INVESTIGATIONS ON BROADBAND PLANAR DIPOLE ANTENNAS
# Contents

## Chapter 1  Introduction

1.1 Waveguide antennas  
1.1.1 Slot element design and development  
1.1.2 Waveguide arrays  
1.1.3 Dielectric waveguide arrays  

1.2 Triplate antennas  
1.2.1 Design of slot element  
1.2.2 Triplate slotted arrays  

1.3 Cavity backed printed antennas  
1.3.1 Printed dipole elements  
1.3.2 Cavity backed printed arrays  

1.4 Microstrip antennas  
1.4.1 Microstrip dipole antenna  

1.5 Motivation for the present work  

1.6 Brief sketch of the present work  

1  
2  
3  
3  
5  
5  
5  
6  
6  
6  
8  
10  
12  
14  
15
Chapter 2  Review of past work in the field

2.1  Printed dipole antenna 16
2.1  Microstrip dipole antenna 27

Chapter 3  Methodology

3.1  Design and fabrication of antennas 42
3.1.1  Printed dipole 43
3.1.2  Microstrip dipole 47
3.2  Antenna feeding 47
3.3  Facilities utilised 50
3.3.1  Anechoic chamber 50
3.3.2  Network Analyser 52
3.3.3  Antenna positioner and controller 56
3.4  Method of measurements 57
3.4.1  Impedance 57
3.4.2  Radiation pattern 58
3.4.3  Gain 60

Chapter 4  Experimental results I: Printed dipoles

4.1  Flared printed dipole 64
4.1.1  Flaring angle 66
4.1.2  Arms overlapping 70
4.1.3  Arm width at feed point 72
4.1.4  Main arm to ground arm ratio 72
4.1.5  Design details 77
4.2  Triangular end-loaded printed dipole 83
4.2.1  Triangle dimensions 83
4.2.2  Arm width at feed point 90
4.2.3  Main arm to ground arm ratio 98
4.2.4  Flaring angle 98
4.2.5  Cavity backed triangular end-loaded printed dipole 106
4.2.6  Design details 112
4.3  Parallelogram end-loaded printed dipole 113
4.3.1  Cavity backed parallelogram end-loaded printed dipole 123
4.3.2  Design details 127
Chapter 5 Experimental results II: Microstrip dipoles

5.1 Triangular end-loaded microstrip dipole
   5.1.1 Main arm length
   5.1.2 Height of triangle
   5.1.3 Apex angle
   5.1.4 Design details

5.2 Triangular microstrip dipole
   5.2.1 Balun length
   5.2.2 Feed point location
   5.2.3 Arms separation
   5.2.4 Flaring angle

Chapter 6 Theoretical analysis

6.1 Rectangular microstrip patch
   6.1.1 Derivation of the Green’s function
   6.1.2 Calculation of complex power
   6.1.3 Space wave radiation

6.2 Rectangular printed dipole

6.3 Flared printed dipole

6.4 Triangular end-loaded printed dipole
   6.4.1 Q of the triangle
   6.4.2 Q of the remaining dipole
   6.4.3 Q of the complete structure

Chapter 7 Conclusions

7.1 Inferences from the experimental studies
   7.1.1 Printed dipole
   7.1.2 Microstrip dipole

7.2 Conclusions from the theoretical analysis

7.3 Some practical applications of the present antennas

7.4 Scope of further work in the field

Appendix A Development of an input impedance tunable circular patch antenna

A.1 Introduction
| A.2 | Antenna geometry and experimental set-up | 187 |
| A.3 | Experimental results and discussions | 187 |
| A.4 | Conclusions | 189 |

**Appendix B Performance study of YBCO superconducting wire loop antenna**

| B.1 | Introduction | 192 |
| B.2 | Antenna fabrication | 194 |
| B.2.1 | Preparation of YBCO powder | 194 |
| B.2.2 | Fabrication of antenna | 194 |
| B.3 | Experimental set-up | 195 |
| B.4 | Experimental results | 195 |
| B.5 | Conclusions | 199 |

**References**

| Index | 211 |
| List of publications of the author | 214 |