PREFACE

As the wireless communication technologies continue to evolve, it is crucial to develop novel, versatile, adaptive, and multifunctional antennas that can meet the dynamic demands of next-generation standards. While current adaptive antenna technologies have successfully optimized performance in alignment with previous generations, the rapid increase in data exchange among communication devices now requires more services to be supported by fewer devices. To address this challenge, reconfigurable antennas offer an innovative and adaptive solution due to their dynamic adaptability in changing scenarios. These antennas enable radio agility and have the potential to overcome the limitations, allowing a single antenna to support multiple services. The exponential increase in number of wireless-connected devices demands huge bandwidth; however, it is a limited resource. The prominent solution for spectrum scarcity is the cognitive radio (CR) technology, which exploits the concept of dynamic spectrum access. In CR, unlicensed or secondary users are allowed to access the spectrum of licensed or primary users without interfering with the primary communication. Secondary users sense the channel state through spectrum sensing and access the channel using one of two techniques: interweave or underlay. One of the major challenges of designing CR antenna is reconfigurable antenna with consistent performance, compact, improved isolation between sensing and transmitting antenna, and to achieve interweave or underlay CR operations. Therefore, this research aims to develop CR antennas with high isolation to overcome the above-discussed limitations. The simulations of these antennas are carried out using Ansys HFSS version 2022 R2 and validated through measurements. Further, a comparison is also performed with similar existing work in different chapters. This thesis begins with the evolution of the reconfigurable antenna for cognitive radio applications. The advantages of the reduced size, high isolation and easy integration with the system are motivated to design, develop, and implement the integrated frequency reconfigurable antenna and ultra-wideband antenna for cognitive radio. Therefore, different frequency reconfigurable antennas, isolation techniques in different antenna systems, their advantages and limitations are studied. A brief review on designing a frequency reconfigurable antenna and cognitive radio are performed. The problem identification from literature review, scope and objective of the thesis, are included in **Chapter 1**.

A compact ultra-wideband antenna and a frequency reconfigurable antenna with high isolation, intended for cognitive radio is proposed. A T-shaped stub is integrated into the ground plane to enhance isolation between antenna ports and improve impedance bandwidth. A low mutual coupling of -21 dB is realized across the communication frequency range of the frequency reconfigurable antenna, as well as over most of the UWB spectrum, as presented in **Chapter 2**.

In **Chapter 3,** an ultra-wideband monopole antenna with dual-band notches is presented. A square slot on the ground plane enhances impedance bandwidth, achieving a -10 dB bandwidth from 2.2 GHz to 15 GHz. Dual band notches are achieved using a U-shaped slot in the monopole for the Wi-MAX band and a U-shaped parasitic resonator on the substrate backside for the WLAN band, covering bands of 3.1-3.9 GHz and 4.6-6.2 GHz, respectively.

In **Chapter 4,** a multifunctional antenna with high isolation is designed for interweave and underlay cognitive radio. The design involves an ultra-wideband antenna with a reconfigurable notch band at Wi-MAX frequency band, and a frequency reconfigurable antenna operating in Wi-MAX, WLAN, and ISM bands. The proposed antenna exhibits interweave and underlay operations with an inter-port mutual coupling of less than -17 dB all over the proposed UWB and communication band.

Finally, this thesis encompasses the investigations and observations conducted throughout the study. It concisely summarizes the key findings and highlights potential directions for future research, as discussed in the concluding **Chapter 5**.