The objective of the thesis is to evolve simple and effective methods for hydrothermal scheduling which are capable of obtaining optimal solution for large practical systems. Special attention is given to investigation of the suitability of Successive Linear Programming (SLP) technique particularly for short-term scheduling problem which has many operating and security constraints. In both the long-term and short-term scheduling problems, the dynamic optimization problem is decomposed into sequence of static optimization problems using Local Variation approach. In each interval, with the hydro generations fixed, the optimal hydrothermal scheduling problem reduces to a thermal subproblem and is solved through suitable methods to obtain thermal generations and the corresponding total fuel cost.

An improved algorithm is proposed for long-term scheduling in which the thermal subproblem is solved using a judicious combination of Participation Factor method and Lambda-iteration method. In each of the thermal subproblems the change in hydro generation due to incremental trajectory perturbation is very small. Hence its distribution among the thermal plants is effectively done using Participation Factor method for the thermal subproblems arising due to perturbation of all hydro plants'
water storage trajectory except the last plant. The approximation of neglecting the change in transmission loss in the modelling is compensated in the algorithm by solving the thermal subproblem pertaining to the last hydro plant using Lambda-iteration method. The algorithm proposed is tested on two sample systems and results obtained reveal that the proposed algorithm is effective in respect of main memory and optimal fuel cost.

The short-term hydrothermal scheduling problem is formulated using an improved model and a new algorithm called Algorithm-I is developed using a judicious combination of Participation Factor method and SLP method. The thermal subproblem arising in each interval is formulated as an Non-linear Programming (NLP) problem and the NLP model is linearised around a given operating state to obtain a Linear Programming (LP) model. This LP problem is solved using SLP technique. Algorithm-I uses LP technique to solve only the thermal subproblems associated with the last hydro plant whereas it uses the Participation Factor method for those thermal subproblems associated with all other hydro plants.

The modelling approximation used in the thesis enables to incorporate certain computational features in the solution of LP problems. They are:
i) Elimination of Phase I computation in LP solution

ii) Variable bounds for control variables and

iii) Optimal step size in the constrained minimization direction.

Further, an effective method of choosing initial step size for water storage trajectory perturbation and its subsequent reductions for fast convergence is proposed.

Algorithm-I is tested on a sample system and a 66-bus Indian utility system. The LP is found to be very effective in correcting the line overloads and limiting the flow in the critical lines.

Algorithm-I is modified to reduce the computational time taken to obtain the optimal solution by searching the direction of perturbation of water storage trajectory at a time instant through a simple procedure and this modified algorithm is named as Algorithm-II. While the results of Algorithm-II give reduction in fuel cost slightly lesser than that of Algorithm-I, the computational time taken by it is only 35 to 60 percent of the time taken by Algorithm-I.

A new problem formulation is proposed for hydrothermal scheduling of systems with pumped-hydro plant. Appropriate constraints are incorporated in the problem to
include the pumped-hydro plant as either a peak-load management plant or a spinning reserve unit against thermal unit outage. This formulation brings out the flexibilities offered by the pumped-hydro plants in system operation. Methods for the selection of initial feasible water storage trajectory are given for pumped-hydro plant. The numerical results show the achievement of the primary objective of pumped-hydro plant in the system operation and the secondary objective of minimizing the total fuel cost of thermal generations.

Summarizing, the algorithms proposed for the long-term and short-term scheduling problems will be of use in the planning and operation of large utility systems.