Nonlinear chemical dynamics evolved in the past three decades into an important and academically beautiful field to which chemists have provided some of the most outstanding visual examples of the nonlinear far-from-equilibrium phenomena which pervade the physical and biological world: periodic and aperiodic (chaotic) oscillations, multistability, excitability, and the formation of chemical waves and spatial patterns. In an oscillating chemical reaction, the concentrations of the reactants and products change with time in a periodic or quasi-periodic manner. Chemical oscillators exhibit chaotic behavior, in which concentrations of products and the course of the reaction depends on the initial conditions of the reaction. The classical modern example of an oscillating reaction is the Belousov-Zhabotinsky (BZ) reaction which involves the metal ion catalyzed oxidation of organic substrate by bromate ion and show temporal oscillations. BZ reaction was further extended for various other organic substrates and different metal ion catalysts, but bromate could not be substituted. Another most spectacular oscillating reaction in solution is probably the Briggs-Rauscher (BR) reaction. When appropriate amounts of hydrogen peroxide, acidic iodate, manganous salt, malonic acid (MA) and starch indicator are mixed in aqueous solution, the system repeats a yellow-blue-colorless sequence several times. During the oscillatory regime, there is a periodic consumption and production of molecular iodine, iodide ion, and other intermediates. Such a type of oscillating chemical reaction helps us in understanding complex processes in biological systems; like the developing of cardiac arrhythmias, nerve signal transmission and animal coat patterning. The literature summarized in the chapter first of this thesis is intended to direct the attention of chemists towards the mechanistic understanding of oscillatory chemical reactions and their applications in biosystems.

The chapter second of this thesis deals the experimental findings of BR system with mixed organic substrates, in which malonic acid (MA) accounts for oscillations and addition of other substrates like itaconic acid (IA), mesaconic acid (MsA) and citraconic acid (CsA) affects the oscillatory behavior of the main system. The systematic study performed at various concentrations has revealed the effective concentrations of the reactants at which better oscillations were exhibited by the reaction system. The effect of various organic substrates on the Dushman mixture confirms the fact that besides malonic acid as the substrate, other added organic
substrates participate in the iodination reaction under the experimental conditions employed and thus influence the reaction dynamics. Besides, a successful attempt was made to distinguish between cis/trans isomers through the effect of CsA and its trans isomer MsA on the Dushman mixture which was monitored spectrophotometrically. It is also found that BR reagents do not cause any significant change to Mn$^{2+}$ epr spectra.

The chapter third of thesis pertains to the use of amino-acid Tyrosine as a co-substrate with Malonic acid based Briggs Rauscher (BR) oscillatory system in order to understand the in-vitro mechanistic details of thyroid metabolism. The effect of increasing concentration of tyrosine on the experimental studies of Briggs Rauscher (BR) oscillatory system with fixed concentration of Malonic acid (MA) was studied. It was observed that the present BR system employing tyrosine and malonic acid as the mixed organic substrates provides an example of entrainment oscillations, in which malonic acid is responsible for oscillations and the presence of tyrosine leads to different oscillatory behavior in the system. Further, the addition of various chemical species to an actively oscillating BR system containing tyrosine as mixed organic substrate show significant behavior. The addition of higher concentration of KBr causes a rapid suppression of oscillation due to quick formation of IBr which competes with I$_2$ in iodinating the organic substrate and thus preventing the formation of I$^-$ ions. The suppression of the oscillatory regime with the addition of higher concentration of KSCN and Fe(III) is due to quick liberation of iodine and its accumulation in the system. However, addition of higher concentrations of SeO$_2$ and KNO$_3$ influence only the oscillatory features but do not inhibit the oscillations. This response of the aforesaid additives on the BR system can be directly used for proposition of a chemical model for the hyper/ hypo thyroidic behavior, based on the concept of iodination of tyrosine.

The chapter fourth of thesis focuses on the dynamic evolution of the oscillatory BR reaction in presence of various alcohols added singly (methanol, ethanol, n-propanol, isopropanol, tert-butanol) as well as in mixed mode conditions (sec-butanol+ethanol and isobutanol+ethanol) at 30$^\circ$C under CSTR conditions. The potentiometric study of the BR reaction in presence of these alcohols reveals that induction period and time period of the BR reaction alters when perturbed with varying concentrations of
different alcohols revealing their interaction with the system. The various alcohols affect the dynamics of the reaction to the extent depending on the concentration of the alcohol. The effect of the perturbation has been attributed to the iodination of alcohols within the reaction system. This interaction of alcohols has also been confirmed by spectrophotometric and cyclic voltammetric studies.

The chapter fifth of thesis is aimed to investigate the perturbations on the oscillatory regime of Briggs-Rauscher (BR) reaction by iron in free and complexed form like $[\text{Fe(bipy)}_3]^{2+}$ and $[\text{Fe(C}_2\text{O}_4)_3]^{3-}$ in a continuous stirred tank reactor (CSTR). The path of the perturbation (immediate quenching of oscillation, inhibition time, resumption of oscillations) caused by iron complexes was found to be different and dependent on the oxidation state of iron in the complex. The $[\text{Fe(C}_2\text{O}_4)_3]^{3-}$ complex owing to its complexed state redox potential causes quick evolution of $\text{I}_2(\text{aq})$ from iodide leading to immediate quenching of oscillations at higher concentration while as $[\text{Fe(bipy)}_3]^{2+}$ complex due to its higher complexed state reduction potential slows down the rate of $\text{I}_2$ production, leading to partial inhibition of oscillations. Further, the perturbant effect of $[\text{Fe(bipy)}_3]^{2+}$ on the studied BR system resembles with the effect shown by antioxidants as free radical scavengers.

The chapter sixth of the thesis is intended to obtain insights into the the type of interactions involved in the binding of the reactants to the micellar aggregates and the role played by micelles of various surfactant systems- SDS (sodium dodecyl sulphate) as anionic, CTAB (cetyl trimethylammonium bromide) as cationic and TritonX-100 {4-(1,1,3,3-(tetramethylbutyl) phenyl polyethylene glycol} as neutral one, by influencing the dynamical behaviors of the BR and BZ system in a CSTR. The presence of these surfactants affects the reaction dynamics to the extent that depends on the nature and concentration of the surfactant. The experimental findings indicate that the oscillatory behaviour of the reaction in presence of surfactants is due to the efficacy of organized surfactant assemblies to selectively distribute the key species involved in the reaction and their interaction with the counter ions in case of ionic micelles. The study reveals that the evolution of oscillations has been found to be characteristic of the surfactant.