The present research focuses on developing certain proposed population – based stochastic evolutionary optimization algorithms inspired by nature behaviour to solve small scale and large scale unit commitment problem with the specified constraints being completely satisfied.

Unit Commitment (UC) aims for scheduling the most cost effective combination of generating units to meet forecasted load and reserve requirements, adhering to that of the generator and transmission constraints. Basically, UC is completed for a scheduled horizon of one day to one week that determines which generator will be operating during which hour. The problem of unit commitment involves determining the minimum - cost dispatch of available generation resources to meet the electrical load. Over the past few decades, numerous algorithms have been developed for optimization of the unit commitment problem, but still researchers working in this field proposes new hybrid algorithms for making the problem more realistic.

The proposed research works in this thesis are of five modules i.e., the contributions involve developing four proposed population based stochastic evolutionary optimization algorithms and their variants and the final module involves developing a hybrid version of evolutionary optimization algorithm and discrete Hopfield neural network to solve unit commitment problem with all the specified constraints being satisfied.
In the first approach, a hybrid cuckoo – imperialist competitive algorithm (HCICA) is proposed to solve UCP with the given constraints being met. Individually, Cuckoo Search Algorithm (CSA) is a meta-heuristic search approach inspired by the obligate brood parasitism of cuckoo species which lay their eggs in the nests of other host birds and Imperialist Competitive Algorithm (ICA) is an optimization inspired by the imperialist competition; that is there exist two types of country: colonies and imperialists and the competition between these two entities results in exploring the search space to determine the optimal solution. The results computed using the proposed HCICA approach prove their effectiveness and robust nature for all the test systems considered than that of the earlier available methods.

A new modified variant of Gravitational Search Algorithm (GSA) is proposed to find solution to unit commitment problem with the considered equality and inequality constraints met in the second approach. The feasibility and effectiveness of the developed Unified Momentum GSA (UMGSA) is verified for the system with 10 – 100 units on a 24 hour scheduled horizon with and without ramp rate constraints. The simulation results computed are compared with the other methods reported in the literature to substantiate their validity. The computed simulation results clearly show that the proposed technique results in better quality solutions than the other methods reported in the literature.

In the third module, a novel population based evolutionary optimization technique called as Refined Charged System Search Algorithm (RCSSA) is proposed and implemented to 10, 20, 40, 60, 80 and 100 units power system under consideration. The new algorithm in RCSSA formulation introduces the updation process after creation of one solution, modification in the velocity updation equation and the methodology adopted
for computing the charge density. From the simulation results computed, it is inferred that the proposed RCSSA computes better solutions for the unit commitment problem considered and this in turn reduced the computational burden to a possible extent. The three refinements made in the developed Refined CSSA simulated the optimization process towards faster local and global search.

A novel stochastic based evolutionary optimization technique which is a variant of Charged System Search Algorithm (CSSA); called Hybrid Differential Evolution - Charged System Search Algorithm (HDE – CSSA) is developed by hybridizing the proposed differential evolution with that of the original CSSA to minimize the fuel running cost and in turn the operating cost of unit commitment problem. The HDE module is invoked to perform exploration and exploitation in a vigorous manner to compute the optimal solutions.

Finally, a novel hybrid approach is developed based on the hybridization of Biogeography Based Optimization and Discrete Hopfield Neural Network. BBO algorithm is employed to tune for the optimal weights of discrete Hopfield Neural Network leading to the minimization of energy function. The proposed hybrid BBO – DHNN is implemented for 10, 20, 40, 60, 80 and 100 units power system under consideration. Based on the simulation results presented in this chapter, it is clearly noted that the proposed HBDHNN approach results in better solutions for the unit commitment problem considered and this in turn reduces the computational burden to a significant extent.
The proposed approaches are developed in MATLAB environment version 7.8.0.347 and executed in a PC with Intel core 2 Duo processor with 2.27 GHz speed and 2 GB RAM with 64 bit operating system. Simulations are conducted with the derived algorithmic models – HCICA approach, UMGSA technique, RCSSA and HDE – CSSA approach, hybrid BBO – Hopfield NN technique to achieve effective and efficient solutions for the considered UCPs.