The main objective of the research work aims to study on the heat transfer characteristics of various heat exchangers namely Shell and Tube Heat Exchanger, Cross Flow Plate Fin Heat Exchanger, Spiral Heat Exchanger and Plate Type Heat Exchanger using both miscible and immiscible systems. The systems considered for this study are Water-Water System, Kerosene-Water System, Toluene-Water System, Acetic acid-Water System and Ethylene Glycol-Water System. The various parameters employed in determining the heat transfer characteristics include Reynolds number, Nusselt number, Overall Heat Transfer Coefficient, Capacity Ratio, Number of Transfer Units (NTU), Effectiveness and Efficiency.

Experiments are conducted on a 1-1 Shell and Tube Heat Exchanger, Spiral Heat Exchanger and Plate Type Heat Exchanger for parallel and counter current flow patterns with different cold side flow rates, and different composition (9%, 10%, 20% and 25% on volume basis) of cold fluid. An investigation on the performance of these heat exchangers is made. The performance characteristics of Cross Flow Plate Fin Heat Exchanger are also discussed in detail, wherein it is found that this type of heat exchanger is the most efficient.
A comparison between parallel flow and counter current flow heat exchangers is made. The result is that, the counter current flow heat exchangers have proved to be more effective.

The application of soft computing technologies like Artificial Neural Networks (ANN) for the simulation of the models has served as an effective tool in adjudging the accuracy of the experiments. The ANN is applied to predict Overall Heat Transfer Coefficient ($U_0$), Effectiveness ($\varepsilon$), Cold Fluid Side Efficiency ($\eta_s$) and Hot Fluid Side Efficiency ($\eta_f$) for different heat exchangers.

In the present research work, efforts have been taken to develop neural networks using General Regression Model, for different heat exchangers, and to train and test it with a set of experimental data. The experimental results are then compared with the simulated results which reveal that both are very much close and coherent. The performance characteristics of various heat exchangers are compared and a thorough analysis is done. Thus among the various heat exchangers compared, the Cross Flow Plate Fin Heat Exchanger has been found to be the most efficient and effective heat exchanger.