

CONTENTS

PREFACE	vii
CHAPTER 1	
THE ALGEBRA OF VECTORS	1
1. Definition of a vector 2. Equality of vectors 3. Multiplication by a scalar 4. Addition of vectors 5. Subtraction of vectors 6. Linear functions 7. Coordinate systems 8. Scalar, or dot, product 9. Applications of the scalar product to space geometry 10. Vector, or cross, product 11. The distributive law for the vector product 12. Examples of the vector product 13. The triple scalar product 14. The triple vector product 15. Applications to spherical trigonometry	
CHAPTER 2	
DIFFERENTIAL VECTOR CALCULUS.	29
16. Differentiation of vectors 17. Differentiation rules 18. The gradient 19. The vector operator del, ∇ 20. The divergence of a vector 21. The curl of a vector 22. Recapitulation 23. Curvilinear coordinates	
CHAPTER 3	
DIFFERENTIAL GEOMETRY.	58
24. Frenet-Serret formulas 25. Fundamental planes 26. Intrinsic equations of a curve 27. Involutes 28. Evolutes 29. Spherical indicatrices 30. Envelopes 31. Surfaces and curvilinear coordinates 32. Length of arc on a surface 33. Surface curves 34. Normal to a surface 35. The second fundamental form 36. Geometrical significance of the second fundamental form 37. Principal directions 38. Conjugate directions 39. Asymptotic lines 40. Geodesics	
CHAPTER 4	
INTEGRATION.	89
41. Point-set theory 42. Uniform continuity 43. Some properties of continuous functions 44. Cauchy criterion for sequences 45. Regular arcs in the plane 46. Jordan curves 47. Functions of bounded variation 48. Arc length 49. The Riemann integral	

CONTENTS

50. Connected and simply connected regions 51. The line integral 52. Line integral (*continued*) 53. Stokes's theorem 54. Examples of Stokes's theorem 55. The divergence theorem (Gauss) 56. Conjugate functions

CHAPTER 5

STATIC AND DYNAMIC ELECTRICITY 127

57. Electrostatic forces 58. Gauss's law 59. Poisson's formula 60. Dielectrics 61. Energy of the electrostatic field 62. Discontinuities of D and E 63. Green's reciprocity theorem 64. Method of images 65. Conjugate harmonic functions 66. Integration of Laplace's equation 67. Solution of Laplace's equation in spherical coordinates 68. Applications 69. Integration of Poisson's equation 70. Decomposition of a vector into a sum of solenoidal and irrotational vectors 71. Dipoles 72. Electric polarization 73. Magnetostatics 74. Solid angle 75. Moving charges, or currents 76. Magnetic effect of currents (Oersted) 77. Mutual induction and action of two circuits 78. Law of induction (Faraday) 79. Maxwell's equations 80. Solution of Maxwell's equations for electrically free space 81. Poynting's theorem 82. Lorentz's electron theory 83. Retarded potentials

CHAPTER 6

MECHANICS 184

84. Kinematics of a particle 85. Motion about a fixed axis 86. Relative motion 87. Dynamics of a particle 88. Equations of motion for a particle 89. System of particles 90. Momentum and angular momentum 91. Torque, or force, moment 92. A theorem relating angular momentum with torque 93. Moment of momentum (*continued*) 94. Moment of relative momentum 95. Kinetic energy 96. Work 97. Rigid bodies 98. Kinematics of a rigid body 99. Relative time rate of change of vectors 100. Velocity 101. Acceleration 102. Motion of a rigid body with one point fixed 103. Applications 104. Euler's angular coordinates 105. Motion of a free top about a fixed point 106. The top (*continued*) 107. Inertia tensor

CHAPTER 7

HYDRODYNAMICS AND ELASTICITY 230

108. Pressure 109. The equation of continuity 110. Equations of motion for a perfect fluid 111. Equations of motion for an incompressible fluid under the action of a conservative field 112. The general motion of a fluid 113. Vortex motion 114. Applications 115. Small displacements. Strain tensor 116. The stress tensor 117. Relationship between the strain and stress tensors 118. Navier-Stokes equation

CONTENTS

CHAPTER 8

TENSOR ANALYSIS AND RIEMANNIAN GEOMETRY 259

119. Summation notation 120. The Kronecker deltas 121. Determinants 122. Arithmetic, or vector, n -space 123. Contravariant vectors 124. Covariant vectors 125. Scalar product of two vectors 126. Tensors 127. The line element 128. Geodesics in a Riemannian space 129. Law of transformation for the Christoffel symbols 130. Covariant differentiation 131. Geodesic coordinates 132. The curvature tensor 133. Riemann-Christoffel tensor 134. Euclidean space

CHAPTER 9

FURTHER APPLICATIONS OF TENSOR ANALYSIS 311

135. Frenet-Serret formula 136. Parallel displacement of vectors 137. Parallelism in a subspace 138. Generalized covariant differentiation 139. Riemannian curvature. Schur's theorem 140. Lagrange's equations 141. Einstein's law of gravitation 142. Two-point tensors

REFERENCES 339

INDEX. 341