6.1 Summary of the Work

Aim of the present doctoral work was to develop tunable filters with better performance, lower noise, and smaller size. To achieve this goal following relevant sub-objectives were identified:

6.1.1 Motivation, Need, and Literature Review

Chapter one of the present, doctoral thesis describes the need for compact filter with lower noise to satiate the demand of information flow on wireless network. With this motivation, an intensive literature survey was carried out to identify the current trends of research in the development of tunable filters, which is given in detail in chapter 1.

Literature review related to Electromagnetic Band Gap Structure (EBGs) as the ideal building block to achieve the foremost objective is carried out:

Frequency selective properties, ability to suppress surface wave and steer EM wave has made them attractive in frequency selective applications.
6.1.2 Material Characterization

Generally, tunability to a device is rendered through field similarly materials like ferroelectric and ferrite. Precise application of these materials in tunable devices needs accurate understanding of the dielectric behaviour of the materials in the frequency range of interest. To achieve this sub-object a material characterization technique was developed using co-centric ring resonator. This method has been described in chapter two of the present thesis work.

Work documented in chapter one was published in *International Journal of Microwave and Wireless technology*, where technique was shown to be effective for both semisolid biological and powder ferrite samples.

6.1.3 EBGs and their Relevance in Present Work

Detailed study on EBGs, their design, and the design challenges are discussed in detail in chapter 3. Work documented in chapter 3 has served as basic foundation to build the research work presented here.

6.1.4 Development of EBG Tunable Filter and their Sensitivity to External Perturbation

Band gap properties of hexagonal planar metallo-dielectric electromagnetic band gap structures in honeycomb lattice have been studied in detail. These structures demonstrate wide bandgap from 33.13 to 42 GHz (Ka band) for electric modes. Detailed simulation studies of the field pattern in the band gap region show
existence of cross couple polarized modes for electric fields. Further, sensitivity of the bandgaps to external mechanical spacer is also studied through experiments and simulations. The studies showed maximum shift in band edge by 4% with reduced isolation. Field simulation studies show formation of mono polarized mode across the capacitance.

### 6.1.5 Electromagnetic Tunability

Work mentioned in chapter 5 is a logical spin-off from previous chapter. Entire work of this chapter can be divided in two parts:

1. **Characterization**

Nano powder of ferromagnetic material SrFe$_{12}$O$_{19}$ was characterized morphologically and electrically at microwave frequency. Thin films of the material were deposited by sol-gel method on RT-Duroid substrate. These thin films of SrFe$_{12}$O$_9$ demonstrated same phase.

In the second part, a tunable filter using honeycomb lattice with hexagonal basis points was designed by sandwiching the EBG filter between two Strontium Ferrite thin films. Thin sandwich was kept in uniform magnetic field using electromagnet.

This method gave band edge tunability of 2.69 GHz with 3dB loss at applied field 22 K Gauss.
The observed tuning is maximum reported in the literature survey to the best of our knowledge with very low insertion lose. The wide incremental tunability with applied magnetic field has potential application in various tunable systems.

6.2 Future Prospective

It is impossible to overlook the application of EBG enabled devices. Especially results of chapter -5 open up a direction for the development of electromagnetically tunable devices with lower losses. Frequency selective nature ensures lower losses and better performance of the device.

The study can be extends to make steerable antenna for imaging and diagnostic applications.