Chemical sensors have growing interest in the determination of food additives, which are creating toxicity and may cause serious health concern, drugs and metal ions. A chemical sensor can be defined as a device that transforms chemical information, ranging from the concentration of a specific sample component to total composition analysis, into an analytically useful signal. The chemical information may be generated from a chemical reaction of the analyte or from a physical property of the system investigated. Two main steps involved in the functioning of a chemical sensor are recognition and transduction. Chemical sensors employ specific transduction techniques to yield analyte information. The most widely used techniques employed in chemical sensors are optical absorption, luminescence, redox potential etc. According to the operating principle of the transducer, chemical sensors may be classified as electrochemical sensors, optical sensors, mass sensitive sensors, heat sensitive sensors etc.

Electrochemical sensors are devices that transform the effect of the electrochemical interaction between analyte and electrode into a useful signal. They are very widespread as they use simple instrumentation, very good sensitivity with wide linear concentration ranges, rapid analysis time and simultaneous determination of several analytes. These include voltammetric, potentiometric and amperometric sensors.

Fluorescence sensing of chemical and biochemical analytes is an active area of research. Any phenomenon that results in a change of fluorescence intensity, anisotropy or lifetime can be used for sensing. The fluorophores are mixed with the analyte solution and excited at its corresponding wavelength. The change in fluorescence intensity (enhancement or quenching) is directly related to the concentration of the analyte. Fluorescence quenching refers to any process that decreases the fluorescence intensity of a sample. A variety of
molecular interactions that can lead to quenching are excited-state reactions, molecular rearrangements, energy transfer, ground-state complex formation and collisional quenching. Generally, fluorescence quenching can occur by two different mechanisms, dynamic quenching and static quenching.

The thesis presents the development of voltammetric and fluorescent sensors for the analysis of pharmaceuticals, food additives metal ions. The thesis is divided into nine chapters.

The first chapter is a general introduction to electrochemical and fluorescent sensors. The principle and applications of the sensors are also discussed. A detailed review of the scientific literature relevant to the development of electrochemical and fluorescent sensors for food and pharmaceutical analysis is also included.

Chapter 2 provides the details of the methods adopted for the fabrication of electrochemical sensors. Procedures followed for the preparation of buffer solutions and cleaning of various electrodes are also presented in this chapter. The details of the instruments used for carrying out the studies are also given in this chapter.

Chapter 3 describes the development of a voltammetric sensor for the determination of nitrite in food samples. The developed sensor was based on the electrochemical oxidation of nitrite on TMOPPMn(III)Cl modified gold electrode. The experimental conditions for electrochemical determination of nitrite were optimized. An excellent catalytic activity and stability for nitrite oxidation was exhibited by the sensor. The determination of nitrite in food samples were carried out using the proposed sensor and the results were found to be in good agreement with those obtained by standard spectrophotometric method.

In chapter 4, fabrication of an electrochemical sensor based on the catalytic activity of gold nanoparticles deposited on a glassy carbon electrode
(AuNP/GCE) for the determination of Sudan I is discussed. The electrochemical behavior of Sudan I on AuNP/GCE was found to be quasi-reversible. The kinetic parameters such as charge transfer coefficient and heterogeneous electron transfer constant involved in the study were calculated and reported in the chapter. The practical utility of the proposed sensor was evaluated by the determination of Sudan I in food products using AuNP/GCE sensor.

Chapter 5 details the electrochemical behavior of artificial antioxidant, butylated hydroxyanisole (BHA), at a glassy carbon electrode modified with poly L-cysteine. The modified electrode showed good electrocatalytic activity towards the oxidation of BHA under optimal conditions. The modified electrode was characterized by scanning electron microscope (SEM). The kinetic parameters were studied using cyclic voltammetry and the results are interpreted in the chapter. Analytical application of the developed sensor for the determination of BHA in oil samples were carried out.

Chapter 6 – 8 are devoted to the development of fluorescent sensors, study of fluorescence quenching mechanism and its application studies.

Chapter 6 outlines the design of a TOPO capped CdSe quantum dots based fluorescent sensor for the selective determination of NIM, a non-steroidal anti-inflammatory drug. The experimental parameters were optimized and the analytical characteristics were determined. The photo induced electron transfer mechanism was explained for selective quenching of fluorescence intensity by NIM and application of present sensor for the determination of NIM in pharmaceutical formulations were performed and presented in the chapter.

Chapter 7 focuses on the determination of BHA based on the fluorescence quenching of CNDs in the presence of BHA. The effect of other phenolic antioxidants on the fluorescence intensity of CNDs was studied. The
developed sensor was employed for the determination of BHA in oil samples and the details are presented in this chapter.

Chapter 8 demonstrates the development of a fluorescent sensor for the selective determination of Fe$^{3+}$ ion in presence of other transition metals. The experimental parameters were optimized and mechanism of fluorescence quenching was also studied. Practical utility of the developed sensor was evaluated by the determination of Fe$^{3+}$ ion in pharmaceutical formulation using the sensor.

Chapter 9 presents the summary and conclusions of the present study.