



# CONTENTS

<b>PREFACE</b>	vii
<b>1 VECTOR ALGEBRA</b>	<b>1</b>
1.1 INTRODUCTION . . . . .	1
1.2 HISTORICAL NOTES . . . . .	1
1.3 VECTOR BASICS . . . . .	2
1.4 DOT AND CROSS PRODUCT . . . . .	5
1.5 PHYSICAL SCALARS AND VECTORS . . . . .	9
1.6 NOTATION OF OTHERS . . . . .	16
<b>2 TENSOR ALGEBRA</b>	<b>17</b>
2.1 TENSORS DEFINED . . . . .	17
2.2 BASIC PROPERTIES OF TENSORS . . . . .	20
2.3 MORE PROPERTIES OF SECOND-ORDER TENSORS . . . . .	22
2.4 PHYSICAL TENSORS . . . . .	24
2.5 NOTATION OF OTHERS . . . . .	28
<b>3 CARTESIAN COMPONENTS</b>	<b>29</b>
3.1 COMPONENTS OF A VECTOR AND COORDINATES OF A POINT . . . . .	29
3.2 TENSOR COMPONENTS . . . . .	34
3.3 EIGENVECTOR REPRESENTATIONS . . . . .	36
3.4 GEOMETRIC DISTORTIONS AND THE POLAR DECOMPOSITION THEOREM . . . . .	42
3.5 PHYSICAL APPLICATIONS . . . . .	45
3.6 NOTATION OF OTHERS . . . . .	50
<b>4 GENERAL COMPONENTS</b>	<b>51</b>
4.1 CHANGE OF CARTESIAN BASE VECTORS AND COORDINATE SYSTEMS . . . . .	51
4.2 ROTATIONS IN TWO DIMENSIONS . . . . .	55
4.3 ROTATIONS IN THREE DIMENSIONS . . . . .	59
4.4 INVARIANCE OF TENSOR COMPONENTS . . . . .	62
4.5 GENERAL BASES . . . . .	67
4.6 NOTATION OF OTHERS . . . . .	71
<b>5 TENSOR FIELDS OF ONE VARIABLE</b>	<b>73</b>
5.1 BASIC CALCULUS OF VECTOR FIELDS . . . . .	73
5.2 MOVING BASE VECTORS . . . . .	75
5.3 NEWTONIAN MECHANICS OF A PARTICLE . . . . .	78
5.4 DIFFERENTIAL GEOMETRY OF A SPACE CURVE . . . . .	84
5.5 MOTION OF A RIGID BODY . . . . .	88

5.6	NOTATION OF OTHERS . . . . .	97
<b>6</b>	<b>TENSOR FIELDS OF MANY VARIABLES</b>	<b>99</b>
6.1	DIFFERENTIATION OF SCALAR FIELDS . . . . .	99
6.2	DIFFERENTIATION OF VECTOR FIELDS . . . . .	104
6.3	LINE, SURFACE, AND VOLUME INTEGRALS . . . . .	108
6.4	GREEN'S THEOREM AND POTENTIAL FIELDS OF TWO VARIABLES . . . . .	113
6.5	STOKES' AND DIVERGENCE THEOREMS AND POTENTIAL FIELDS OF THREE VARIABLES . . . . .	122
6.6	NOTATION OF OTHERS . . . . .	129
<b>7</b>	<b>APPLICATIONS</b>	<b>131</b>
7.1	HEAT CONDUCTION . . . . .	131
7.2	SOLID MECHANICS . . . . .	138
7.3	FLUID MECHANICS . . . . .	148
7.4	NEWTONIAN ORBITAL MECHANICS . . . . .	157
7.5	ELECTROMAGNETIC THEORY . . . . .	164
7.6	NOTATION OF OTHERS . . . . .	176
<b>8</b>	<b>GENERAL COORDINATES</b>	<b>177</b>
8.1	GENERAL CURVILINEAR COORDINATES . . . . .	177
8.2	ORTHOGONAL CURVILINEAR COORDINATES . . . . .	184
8.3	SURFACE COORDINATES . . . . .	191
8.4	MECHANICS OF CURVED MEMBRANES . . . . .	200
8.5	NOTATION OF OTHERS . . . . .	205
<b>9</b>	<b>FOUR-DIMENSIONAL SPACETIME</b>	<b>207</b>
9.1	SPECIAL RELATIVITY . . . . .	207
9.2	GENERAL RELATIVITY . . . . .	216
9.3	NOTATION OF OTHERS . . . . .	222
	<b>REFERENCES</b>	<b>225</b>
	HISTORICAL . . . . .	225
	MATHEMATICAL . . . . .	225
	PHYSICAL . . . . .	227
	<b>ANSWERS TO PROBLEMS</b>	<b>231</b>
	<b>INDEX</b>	<b>273</b>

