CHAPTER 3

Objectives

Use of synthetic refrigerants have significant direct contribution to ozone depletion and/or global warming. An obvious solution is to replace artificial refrigerants with natural ones which have zero ODP and low GWP. Among the many recognized natural refrigerants, CO_2 finds wider acceptance owing to its overall safety and favorable thermo-physical properties. The performance of single stage trans-critical cycles with CO_2 as refrigerant are relatively low and are also highly sensitive to operating temperature and pressure which is an issue while operated in a country like India. From time to time, researchers have put forward various suggestions for improvement of performance of the basic CO_2 trans-critical cycle. Some of the prominent modifications include adoption of Internal Heat Exchanger (IHX), ejector expansion, work recovery expander, dedicated sub-cooling, flooded evaporator, twin-staging and cascading. Based on the literature survey and the existing research gap, this thesis work is carried out based on the following agenda:

1. With aid of funding received from DST (DST/TSG/NTS/2012/19) and BITS Pilani, an indigenous CO_2 trans-critical refrigeration test setup equipped with IHX is fabricated and extensive experiment is carried out on the same, in warm climate up to 45ºC.
2. Mathematical model is developed based on physics of the system and also experimental input output data based Artificial Neural Network model is trained for the system. The validated models are then applied to perform parametric investigation and optimization of two controllable parameters viz gas cooler pressure and gas cooler face velocity for various ambient and evaporation conditions.
3. Application of CO_2 in supermarket refrigeration is investigated for operation in warm climate. Detailed thermodynamic analysis on booster, indirect/cascade and integrated configurations are conducted out. For booster configuration various modification reported

in literature are analysed and compared based on energy and economic perespectives. The performance of booster configurations are also compared to indirect/cascade configurations. With regard to intergated system, multi-jet ejetcor configuartion is compared to cascaded booster configuration for high temperature operation based on energy and environmental perspectives.

The objectives of the thesis are summarized in Fig. 3.1

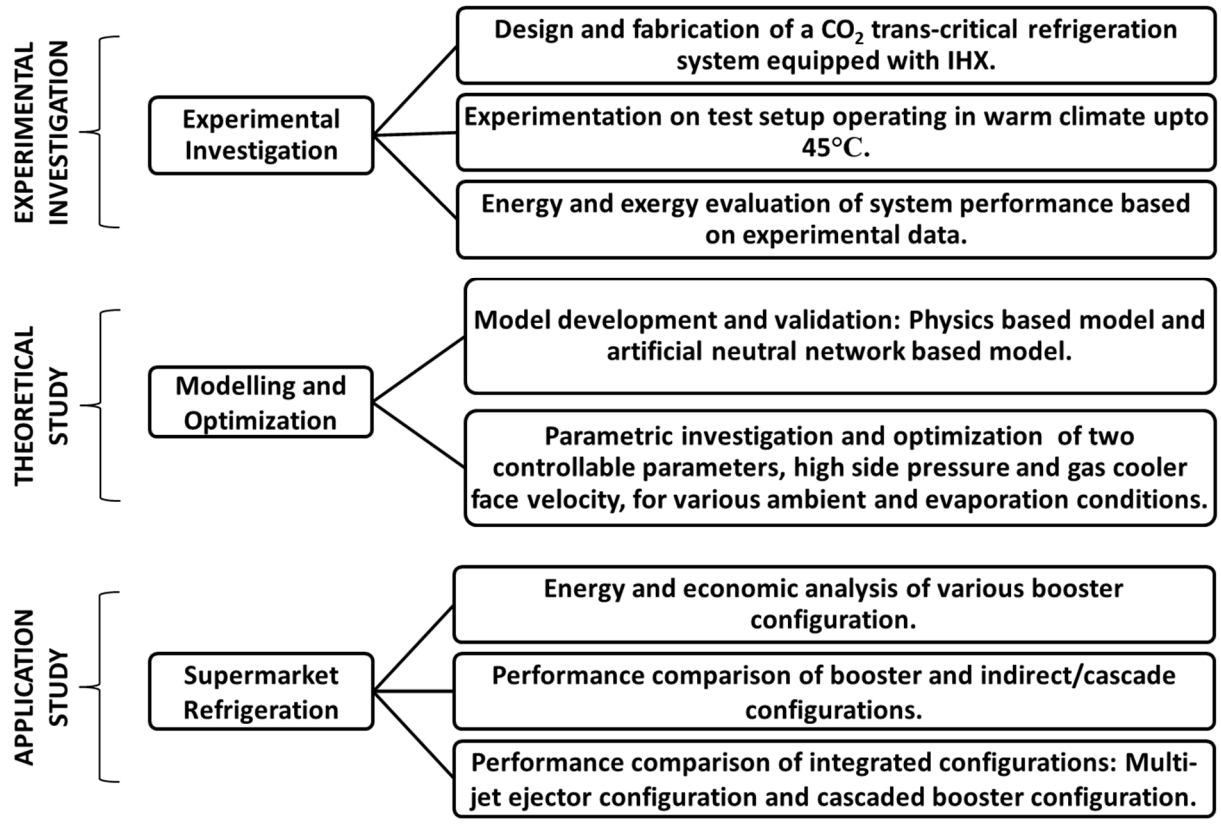

Fig. 3.1 Flow chart representing the thesis objectives