

# Contents

<b>Preface</b>	ix
<b>Chapter 1 Calculus of functions from <math>R</math> to <math>R^n</math></b>	1
1.1 Differentiation of vector functions of one variable.	2
1.1.1 Exercises	3
1.2 Arc length.	3
1.2.1 Exercises	7
1.3 Line integrals	8
1.3.1 Exercises	12
<b>Chapter 2 Calculus of functions from <math>R^n</math> to <math>R</math></b>	14
2.1 Partial differentiation	14
2.1.1 Exercises	18
2.2 Related 'independent' variables	19
2.2.1 Exercises	21
2.3 The chain rule	21
2.3.1 Exercises	24
2.4 Differentiation of implicit functions	24
2.4.1 Exercises	25
2.5 Higher partial derivatives	25
2.5.1 Exercises	29
2.6 Taylor series for functions from $R^2$ to $R$	31
2.6.1 Exercises	34
2.7 Taylor series for functions from $R^n$ to $R$	34
2.7.1 Exercises	36
<b>Chapter 3 Extrema of functions from <math>R^n</math> to <math>R</math></b>	37
3.1 Stationary points	37
3.1.1 Exercises	39
3.2 Classification of stationary points	39

3.2.1	Functions of two variables . . . . .	43
3.2.2	Functions of more than two variables . . . . .	49
3.2.3	Exercises . . . . .	53
3.3	Maxima and minima subject to constraint . . . . .	54
3.3.1	Exercises . . . . .	55
3.4	The Lagrange multiplier method. . . . .	56
3.4.1	Exercises . . . . .	60
<b>Chapter 4 Calculus of functions from <math>R^n</math> to <math>R^m</math></b>		62
4.1	Differentiable functions . . . . .	63
4.1.1	Exercises . . . . .	68
4.2	The chain rule . . . . .	69
4.2.1	Exercises . . . . .	76
<b>Chapter 5 Surfaces in space</b>		77
5.1	Parametric representation . . . . .	77
5.1.1	Exercises . . . . .	80
5.2	Explicit representation . . . . .	81
5.2.1	Exercises . . . . .	82
5.3	Implicit representation . . . . .	82
5.3.1	Exercises . . . . .	83
5.4	Normals to surfaces . . . . .	85
5.4.1	Surface given parametrically . . . . .	85
5.4.2	Surface given explicitly . . . . .	86
5.4.3	Surface given implicitly. . . . .	87
5.4.4	Exercises . . . . .	87
<b>Chapter 6 Curvilinear coordinates</b>		89
6.1	Plane polar coordinates . . . . .	89
6.2	Spherical polar coordinates. . . . .	92
6.3	Cylindrical polar coordinates . . . . .	94
6.4	General systems. . . . .	96
6.4.1	Exercises . . . . .	101
<b>Chapter 7 Multiple integrals</b>		103
7.1	Iterated integrals . . . . .	103
7.1.1	Exercises . . . . .	109
7.2	Double integrals . . . . .	110
7.2.1	Exercises . . . . .	114
7.3	Triple integrals (Volume integrals) . . . . .	115
7.3.1	Exercises . . . . .	117
7.4	Change of variables in multiple integrals . . . . .	117
7.4.1	Exercises . . . . .	123

<b>Chapter 8</b>	<b>Surface integrals</b>	127
8.1.1	Exercises . . . . .	135
<b>Answers</b>		137
<b>Index</b>		145