

CONTENTS

CHAPTER I

PRELIMINARY SURVEY

	PAGE
1. Electrostatics	1
2. Electric currents	4
3. Magnetism	5
4. Electrodynamics	8

CHAPTER II

ELECTROSTATICS

5. Law of Force	11
6. Potential and field for a single charge	12
7. Field due to several charges	14
8. Equipotentials and Lines of Force	16
9. Flux	19
10. Gauss' Law	20
11. Deductions from Gauss' Law	22
12. Examples	25

CHAPTER III

CONDUCTORS, DIPOLES AND CONDENSERS

13. Conductors	29
14. Mechanical force on a charged conducting surface	33
15. Attracted-disc electrometer	34
16. Energy of the electrostatic field	35
17. Introducing a new conductor lessens the energy	37
18. Dipoles	38
19. Forces on dipoles	40
20. The Electric Double Layer	42
21. Condensers	43
22. Mechanical forces on a conductor	47
23. Examples	47

CHAPTER IV

DIELECTRICS

24. Dielectric constant	52
25. Polarisation	52
26. Electric displacement	54
27. Parallel plate condenser	59
28. Energy of the field	61
29. Minimum energy	62

	PAGE
30. Stresses in the medium	64
31. Cavities in a solid dielectric	67
32. Examples	69

CHAPTER V

STEADY CURRENTS

33. The current vector	73
34. Conductivity	75
35. Differential equations of the field and flow	78
36. Resistance	79
37. Heat loss	79
38. Comparison with electrostatics	81
39. A worked example	82
40. Networks	83
41. The Wheatstone Bridge	85
42. Heat generated in a network	86
43. Examples	87

CHAPTER VI

MAGNETIC EFFECTS OF CURRENTS

44. Magnetic effects of a small coil	91
45. Electromagnetic units	92
46. Magnetostatic field.	93
47. Magnetic poles	94
48. Large coils	95
49. Solenoids and circular coils	98
50. Flux theorem for H	100
51. Field of a straight wire	100
52. Volume currents and the Vector Potential	101
53. Coefficient of mutual induction	104
54. Coefficient of self-induction	106
55. Examples	106

CHAPTER VII

STEADY CURRENTS IN MAGNETIC MATERIAL

56. Magnetic media	110
57. Magnetic induction	111
58. Equations of the magnetic field	113
59. Cavities	116
60. Potential energy of a small coil	117
61. Force on current in a magnetic field.	119
62. Force on a moving charge	121
63. Faraday's disc	122
64. Magnetic energy	123
65. Examples	128

CONTENTS

xi

CHAPTER VIII

PERMANENT MAGNETISM

	PAGE
66. Small magnets	132
67. A worked example	136
68. Large magnets	137
69. A uniform bar magnet	141
70. Energy	143
71. Terrestrial magnetism	145
72. Examples	148

CHAPTER IX

POTENTIAL PROBLEMS

73. Mathematical equivalence of all potential problems	153
74. Methods available	155
75. Spherical conductor in a uniform field	156
76. Dielectric sphere in a uniform field	159
77. Small magnet in a spherical hole	160
78. Point charge outside a dielectric sphere	161
79. A two-dimensional problem in magnetism.	163
80. Another two-dimensional problem	164
81. Problems with axial symmetry—a useful device	165
82. Examples	167

CHAPTER X

SPECIAL METHODS

83. Uniqueness	171
84. An application of uniqueness	173
85. Images in a plane	173
86. Images with spheres and cylinders	176
87. Two-dimensional problems, conjugate functions	178
88. Conformal representation	183
89. Two worked examples	185
90. Examples	188

CHAPTER XI

INDUCTION

91. Electromagnetic induction	193
92. Proof of induction law for a stationary circuit	194
93. Proof of induction law for a moving circuit	195
94. A simple dynamo	197
95. Induction in a single circuit	198
96. Two circuits—the transformer	201
97. Generalised law of induction	203
98. Examples	206

CHAPTER XII

ALTERNATING-CURRENT THEORY

	PAGE
99. Introduction	209
100. Impedance and reactance	210
101. Mathematical justification	212
102. Bridge circuits	216
103. Acceptor and rejector circuits	218
104. Power factor	219
105. Examples	220

CHAPTER XIII

MAXWELL'S EQUATIONS

106. Displacement current	224
107. Maxwell's equations	226
108. Decay of free charge	227
109. Electric waves	228
110. Conducting media	229
111. Poynting vector	230
112. The potentials	233
113. Retarded potentials	234
114. Potential of a moving electron	234
115. Recent developments	235
116. Examples	236

CHAPTER XIV

UNITS AND DIMENSIONS

117. Dimensions	240
118. Ratio of e.m.u. and e.s.u.	241
119. Gaussian units	243
120. Rationalised units	243
121. Practical units—c.g.s. system	244
122. m.k.s. units	247
Note on similarities between E , D , B and H	248
Index	251