Contents

Preface ix

	1 The electromagnetic field 1
1.1	Maxwell's Equations in Simple Media 1
1.2	Duality 6
1.3	Boundary Conditions 8
1.4	The Field Potentials and Antipotentials 9
1.5	Energy Relations 14
	2 Radiation from monochromatic sources in unbounded regions 19
2.1	The Helmholtz Integrals 19
2.2	Free-space Dyadic Green's Function 26
2.3	Radiated Power 29
	3 Radiation from wire antennas 37
3.1	Simple Waves of Current 37
3.2	Radiation from Center-driven Antennas 42
3.3	Radiation Due to Traveling Waves of Current,
	Cerenkov Radiation 45
3.4	Integral Relations between Antenna Current
	and Radiation Pattern 48
3.5	Pattern Synthesis by Hermite Polynomials 50
3.6	General Remarks on Linear Arrays 56
3.7	Directivity Gain 73

4 Multipole expansion of the radiated field 81

4.1	Dipole and Quadrupole Moments 81	
4.2	Taylor Expansion of Potentials 86	
4.3	Dipole and Quadrupole Radiation 89	
4.4	Expansion of Radiation Field in Spherical Waves 97	
	5 Radio-astronomical antennas	109
	C . 1 D	
5.1	Spectral Flux Density 111	
5.2	Spectral Intensity, Brightness, Brightness Temperature,	
= 0	Apparent Disk Temperature 115	
5.3 5.4	Poincaré Sphere, Stokes Parameters 118 Coherency Matrices 134	
5.5	Reception of Partially Polarized Waves 140	
5.6	Antenna Temperature and Integral Equation	
0.0	for Brightness Temperature 148	
5.7	Elementary Theory of the Two-element	
٠	Radio Interferometer 151	
5.8	Correlation Interferometer 159	
	6 Electromagnetic waves	
	in a plasma	169
6.1	Alternative Descriptions of Continuous Media 170	
6.2	Constitutive Parameters of a Plasma 175	
6.3	Energy Density in Dispersive Media 178	
6.4	Propagation of Transverse Waves in Homogeneous	
	Isotropic Plasma 183	
6.5	Dielectric Tensor of Magnetically Biased Plasma 187	
6.6	Plane Wave in Magnetically Biased Plasma 195	
6.7	Antenna Radiation in Isotropic Plasma 205	
6.8	Dipole Radiation in Anisotropic Plasma 209	
6.9	Reciprocity 212	

7 The Doppler effect 217

- 7.1 Covariance of Maxwell's Equations 218
- 7.2 Phase Invariance and Wave 4-vector 223
- 7.3 Doppler Effect and Aberration 225
- 7.4 Doppler Effect in Homogeneous Dispersive Media 227
- 7.5 Index of Refraction of a Moving Homogeneous Medium 230
- 7.6 Wave Equation for Moving Homogeneous Isotropic Media 233

Index 241