

LIST OF FIGURES

PAGE NO.

Figure 1.1: Basic geometry of microstrip patch	3
Figure 1.2: Coaxial feed	6
Figure 2.1 Gap-coupled rectangular microstrip antenna design-1	26
Figure 2.2 Graph between return loss and frequency for antenna design-1	27
Figure 2.3 Graph between VSWR and frequency for antenna design-1	28
Figure 2.4 Graph between directivity and frequency for antenna design-1	29
Figure 2.5 Radiation pattern for antenna design-1	30
Figure 2.6 Graph between efficiency and frequency for antenna design-1	31
Figure 2.7 Impedance loci for antenna design-1	32
Figure 2.8 Gap-coupled rectangular microstrip antenna design-2	34
Figure 2.9 Graph between return loss and frequency for antenna design-2	35
Figure 2.10 Graph between VSWR and frequency for antenna design-2	36
Figure 2.11 Graph between directivity and frequency for antenna design-2	37
Figure 2.12 Radiation pattern for antenna design-2	38
Figure 2.13 Graph between efficiency and frequency for antenna design-2	39
Figure 2.14 Impedance loci for antenna design-2	40
Figure 2.15 Gap-coupled rectangular microstrip antenna design-3	42
Figure 2.16 Graph between return loss and frequency for antenna design-3	43
Figure 2.17 Graph between VSWR and frequency for antenna design-3	44
Figure 2.18 Graph between directivity and frequency for antenna design-3	45

Figure 2.19 Radiation pattern for antenna design-3	46
Figure 2.20 Graph between efficiency and frequency for antenna design-3	47
Figure 2.21 Impedance loci for antenna design-3	48
Figure 2.22 Gap-coupled rectangular microstrip antenna design- 4	50
Figure 2.23 Graph between return loss and frequency for antenna design-4	51
Figure 2.24 Graph between VSWR and frequency for antenna design-4	52
Figure 2.25 Graph between directivity and frequency for antenna design-4	53
Figure 2.26 Radiation pattern for antenna design-4	54
Figure 2.27 Graph between efficiency and frequency for antenna design-4	55
Figure 2.28 Impedance loci for antenna design-4	56
Figure 2.29 Gap-coupled compact rectangular microstrip antenna design-5	58
Figure 2.30 Graph between return loss and frequency for antenna design-5	59
Figure 2.31 Graph between directivity and frequency for antenna design-5	60
Figure 2.32 Impedance loci for antenna design-5	61
Figure 3.1 Truncated gap-coupled rectangular microstrip antenna design-1	65
Figure 3.2 Graph between return loss and frequency for antenna design-1	66
Figure 3.3 Graph between VSWR and frequency for antenna design-1	67
Figure 3.4 Graph between directivity and frequency for antenna design-1	68
Figure 3.5 Radiation pattern for antenna design-1	69
Figure 3.6 Graph between efficiency and frequency for antenna design-1	70
Figure 3.7 Graph between gain and frequency for antenna design-1	71
Figure 3.8 Impedance loci for antenna design-1	72

Figure 3.9 Truncated gap-coupled rectangular microstrip antenna design-2	74
Figure 3.10 Graph between return loss and frequency for antenna design-2	75
Figure 3.11 Graph between VSWR and frequency for antenna design-2	76
Figure 3.12 Graph between directivity and frequency for antenna design-2	77
Figure 3.13 Radiation pattern for antenna design-2	78
Figure 3.14 Graph between efficiency and frequency for antenna design-2	79
Figure 3.15 Graph between gain and frequency for antenna design-2	80
Figure 3.16 Impedance loci for antenna design-2	81
Figure 3.17 Truncated gap-coupled rectangular microstrip antenna design-3	83
Figure 3.18 Graph between return loss and frequency for antenna design-3	84
Figure 3.19 Graph between VSWR and frequency for antenna design-3	85
Figure 3.20 Graph between directivity and frequency for antenna design-3	86
Figure 3.21 Radiation pattern for antenna design-3	87
Figure 3.22 Graph between efficiency and frequency for antenna design-3	88
Figure 3.23 Graph between gain and frequency for antenna design-3	89
Figure 3.24 Impedance loci for antenna design-3	90
Figure 3.25 Four corners truncated gap-coupled rectangular microstrip antenna design-4	92
Figure 3.26 Graph between return loss and frequency for antenna design-4	93
Figure 3.27 Graph between VSWR and frequency for antenna design-4	94
Figure 3.28 Graph between directivity and frequency for antenna design-4	95
Figure 3.29 Radiation pattern for antenna design-4	96
Figure 3.30 Graph between efficiency and frequency for antenna design-4	97
Figure 3.31 Graph between gain and frequency for antenna design-4	98

Figure 3.32 Impedance loci for antenna design-4	99
Figure 3.33 Two corners truncated gap-coupled rectangular microstrip antenna design-5	101
Figure 3.34 Graph between return loss and frequency for antenna design-5	102
Figure 3.35 Graph between VSWR and frequency for antenna design-5	103
Figure 3.36 Graph between directivity and frequency for antenna design-5	104
Figure 3.37 Radiation pattern for antenna design-5	105
Figure 3.38 Graph between efficiency and frequency for antenna design-5	106
Figure 3.39 Graph between gain and frequency for antenna design-5	107
Figure 3.40 Impedance loci for antenna design-5	108
Figure 4.1: Front view of slot loaded square microstrip patch antenna	112
Figure 4.2: Back view of slot loaded square microstrip patch antenna	113
Figure 4.3: Graph between return loss and frequency for antenna design-1	114
Figure 4.4: Radiation pattern for antenna design-1	115
Figure 4.5: Impedance loci for antenna design-1	116
Figure 4.6 Front view of MSA with finite ground plane	118
Figure 4.7 Graph between return loss and frequency for antenna design-2	119
Figure 4.8 Graph between VSWR and frequency for antenna design-2	120
Figure 4.9 Graph between directivity and frequency for antenna design-2	121
Figure 4.10 Graph between efficiency and frequency for antenna design-2	122
Figure 4.11 Radiation pattern for antenna design-2	123

Figure 4.12 Impedance loci for antenna design-2	124
Figure 4.13: Front view of modified square MSA with slot loaded finite ground plane	126
Figure 4.14: Back view of modified square MSA with slot loaded finite ground plane	127
Figure 4.15: Graph between return loss and frequency for antenna design-3	128
Figure 4.16 Graph between VSWR and frequency for antenna design-3	129
Figure 4.17: Graph between directivity and frequency for antenna design-3	130
Figure 4.18: Graph between efficiency and frequency for antenna design-3	131
Figure 4.19: Radiation pattern for antenna design-3	132
Figure 4.20: Impedance loci for antenna design-3	133
Figure 4.21: Modified square microstrip patch antenna with finite ground plane	135
Figure 4.22: Graph between return loss and frequency for antenna design-4	136
Figure 4.23 Graph between VSWR and frequency for antenna design-4	137
Figure 4.24: Graph between directivity and frequency for antenna design-4	138
Figure 4.25: Graph between efficiency and frequency for antenna design-4	139
Figure 4.26: Radiation pattern for antenna design-4	140
Figure 4.27: Impedance loci for antenna design-4	141
Figure 5.1: Dual-frequency rectangular microstrip antenna with square slot cut at the center	145

Figure 5.2: Graph between return loss and frequency for antenna design-1	146
Figure 5.3: Radiation pattern for antenna design-1 at lower resonance frequency $f_1 = 1.06$ GHz	147
Figure 5.4: Radiation pattern for antenna design-1 at higher resonance frequency $f_2 = 1.38$ GHz	148
Figure 5.5: Impedance loci for antenna design-1	149
Figure 5.6: Gap-coupled multiresonator rectangular microstrip antenna with square cut corner of antenna design-2	152
Figure 5.7: Graph between return loss and frequency for antenna design-2	153
Figure 5.8: Radiation pattern for antenna design-2 at lower resonance frequency $f_1 = 1.52$ GHz	154
Figure 5.9: Radiation pattern for antenna design-2 at higher resonance frequency $f_2 = 2.25$ GHz	155
Figure 5.10: Impedance loci for antenna design-2	156
Figure 5.11: Front view of modified square MSA with slot loaded and corner cut finite ground	158
Figure 5.12: Back view of modified square MSA with slot loaded and corner cut finite ground	159
Figure 5.13: Graph between return loss and frequency for antenna design-3	160
Figure 5.14 Graph between VSWR and frequency for antenna design-3	161
Figure 5.15: Graph between directivity and frequency for antenna design-3	162

Figure 5.16: Radiation pattern for antenna design-3 at lower resonance frequency $f_1 = 3.21$ GHz.	163
Figure 5.17: Radiation pattern for antenna design-3 at higher resonance frequency $f_2 = 4.03$ GHz.	164
Figure 5.18: Graph between efficiency and frequency for antenna design-3	165
Figure 5.19: Impedance loci for antenna design-3	166
Figure 5.20: Front view of modified square microstrip patch antenna with slot loaded finite ground	168
Figure 5.21: Back view of modified square microstrip patch antenna with slot loaded finite ground	169
Figure 5.22: Graph between return loss and frequency for antenna design-4	170
Figure 5.23: Graph between directivity and frequency for antenna design-4	171
Figure 5.24 Graph between VSWR and frequency for antenna design-4	172
Figure 5.25: Radiation pattern for antenna design-4 at lower resonance frequency $f_1 = 3.16$ GHz.	173
Figure 5.26: Radiation pattern for antenna design-4 at higher resonance frequency $f_2 = 4.21$ GHz.	174
Figure 5.27: Graph between efficiency and frequency for antenna design-4	175
Figure 5.28: Impedance loci for antenna design-4	176
Figure 6.1: Increased substrate height rectangular microstrip antenna design-1	180
Figure 6.2: Graph between return loss and frequency for antenna design-1	181

Figure 6.3: Graph between directivity and frequency for antenna design-1	182
Figure 6.4: Radiation pattern for antenna design-1	183
Figure 6.5: Impedance loci for antenna design-1	184
Figure 6.6: Front view of modified square microstrip patch antenna with slits at the edges and having finite ground	186
Figure 6.7: Graph between return loss and frequency for antenna design-2	187
Figure 6.8 Graph between VSWR and frequency for antenna design-2	188
Figure 6.9: Graph between directivity and frequency for antenna design-2	189
Figure 6.10: Impedance loci for antenna design-2	190