Problems .....10-1
10.2	Definition : Beta and Gamma Function .....10-1
10.2.1	Gama Function .....10-1
10.2.2	Beta Function .....10-1
10.2.3	Properties of Beta and Gamma Functions .....10-1
10.2.4	Solved Problems .....10-4
✓	<b>Syllabus Topic</b> : Duplication Formula .....10-16
10.3	Duplication Formula .....10-16

### Chapter 11 : Differentiation Under Integral Sign

11-1 to 11-17

✓	<b>Syllabus Topic</b> : Differentiation Under Integral sign .....11-1
11.1	Introduction .....11-1
11.2	Steps to be followed to Evaluate the Integral .....11-1
11.3	Examples .....11-2
11.4	Leibnitz Theorem for DUIS .....11-14

### Chapter 12 : Error Functions 12-1 to 12-7

✓	<b>Syllabus Topic</b> : Error Functions .....12-1
12.1	Introduction .....12-1
12.2	Definitions of Error Functions .....12-1
12.3	Properties of Error Functions .....12-1
12.4	Solved Examples .....12-3
•	<b>Model Question Papers</b> .....M-1 to M-6
•	<b>Appendix A : Solved University Question Paper of Oct. 2017</b> .....A-1 to A-8