

Contents

Chapter 1. Electromagnetic Waves	1
1-1. Characteristics of Electromagnetic Waves	2
1-2. Radio-Wave Optical Principles	17
1-3. Radiation and Reception	34
1-4. Environmental Wave-Propagation Effects	39
Problems and Exercises	55
Chapter 2. Transmission Lines	57
2-1. Basic Transmission-Line Concepts	57
2-2. Transmission-Line Equations	65
2-3. Impedance Matching and Power Division	79
2-4. Forms of Transmission Lines	86
2-5. Waveguides	89
2-6. Hybrid and Directional Couplers	99
Problems and Exercises	104
Chapter 3. Antenna Parameters	107
3-1. Antenna Structures	109
3-2. Radiation Pattern	113
3-3. Antenna Gain	123
3-4. Receiving Cross Section	131
3-5. Beamwidth	133
3-6. Minor Lobes	136
3-7. Radiation Resistance and Efficiency	138
3-8. Input Impedance	140

3-9.	Bandwidth	142
3-10.	Polarization	144
	Problems and Exercises	146
Chapter 4. Basic Radiators and Feed Methods		149
4-1.	Short Dipoles	150
4-2.	Current and Voltage in Longer Antennas	166
4-3.	The Half-Wave Dipole	173
4-4.	Long-Wire Antennas	177
4-5.	Loop Antennas	183
4-6.	Helical Antennas	187
4-7.	Horn Radiators	191
4-8.	Slot Radiators	196
4-9.	Surface-Wave and Leaky-Wave Antennas	200
4-10.	Basic Feed Methods	200
	Problems and Exercises	207
Chapter 5. Arrays		209
5-1.	Basic Array Theory	209
5-2.	Multielement Uniform Linear Arrays	223
5-3.	Parasitically Excited Endfire Arrays	231
5-4.	Planar Arrays	233
5-5.	Volume Arrays and Plane Reflectors	237
5-6.	Beamwidth and Gain of Broadside Arrays	239
5-7.	Array Tapering for Side-Lobe Reduction	241
5-8.	Long-Wire Arrays	247
5-9.	Horn and Slot Arrays	249
5-10.	Phased Arrays for Scanning	250
	Problems and Exercises	252
Chapter 6. Reflectors and Lenses		256
6-1.	Focusing and Collimation	257
6-2.	Beamwidth and Directivity	262
6-3.	Feed Radiators	264
6-4.	Parabolic-Reflector Construction	279
6-5.	Corner-Reflector Antennas	283

6-6.	Lens Antennas	286
6-7.	Beam Steering by Feed Offset	293
6-8.	Pattern Calculation for Radiation from Apertures	294
6-9.	Comparison of Directive Antenna Types	297
	Problems and Exercises	298

Chapter 7. Antennas with Special Properties **301**

7-1.	Broad-Band Antennas	301
7-2.	Frequency-Independent (Log-Periodic) Antennas	315
7-3.	Antennas for Circular Polarization	325
7-4.	Omnidirectional Antennas	330
7-5.	Electrically Small Antennas	332
7-6.	Direction-Finding Antennas	335
7-7.	Scanning Antennas	340
7-8.	Low-Noise Receiving Antennas	342
	Problems and Exercises	347

Chapter 8. Antenna Measurements **349**

8-1.	Impedance Measurement	350
8-2.	Impedance Charts	359
8-3.	Pattern Measurement	364
8-4.	Gain Measurement	373
8-5.	Antenna Efficiency	378
8-6.	Radiation Resistance	380
8-7.	Polarization Measurement	381
8-8.	Scale-Model Measurements	382
8-9.	Antenna Noise Measurement	384
	Problems and Exercises	394

Chapter 9. Space-Age Advances in Antenna Technology **397**

9-1.	Frequency Band Designations	398
9-2.	Advances in Antenna Theory	399
9-3.	Developments in Phased-Array Beam-Steering Technology	401
9-4.	Adaptive Array Antennas	414
9-5.	Synthetic-Aperture Antennas	418

9-6.	Antennas with Extremely Low Sidelobes	420
9-7.	Antennas for Spacecraft	423
9-8.	Antennas for Radio Astronomy	429
9-9.	Antenna Measurements	432
	References	437
Appendix A. Review of Complex-Variable Algebra		443
Bibliography		449
Answers to Problems and Exercises		451
Index		455