

# Contents

Preface

..... (v)

## Unit – I

### Recapitulation of Mathematics

#### Chapter – 1: Basics of Differentiation

1.1	Introduction .....	3
1.2	Differential Coefficient of a Function at a Point .....	3
1.3	Differentiation from First Principle.....	4
1.4	Differential Coefficient of a Function of Function .....	6
1.5	Differential Coefficient of Inverse Trigonometric Functions or Trigonometrical Transformation.....	7
1.6	Differentiation of Implicit Functions.....	10
1.7	Logarithmic Differentiation .....	11
1.8	Differentiation of Parametric Equation .....	11
1.9	Differentiation of Infinite Series .....	12
1.10	Successive Differentiation .....	14
	<i>Practice Problems</i> .....	16

#### Chapter – 2: Rolle’s and Lagrange’s Theorem

2.1	Rolle’s Theorem .....	26
2.2	Geometrical Interpretation of Rolle’s Theorem .....	27
2.3	Algebraic Meaning of Rolle’s Theorem.....	28
2.4	Lagrange’s Mean Value Theorem (First Mean Value Theorem).....	37
2.5	Geometrical Interpretation of Lagrange’s Mean Value Theorem .....	38
2.6	Cauchy’s Mean Value Theorem .....	42
	<i>Practice Problems</i> .....	44

#### Chapter – 3: Tangent and Normal

3.1	Slopes of the Tangent and Normal .....	45
3.2	Equations of the Tangent and Normal.....	48
	<i>Practice Problems</i> .....	52

## Chapter – 4: Indefinite and Definite Integral

4.1	Introduction .....	54
4.2	Integration by Substitution .....	55
4.3	Indefinite Integrals of Additional Standard Form .....	57
4.4	Integration by Parts .....	58
4.5	Integration by Partial Fraction .....	59
4.6	Definite Integral .....	61
	<i>Practice Problems</i> .....	85

## Unit - II

### Ordinary Derivatives and Applications

## Chapter – 5: Expansion of Functions

5.1	$n^{\text{th}}$ Derivatives of Some Standard Functions.....	95
5.2	Leibnitz's Theorem.....	95
5.3	Taylor's Theorem .....	105
	<i>Practice Problems</i> .....	112

## Chapter – 6: Maxima and Minima

6.1	Maxima and Minima of a Function of One Variable.....	115
6.2	Maxima and Minima of a Function of Two Variable .....	124
6.3	Lagrange's Method of undetermined Multipliers .....	129
	<i>Practice Problems</i> .....	132

## Chapter – 7: Curvature

7.1	Definition .....	135
7.2	Intrinsic Formula for the Radius of Curvature .....	136
7.3	Cartesian Formula for Radius of Curvature .....	136
7.4	Parametric Formula for Radius of Curvature.....	137
7.5	Pedal Formula for Radius of Curvature .....	149
7.6	Polar Formula for Radius of Curvature .....	150
7.7	Curvature at Origin .....	155
7.8	Chord of Curvature through the Origin .....	160
7.9	Centre of Curvature .....	165
7.10	The Evolute of a Curve .....	166
	<i>Practice Problems</i> .....	171

## Chapter – 8: Curve Tracing

8.1	Rules for Tracing of Cartesian Curves .....	174
8.2	Tracing of Polar Curves .....	183
8.3	Some well-known Curves.....	187
	<i>Practice Problems</i> .....	191

### Unit - III

## Partial Derivatives and Applications

## Chapter – 9: Partial Differentiation

9.1	Introduction .....	195
9.2	Homogeneous Functions .....	205
9.3	Euler’s Theorem.....	205
9.4	Total Differential coefficient.....	215
9.5	First Differential Coefficient of an Implicit Function .....	216
9.6	Second Differential Coefficient of an Implicit Function.....	216
9.7	Change of Independent Variable into Dependent Variable .....	222
9.8	To Change the Independent Variable $x$ into another Variable $t$ .....	222
9.9	Change of Two Independent Variables.....	224
	<i>Practice Problems</i> .....	229

## Chapter – 10: Jacobian

10.1	Jacobian .....	231
10.2	Some Properties of Jacobian .....	232
10.3	Jacobian of Composite Functions .....	239
10.4	Jacobian of Implicit Functions .....	241
10.5	Functional Dependence and Independence of Functions .....	244
	<i>Practice Problems</i> .....	250

## Chapter – 11: Approximations and Errors

11.1	Approximations and Errors.....	252
	<i>Practice Problems</i> .....	257

**Unit - IV**

**Integral Calculus**

**Chapter – 12: Definite Integral as a Limit of Sum**

12.1	Definite Integral as Limit of a Sum.....	261
12.2	The Sum as a Definite Integral .....	265
	<i>Practice Problems</i> .....	273

**Chapter – 13: Beta and Gamma Functions**

13.1	Introduction .....	276
13.2	Beta Function .....	276
13.3	Gamma Function .....	277
13.4	Relation between Beta and Gamma Function.....	281
13.5	Duplication Formula .....	284
	<i>Practice Problems</i> .....	296

**Unit - V**

**Applications of Integral Calculus**

**Chapter – 14: Multiple Integrals**

14.1	Double Integrals.....	301
14.2	Evaluation of Double Integrals.....	301
14.3	Double Integral in Polar Coordinates.....	312
14.4	Evaluation of Area by Double Integral .....	317
14.5	Triple Integrals .....	324
14.6	Evaluation of Triple Integrals .....	324
14.7	Change of Order of Integration .....	331
	<i>Practice Problems</i> .....	338

**Chapter – 15: Volume and Surface of Solid**

15.1	Volume by Double Integral .....	340
15.2	Volume by Triple Integral .....	340
15.3	Volume of Solids of Revolution.....	340
15.4	Surface of Solid by Revolution .....	353
	<i>Practice Problems</i> .....	361