PREFACE

A broadband antenna is a key element of any high speed wireless communication system. It has the capability to radiate or receive electromagnetic wave over wireless medium at high rate. The broadband antennas are very demanding in many applications such as television, radar, satellite, imaging, surveillance, and navigation as well as high speed communication.

Frequency independent antenna (FIA) theoretically provides infinite bandwidth. However, to achieve infinite bandwidth, the antenna must have zero to infinite dimensional segments/elements. Therefore, infinite bandwidth is impractical because of finite dimension of any real antenna. The trapezoidal toothed log-periodic antenna (TTLPA) is one of the earliest developed FIAs which is a balanced type antenna and thereby require balun for its proper excitation. Performance of this type of antenna is also affected by the characteristics of balun used. In addition, the aperture size of antenna decides its bandwidth. Thus, bandwidth enhancement or size miniaturization of antenna requires modification in size or shape of antenna geometry. After the release of unlicensed frequency spectrum (3.1−10.6 GHz) with a very low spectral emission limit of -41.3 dB/MHz, planar broadband antennas developed for UWB applications gained attention due to many advantages. The UWB system utilized for short range indoor dense environment suffers from multipath fading. This problem of UWB system can be mitigated with the aid of multiple-input-multiple-output (MIMO) technology.

In the present thesis, an effort is made to enhance the performance of broadband antennas and to investigate new broadband antennas having multiple segments and curved boundaries inspired by nature. Planar balun is designed for proper excitation of conventional non-planar TTLPA and its effect on performance of TTLPA is observed. In addition, dielectric loading of TTLPA is utilized for its bandwidth enhancement towards lower frequency side without changing the shape or cross-sectional aperture of the antenna. Moreover, the non-planar antennas are unsuitable for compact handheld mobile devices. Therefore,

an attempt is also made to investigate new planar broadband antennas, which cover the UWB spectrum along with Bluetooth spectrum and are also suitable for broadband MIMO applications. The work carried out for the present thesis is divided into different chapters as given below.

In chapter 1, brief introduction to broadband antenna and its classification as well as bandwidth enhancement techniques: dielectric loading for TTLPA and nature inspired patch geometry for planar antennas are explained. Further, motivation and scope of the present work is discussed in this chapter.

In chapter 2, the literature related to bandwidth enhancement and size miniaturization of log-periodic antennas and planar monopole antennas along with antennas suitable for UWB and UWB MIMO antennas is extensively reviewed.

In chapter 3, conventional balanced TTLPA and tapered microstrip-to-coplanar stripline transition as planar balun for excitation of the antenna are described. The TTLPA along with transition is studied and the effect of transition on the performance of TTLPA is discussed. In the second part of this chapter, dielectric loaded TTLPA (DLTTLPA) is investigated to illustrate the bandwidth enhancement and size miniaturization of TTLPA.

In chapter 4, a new flower-shaped patch having multiple segments and curved boundaries as a modified version of conventional circular patch is described. The mechanism of bandwidth enhancement of the proposed antenna as compared with the circular patch of same outer diameter is discussed. Further, performance of the proposed nature inspired flower-shaped patch antenna is excited using coplanar waveguide (CPW) and microstrip line (MS) feeds are compared.

In chapter 5, the design of two configurations of castor leaf-shaped quasi-self-complementary antennas (QSCAs): one having sharp corners and another having smooth corners is discussed and their bandwidth characteristics are compared. Further, two-element MIMO antennas designed using smooth corner QSCA without and with dual band-rejection characteristics are investigated. The

empirical formulas for resonator design are also derived. Thereafter, input, radiation and diversity characteristics of both MIMO antennas without and with resonators are also studied. The proposed QSCA MIMO antenna achieves acceptable isolation between antenna ports without using any isolation technique.

In chapter 6, a new leaf-shaped shared radiator MIMO antenna having two ports is investigated. The shared radiator in general degrades the isolation between the antenna ports. Acceptable isolation between the antenna ports is achieved using meandered line stub and slot on the ground plane. Further, the input, radiation and diversity characteristics of the MIMO antenna are discussed.

In chapter 7, all investigations and observations of the present thesis are summarized. Further, scope for future work arising from the work carried out by the author is also presented in this chapter.