6.1 Graphical Essence of the Dissertation

**Figure 6.1** Optimal Operation of CHP System using Proposed Methodology
This research work carried out in the field of optimal operation of CHP plants that is summarized in a graphical form and is shown in the Figure 6.1. The basic functional blocks include CHP plant, state-of-the-art models for power-only, heat-only and cogenerating units and the forecasted heat and electric power demands. The mathematical representation for cogenerating units to construct the heat-power plane is proposed and is highlighted in the graphical essence. The GWO algorithm is chosen as an optimization tool to determine the optimal output settings of operating units in a CHP plant. The main contributions of this dissertation are, FOR model for cogenerating units and new optimization tool for optimal operation of CHP plant.

6.2 Enhancements over State-of-the Art Literature

- The heat-power relation of cogenerating unit is highly complex and construction of the same is also difficult. To our knowledge, there are no reports available in the literature to construct heat-power plane of cogenerating unit. In this work, a generalized mathematical model is proposed to construct FOR of cogenerating unit. Moreover, this model uses simple analytical geometry equations.
- The optimal operational problem of CHP plant involves variety of equality and inequality constraints. Among these, handling FOR constraint is crucial as it affects the power and heat demands constraints. It is observed in the literature that effective FOR handling procedure is not reported. In this work, a simple and efficient FOR handling mechanism is proposed that always ensures the operating point of cogenerating unit within its FOR.
- Exploration of search space is highly affected due to the FOR of cogenerating unit. With the support of proposed constraint handling mechanism, a newly developed heuristic algorithm, GWO determines new feasible solutions for different kinds of CHPD problems.
The potential of the suggested tool is validated with the performance and statistical analysis. These analyses indicate that the proposed tool is step ahead than the earlier methods.

### 6.3 Findings and Implications

- Accurate models are needed to solve the optimal operational problem. The state of the art models except FOR model of cogenerating unit are available in the literature. A simple construction procedure using analytical geometry equations is proposed to construct the FOR model.

- Like the FOR model of cogenerating unit, a simple and efficient FOR constraint handling mechanism is proposed. The GWO is used as the main optimization tool and its potential for solving different kinds of CHP plant operational problems is verified. The results presented in this thesis provide relevant knowledge on scheming future informative policy measures in CHP systems. Both economic motives and environmental awareness are very important for reduction of unnecessary waste of heat and toxic pollutants from power stations in the present scenario.

- Campaigns of cogeneration system which tend to lay stronger emphasis on disseminating energy saving measures to power producers should be promoted and initiated by research organizations of the government. An effective inference of CHP systems, coordinating with dissemination of energy saving information and financial incentives needs to be constructed to render the pro-environment consciousness into electricity saving actions.
6.4 Recommendations for Future Work

This thesis focuses on dealing with wind power uncertainty which straightforward; but other sources of uncertainty such as hydro inflows, demand response, generators and line outages should be integrated in future.