

Contents

CHAPTER 1. VECTOR ALGEBRA

1-1. Elementary Definitions	1
1-2. The Addition of Vectors	2
1-3. Representation of Vectors by Cartesian Components	5
1-4. The Product of Two Vectors	9
1-5. The Product of Three Vectors	14
1-6. Summary of Vector Identities	17
<i>Problems</i>	18

CHAPTER 2. DIFFERENTIAL AND INTEGRAL CALCULUS OF VECTORS

2-1. Vector and Scalar Fields	21
2-2. Differentiation of Vector Fields	22
2-3. Differentiation Rules	24
2-4. The Gradient	25
2-5. The Divergence of a Vector Field	30
2-6. The Curl of a Vector Field	35
2-7. The Line Integral over a Vector Field	38
2-8. The Divergence Theorem	43
2-9. Green's Theorem	52
2-10. Stokes' Theorem	54
2-11. Helmholtz' Theorem	59
2-12. Summary of Identities	64
<i>Problems</i>	65

CHAPTER 3. CURVILINEAR COORDINATES

3-1. Unitary and Reciprocal Unitary Vectors	69
3-2. Line, Surface and Volume Elements	78
3-3. The Differential Operators in Generalized Coordinates	84
3-4. Orthogonal Coordinate Systems	90
<i>Problems</i>	98

CONTENTS

CHAPTER 4. LINEAR TRANSFORMATIONS

4-1. Orthogonal Transformations	101
4-2. Euler's Theorem	113
4-3. Representations of the Rotation Group	118
4-4. The General Linear Transformations	129
<i>Problems</i>	138

CHAPTER 5. TENSOR FORMALISM

5-1. The Admissible Transformations	141
5-2. Transformation Laws	144
5-3. The Algebra of Tensors	151
5-4. The Metric Tensor	157
5-5. The Christoffel Symbols	162
5-6. Differentiation of Tensors	167
5-7. The Completely Anti-symmetric Unit Tensor	178
5-8. Vector Analysis	182
<i>Problems</i>	186

CHAPTER 6. VECTORIAL MECHANICS

6-1. Mechanics of a Particle	189
6-2. Systems of Particles	197
6-3. Variational Principles and Lagrange's Equations	204
6-4. Symmetries and Conservation Laws	217
6-5. Rigid Body Motion	224
<i>Problems</i>	235

CHAPTER 7. THE ELECTROMAGNETIC FIELD

7-1. The Field Equations	238
7-2. Vector and Scalar Potentials	252
7-3. The Hertz Potentials	256
7-4. The Electrostatic Field	262
7-5. The Magnetostatic Field	272
<i>Problems</i>	276

APPENDIX: VECTOR RELATIONS IN CURVILINEAR COORDINATES

1. Rectangular Cartesian Coordinates	278
2. Circular Cylinder Coordinates	279

3.	Elliptic Cylinder Coordinates	279
4.	Parabolic Cylinder Coordinates	281
5.	Spherical Polar Coordinates	282
6.	Conical Coordinates	283
7.	Parabolic Coordinates	284
8.	Prolate Spheroidal Coordinates	285
9.	Oblate Spheroidal Coordinates	287
10.	Ellipsoidal Coordinates	288
11.	Paraboloidal Coordinates	290
	REFERENCES	293
	INDEX	295