PREFACE

Presently engineers and scientists look for miniaturization and improved performance as important attributes while designing components/sub-systems for modern wireless communication and ultra-wideband systems. An antenna and a bandpass filter (BPF) are most common and essential components employed at the front-ends of any wireless transceiver. Antennas and BPFs are ordinarily designed separately and connected through impedance matching circuit so that maximum power is transferred. But this extra impedance matching circuit would increase the size and manufacturing cost of the system. In addition, finite length of transmission line connecting the antenna to filter will increase the system losses. Therefore, to design and develop compact and cost effective filter-antenna system having reduced losses and improved signal-to-noise ratio (S/N) performance, the system can be made free from matching network. This can be done by directly integrating the antenna with filter, and this combination is called filtering antenna.

In the present thesis, investigation is made through simulation and experimentally on the miniaturized versions of some BPFs, monopole antennas, and filtering antennas with improved passband and stopband performances. The experimental results for the filters, antennas, and filtering antennas are compared with the corresponding simulation results. For demonstrating the superiority of the proposed filters, antennas, and filtering antennas, dimension and performance based comparisons of these components with the respective components reported in the literature are done and the results for the comparisons depict the superiority of the proposed components. The research work carried out for the present thesis is described in six chapters as given below.

Chapter 1 provides discussion pertaining to brief introduction of filters, antennas and filtering antennas. Based on detailed literature survey on filters, antennas and filtering antennas, the major outcomes are discussed. Further, scope of the present thesis is outlined at the end of this chapter.

Chapter 2 investigates the compact modified microstrip interdigital bandpass filter (IBPF) having sharp roll-off and wide stopband with high out-of-band unwanted harmonics rejection capability for L-band applications. Starting from conventional IBPF and incorporating two subsequent design modifications, final optimized design of the filter is proposed. The proposed filter consists of combination of two pairs of spurlines and a pair of defected ground structures (DGSs) along with the conventional IBPF. The proposed modified IBPF is analysed through numerical simulation and experimental studies.

Chapter 3 reports an integrated design of compact L-band filtering antenna having sharp cut-off performance and wide stopband with reasonably suppressed unwanted harmonics for various L-band wireless communication applications. The proposed filtering antenna is obtained by integrating a modified elliptic-shaped monopole antenna with the modified IBPF reported in chapter 2. The modified IBPF is responsible for obtaining improved cut-off performance in the desired frequency band with suppression of out-of-band unwanted harmonics. In the initial phase, a modified wideband elliptic-shaped monopole antenna is designed and analysed through numerical simulation and measurement. Further, the modified IBPF reported in chapter 2 is integrated with the proposed wideband monopole antenna without any extra matching circuit to achieve compact integrated system called filtering antenna. The proposed L-band filtering antenna is analysed through numerical simulation and experimental studies.

Since UWB technology has great potential in the development of various modern transmission systems, for instance, through-wall imaging, medical imaging, vehicular radar, indoor and hand-held UWB systems. Therefore, UWB BPF and UWB filtering antenna are reported in subsquent chapters.

Chapter 4 presents the compact UWB BPF having sharp roll-off and wide stopband with high rejection capability for applications in UWB systems. The proposed filter uses modified multi-mode resonator (MMR) and DGS-based LPF. The modified MMR, which consists of meandered coupled-lines, stepped-impedance stubs, open-circuited stubs and coupled-line sections is responsible for compactness along with good impedance matching in passband of the filter. To obtain wide stopband for compact size filter, DGS-based LPF is used. An equivalent *RLC* circuit model of the LPF is proposed to validate its results obtained through numerical simulation and experimental studies. The proposed compact filter formed by integrating modified MMR-based UWB BPF with the DGS-based LPF is numerically simulated and experimentally tested.

Chapter 5 presents a new compact UWB filtering antenna having sharp passband cut-off performance and wide stopband with highly suppressed unwanted harmonics for UWB systems. The proposed UWB filtering antenna is obtained by integrating UWB monopole antenna with optimized version of UWB BPF reported in chapter 4. The UWB BPF is responsible for obtaining improved cut-off performance in passband and high suppression of unwanted harmonics for the proposed UWB filtering antenna. Initially, a compact UWB antenna is designed and investigated through numerical simulation and experimental studies. Further, the optimized UWB BPF is integrated with the proposed UWB antenna without any extra matching circuit to achieve compact

integrated system called the UWB filtering antenna. The proposed UWB filtering antenna is analysed through numerical simulation and experimental studies.

The experimental results for the proposed filters, antennas, and filtering antennas presented in chapters 2, 3, 4, and 5 are nearly in agreement with corresponding numerical simulation results. In chapters 2, 3, 4, and 5, performance and dimension based comparisons of the proposed filters, antennas, and filtering antennas with the respective components reported in the literature are also provided.

Finally, **Chapter 6** includes the summary and conclusion for the whole work. The scope for future work in the related area is presented at the end of this chapter.

At the end, the references are intended to include the significant source of reference material for different types of BPFs, monopole antennas, and filtering antennas for wireless communication and UWB applications related to present work.