Contents

Preface ix

1 Orthogonal Functions and Introductory Mathematics 1

1.1 Introduction to Orthogonal Functions and Fourier Series, 1
1.2 Sturm-Liouville Equation, 4
1.3 Orthogonal Functions, 9
1.4 Bessel Functions, 11
1.5 Legendre Functions, 15
1.6 Tesseral or Spherical Harmonics, 17
1.7 Spherical Harmonics of Nonintegral Degree and Order, 18
1.8 Spherical Bessel Functions, 22
1.9 Mathieu Functions, 24
Problems, 27

2 Green's Functions 30

2.1 Introduction to Green's Functions and Dirac's Delta, 30

2.2 Green's Functions for Sturm-Liouville Equation, 38
2.3 Green's Function for Various Boundary Conditions, 41
2.4 Alternate Forms for Green's Functions, 43
Problems, 50

3 Transforms **54**

3.1 Transform Methods, 54
3.2 Cylindrical Fourier Transforms, 75
3.3 Spherical Fourier Transforms, 81
Problems, 87

4 Electromagnetics **91**

4.1 Equations of Electromagnetics, 91
4.2 Inhomogeneous Media, 103
4.3 Anisotropic Media, 106
Problems, 116

5 Problems in Bounded and Unbounded Space **121**

5.1 Normal Modes in Cartesian and Cylindrical Coordinates—Source-Free Problems, 121
5.2 Green's Functions for Laplace's Equation in Cartesian and Cylindrical Coordinates, 127
5.3 Green's Functions for Helmholtz's Equation in Cartesian and Cylindrical Coordinates, 137
5.4 Normal Modes in Spherical Coordinates—Source-Free Problems, 154
5.5 Green's Functions for Laplace's Equation in Spherical Coordinates, 155
5.6 Green's Functions for Helmholtz's Equation in Spherical Coordinates, 159
Problems, 164

6 Wave Propagation in Unbounded Space **177**

6.1 Plane Wave Progagation in Simple Media, 177
6.2 Plane Wave Propagation in Anisotropic Electric Media, 179

6.3 Plane Wave Propagation in Anisotropic Magnetic Media, 192
6.4 Wave Propagation in Inhomogeneous Media, 198
6.5 Wave Propagation in Anisotropic Media, 203
Problems, 219

7 Radiation of Sources in a Half Space **227**

7.1 Electric and Magnetic Line Sources, 227
7.2 Electric and Magnetic Dipoles, 236
Problems, 246

Appendices **250**

A Vector and Electromagnetic Field Relations, 250
B The Dirac Delta, 258
C Special Functions, 260

Index **281**