The present thesis involves the development of NaCMC/poly (AAm-co-AMPS) semi-IPN hydrogels, PLA-Lapatinib films, collagen coated PLA-Imatinib microspheres and Aripiprazole loaded PLGA nanoparticles for controlled drug release. The developed hydrogels, films, microspheres and nanoparticles can be used alone or as combination with other agents, for the delivery of drugs to treat anti-cancer, antipsychotic and other conventional diseases. In the present investigation Lapatinib (anti-cancer drug), Imatinib (anti-cancer drug) and Aripiprazole (anti-psycotic drug), drugs are used as model drugs, for drug delivery of polymeric films, microspheres and nanoparticles respectively. These investigations are presented in seven major chapters of this thesis.

Chapter 1 covers the basic introduction in the field of hydrogels, films, microspheres and nanoparticles for different applications. The latest development in the production of hydrogels/films/micro/nanospheres for antibacterial and drug delivery systems has been presented in general. This chapter also covers the survey of literature relating/pertaining to the systems studied in the present work.

Chapter 2 presents the details of the chemicals and experimental procedures used throughout this research work. The complete details of several characterization techniques, such as UV-visible spectrophotometry, Fourier Transform Infrared (FTIR) spectroscopy, Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and X-ray diffraction studies (X-RD) have been employed. The methods employed to prepare different types of Hydrogel/films/micro/nanospheres used for drug delivery and silver nano structured hydrogel networks for biological applications are also given in detail in this chapter.
Chapter 3 explains preparation of Sodium Carboxy methyl cellulose / poly (acrylamide-co-2-acrylamido2-methyl propane sulphonic acid) Semi-interpenetrating polymer network (semi-IPN) hydrogels by using free radical polymerization technique. Silver nanoparticles were formed by reduction of silver nitrate in semi-IPN hydrogels with sodium borohydrate at room temperature. UV-visible spectroscopy, thermo gravimetrical analysis, X-ray diffractrometry, scanning electron microscopy and transmission electron microscopy techniques were used to characterize the formation of silver nanoparticles in hydrogels. SEM images indicated clearly the formation of group of silver nanoparticles with size range of 10–20 nm. The sizes of silver nanoparticles were also supported by transmission electron microscopy results. The semi-IPN silver nanocomposite hydrogels reported here might be a potentially smart material in the range of applications of antibacterial activity.

Chapter 4 presents the biodegradable poly (lactic acid) films containing Lapatinib were prepared by spreading polymer / Lapatinib solution on the non-solvent surface. Different drug loading polymer films can be obtained by controlling the weight ratios of drug and polymer. The synthesized Lapatinib loaded PLA films were evaluated by different parameters such as drug loading, encapsulation efficiency, surface morphology, differential scanning calorimetry, powder X-ray diffractometry and in-vitro drug release kinetics. Various combinations of the polymer-drug weight ratios were used to achieve in-vitro release of drug over a period of 30-35 days, with initial burst release < 25% and a steady release rate over the entire period of release. Furthermore the drug release rate of the film could be controlled by the drug loading content and pH of the release medium. Our results suggest that these Lapatinib loaded PLA film formulations could constitute a promising approach for the controlled drug delivery applications. This is the first study to show the in-vitro release profile of Lapatinib using a polymeric delivery system.
**Chapter 5** presents, the development of injectable microspheres for controlled drug delivery to the desired site is a major challenge. The author demonstrated the possibility of entrapping an anticancer drug, Imatinib mesylate, in collagen coated biodegradable poly (lactic acid) microspheres with a mean diameter of 10-20 µm. The collagen coating on polymeric matrix surfaces through various surface modification techniques was the current scenario to improve bio-integration of the polymers with the in-vivo system. Here protein adsorption principle is used and various characterization techniques like FTIR, DSC and SEM analysis are used to confirm collagen coating. The reduction in burst release of the Imatinib from the PLA microspheres further confirms its presence and role in controlled release. This collagen coated PLA microspheres may have potential for the targeted delivery of Imatinib mesylate to treat gastrointestinal stromal tumors, chronic myeloid leukemia cancer.

**Chapter 6** explains, the Poly (lactic-co-glycolic acid) nanoparticles loaded with Aripiprazole has been developed as a new therapeutic strategy to achieve its controlled release profile suitable for parenteral administration. Nanospheres composed of different lactic/glycolic acid ratios and drug compositions were synthesized and loaded with Aripiprazole by emulsion/solvent evaporation method and subsequently characterized by particle-size distribution, scanning electron microscopy, encapsulation efficiency and in-vitro drug release studies. Specific drug-polymer interactions are engineered by optimizing the lactide to glycolide ratio (L:G ratio) and including specific polymer hydrophobicity.

Summary of the present research results are presented in **Chapter 7**. In conclusion, the study demonstrates successful development of, hydrogels, films, microspheres and nanoparticles with natural and synthetic polymers for drug delivery studies and for antibacterial applications. In
the course of this study some novel techniques/polymeric systems were developed, which will be useful to the future researchers working in this area. The systems developed in this research are promising controlled release systems to deliver anti-cancer drugs.