		W _i	

CONTENTS

PREFACE	page xiii
INTRODUCTION	xv-xxii
CHAPTER I	
THE CLASSICAL EQUATIONS	
§§ 1·11-1·14. Uniform motion, boundary conditions, problems, a passage to the limit.	1-7
§§ 1·15-1·19. Fourier's theorem, Fourier constants, Cesàro's method of summation, Parseval's theorem, Fourier series, the expansion of the integral of a bounded function which is continuous bit by bit.	7–16
§§ 1.21-1.25. The bending of a beam, the Green's function, the equation of three moments, stability of a strut, end conditions, examples.	16–25
§§ 1.31-1.36. Free undamped vibrations, simple periodic motion, simultaneous linear equations, the Lagrangian equations of motion, normal vibrations, compound pendulum, quadratic forms, Hermitian forms, examples.	
§§ 1·41-1·42. Forced oscillations, residual oscillation, examples.	40–44
§ 1.43. Motion with a resistance proportional to the velocity, reduction to algebraic equations.	44-47
§ 1.44. The equation of damped vibrations, instrumental records.	47 –52
§ 1·45–1·46. The dissipation function, reciprocal relations.	52–54
§§ 1.47-1.49. Fundamental equations of electric circuit theory, Cauchy's method of solving a linear equation, Heaviside's expansion.	54–6 0
§§ 1.51-1.56. The simple wave-equation, wave propagation, associated equations, transmission of vibrations, vibration of a building, vibration of a string, torsional oscillations of a rod, plane waves of sound, waves in a canal, examples.	
§§ 1.61-1.63. Conjugate functions and systems of partial differential equations, the telegraphic equation, partial difference equations, simultaneous equations involving high derivatives, example.	
§§ 1.71-1.72. Potentials and stream-functions, motion of a fluid, sources and vortices, two-dimensional stresses, geometrical properties of equipotentials and lines of force, method of inversion, examples.	
§§ 1.81-1.82. The classical partial differential equations for Euclidean space, Laplace's equation, systems of partial differential equations of the first order which lead to the classical equations, elastic equilibrium, equations leading to the	
equations of wave-motion.	90–95
§ 1.91. Primary solutions, Jacobi's theorem, examples.	95–100
§ 1.92. The partial differential equation of the characteristics, bicharacteristics and rays.	s 101105
§§ 1.93-1.94. Primary solutions of the second grade, primitive solutions of the wave-equation, primitive solutions of Laplace's equation.	105–111
§ 1.95. Fundamental solutions, examples.	111–114
	9 <u>13</u> 70

CHAPTER II

APPLICATIONS OF THE INTEGRAL THEOREMS OF GREEN AND STOKES

§§ 2·11-2·12. Green's theorem, Stokes's theorem, curl of a vector, velocity potentials, equation of continuity. pages	115–118
§§ 2·13-2·16. The equation of the conduction of heat, diffusion, the drying of wood, the heating of a porous body by a warm fluid, Laplace's method, example.	118–125
§§ 2·21–2·22. Riemann's method, modified equation of diffusion, Green's functions, examples.	126–131
§§ 2:23-2:26. Green's theorem for a general linear differential equation of the second order, characteristics, classification of partial differential equations of the second order, a property of equations of elliptic type, maxima and minima of solutions.	131–138
§§ 2·31–2·32. Green's theorem for Laplace's equation, Green's functions, reciprocal relations.	138–144
§§ 2·33–2·34. Partial difference equations, associated quadratic form, the limiting process, inequalities, properties of the limit function.	144–152
§§ 2·41–2·42. The derivation of physical equations from a variational principle, Du Bois-Reymond's lemma, a fundamental lemma, the general Eulerian rule, examples.	152–157
§§ 2·431–2·432. The transformation of physical equations, transformation of Eulerian equations, transformation of Laplace's equation, some special transformations, examples.	157–162
\S 2·51. The equations for the equilibrium of an isotropic elastic solid.	162-164
§ 2·52. The equations of motion of an inviscid fluid.	164–166
§ 2·53. The equations of vortex motion and Liouville's equation.	166-169
§ 2·54. The equilibrium of a soap film, examples.	169-171
§§ 2·55–2·56. The torsion of a prism, rectilinear viscous flow, examples.	172–176
§ 2·57. The vibration of a membrane.	176–177
§§ 2·58–2·59. The electromagnetic equations, the conservation of energy and momentum in an electromagnetic field, examples.	177–183
§§ 2·61–2·62. Kirchhoff's formula, Poisson's formula, examples.	184-189
§§ 2·63–2·64. Helmholtz's formula, Volterra's method, examples.	189–192
§§ 2.71-2.72. Integral equations of electromagnetism, boundary conditions, the retarded potentials of electromagnetic theory, moving electric pole, moving electric and magnetic dipoles, example.	192–201
§ 2.73. The reciprocal theorem of wireless telegraphy.	201-203
Saio. The recibiocar ancorem or anteress acrestability.	201-203

CHAPTER III

TWO-DIMENSIONAL PROBLEMS

§ 3·11. Simple solutions and methods of generalisation of solutions, example. pages	204-207
§ 3·12. Fourier's inversion formula.	207-211
§§ 3·13-3·15. Method of summation, cooling of fins, use of simple solutions of a complex type, transmission of vibrations through a viscous fluid, fluctuating tem-	
peratures and their transmission through the atmosphere, examples.	211-215
§ 3·16. Poisson's identity, examples.	215-218
§ 3·17. Conduction of heat in a moving medium, examples.	218-221
§ 3.18. Theory of the unloaded cable, roots of a transcendental equation, Koshliakov's theorem, effect of viscosity on sound waves in a narrow tube.	221–228
§ 3.21. Vibration of a light string loaded at equal intervals, group velocity, electrical filter, torsional vibrations of a shaft, examples.	228–236
§§ 3·31-3·32. Potential function with assigned values on a circle, elementary treatment of Poisson's integral, examples.	236-242
§§ 3·33-3·34. Fourier series which are conjugate, Fatou's theorem, Abel's theorem for power series.	242–245
§ 3.41. The analytical character of a regular logarithmic potential.	245-246
§ 3·42. Harnack's theorem.	246-247
§ 3.51. Schwarz's alternating process.	247-249
§ 3·61. Flow round a circular cylinder, examples.	249-254
§ 3.71. Elliptic co-ordinates, induced charge density, Munk's theory of thin aerofoils.	254–260
§§ 3.81-3.83. Bipolar co-ordinates, effect of a mound or ditch on the electric potential, example, the effect of a vertical wall on the electric potential.	260–265
CHAPTER IV	

CONFORMAL REPRESENTATION

§§ 4·11–4·21. Properties of the mapping function, invariants, Riemann surfaces	
and winding points, examples.	266–270
§§ 4·22-4·24. The bilinear transformation, Poisson's formula and the mean value	
theorem, the conformal representation of a circle on a half plane, examples.	270–275
§§ 4·31–4·33. Riemann's problem, properties of regions, types of curves, special and exceptional cases of the problem.	275–280
§§ 4·41–4·42. The mapping of a unit circle on itself, normalisation of the mapping	
problem, examples.	280–283
§ 4.43. The derivative of a normalised mapping function, the distortion theorem	
and other inequalities.	283-285
§ 4.44. The mapping of a doubly carpeted circle with one interior branch point.	285–287
§ 4·45. The selection theorem.	287–291
§ 4·46. Mapping of an open region.	291–292

292–294
294–305
305–309
309–316
316–322
322–328
329–331
331–338
338-345
345-350
351-354
354-366
367–375
375–384
384–395
395-397

Contents

CHAPTER VII

CYLINDRICAL CO-ORDINATES

§ 7·11. The diffusion equation in two dimensions, diffusion from a cylindrical rod,

examples. pages	398-399
§ 7.12. Motion of an incompressible viscous fluid in an infinite right circular cylinder rotating about its axis, vibrations of a disc surrounded by viscous fluid, examples.	399-401
§ 7·13. Vibration of a circular membrane.	401
§ 7.21. The simple solutions of the wave-equation, properties of the Bessel functions, examples.	402–404
§ 7.22. Potential of a linear distribution of sources, examples.	404-405
§ 7.31. Laplace's expression for a potential function which is symmetrical about an axis and finite on the axis, special cases of Laplace's formula, extension of the formula, examples.	4 05 –4 09
§ 7.32. The use of definite integrals involving Bessel functions, Sommerfeld's expression for a fundamental wave-function, Hankel's inversion formula, examples.	409-412
§ 7.33. Neumann's formula, Green's function for the space between two parallel planes, examples.	412-415
§ 7.41. Potential of a thin circular ring, examples.	416–417
§ 7.42. The mean value of a potential function round a circle.	418-419
§ 7.51. An equation which changes from the elliptic to the hyperbolic type.	419–420
CHAPTER VIII	
CHAPTER VIII ELLIPSOIDAL CO-ORDINATES	
	421-425
ELLIPSOIDAL CO-ORDINATES §§ 8·11-8·12. Confocal co-ordinates, special potentials, potential of a homogeneous	421-425 426-427
ELLIPSOIDAL CO-ORDINATES §§ 8·11-8·12. Confocal co-ordinates, special potentials, potential of a homogeneous solid ellipsoid, Maclaurin's theorem. § 8·21. Potential of a solid hypersphere whose density is a function of the distance	
§§ 8·11-8·12. Confocal co-ordinates, special potentials, potential of a homogeneous solid ellipsoid, Maclaurin's theorem. § 8·21. Potential of a solid hypersphere whose density is a function of the distance from the centre. §§ 8·31-8·34. Potential of a homogeneous elliptic cylinder, elliptic co-ordinates, Mathieu functions,	426–427
§§ 8·11-8·12. Confocal co-ordinates, special potentials, potential of a homogeneous solid ellipsoid, Maclaurin's theorem. § 8·21. Potential of a solid hypersphere whose density is a function of the distance from the centre. §§ 8·31-8·34. Potential of a homoeoid and of an ellipsoidal conductor, potential of a homogeneous elliptic cylinder, elliptic co-ordinates, Mathieu functions, examples. §§ 8·41-8·45. Prolate spheroid, thin rod, oblate spheroid, circular disc, conducting ellipsoidal column projecting above a flat conducting plane, point charge above a hemispherical boss, point charge in front of a plane conductor with a pit	426-427

INDEX

CHAPTER IX

PARABOLOIDAL CO-ORDINATES

TILINIDOLOIDILI OO-OIDINALED	
§ 9-11. Transformation of the wave-equation, Lamé products. pages	449-451
§§ 9·21-9·22. Sonine's polynomials, recurrence relations, roots, orthogonal properties, Hermite's polynomial, examples.	451 -4 55
§ 9.31. An expression for the product of two Sonine polynomials, confluent hypergeometric functions, definite integrals, examples.	455–460
CHAPTER X	
TOROIDAL CO:ORDINATES	
§ 10·1. Laplace's equation in toroidal co-ordinates, elementary solutions, examples.	461–462
§ 10.2. Jacobi's transformation, expressions for the Legendre functions, examples.	463-465
§ 10.3. Green's functions for the circular disc and spherical bowl.	465-468
§ 10.4. Relation between toroidal and spheroidal co-ordinates.	468
§ 10.5. Spherical lens, use of the method of images, stream-function.	468-472
§§ 10·6-10·7. The Green's function for a wedge, the Green's function for a semi-	
infinite plane.	472-474
§ 10·8. Circular disc in any field of force.	474-475
CHAPTER XI	
DIFFRACTION PROBLEMS	
§§ 11·1-11·3. Diffraction by a half plane, solutions of the wave-equation, Sommerfeld's integrals, waves from a line source, Macdonald's solution, waves from	
a moving source.	476-483
§ 11·4. Discussion of Sommerfeld's solution.	483-486
§§ 11·5–11·7. Use of parabolic co-ordinates, elliptic co-ordinates.	486-490
CHAPTER XII	
NON-LINEAR EQUATIONS	
§ 12.1. Riccati's equation, motion of a resisting medium, fall of an aeroplane, bimolecular chemical reactions, lines of force of a moving electric pole, examples.	491–496
§ 12.2. Treatment of non-linear equations by a method of successive approximations, combination tones, solid friction.	497–501
§ 12.3. The equation for a minimal surface, Plateau's problem, Schwarz's method, helicoid and catenoid.	501-509
§ 12.4. The steady two-dimensional motion of a compressible fluid, examples.	509-511
APPENDIX	512–514
LIST OF AUTHORS CITED	515-519

520-522