One of the important aspects of any heat exchanger is to increase the rate of heat exchange between two streams of fluids. When one stream of the flowing fluid is gas and the other is a liquid, the heat transfer surface on the gas side needs to have a much larger surface area, as it is well known that the heat transfer coefficient for gases is much lower than that for liquids. A heat exchanger having a surface area density greater than about 700 m$^2$/m$^3$ is quite arbitrarily referred to as a compact heat exchanger. The heat transfer coefficient of the extended surfaces may be higher or lower than that of the unfinned surfaces. The louvered fins increase both the surface area and the heat transfer coefficient. They are available in a wide variety of configurations of the heat transfer matrix. Their heat transfer and pressure drop characteristics are very important, and hence, the extensive studies were done on louvered fin heat exchangers by various researchers.

In the present work, an experimental investigation was carried out to analyze the heat transfer and pressure drop characteristics of a corrugated louvered fin and flat tube compact heat exchanger used as a radiator in an internal combustion engine. Experiments were conducted by positioning the radiator in an open-loop wind tunnel.
Hot water at 90°C was supplied through the radiator, and the air was made to flow across the radiator at atmospheric temperature. During the experiment the mass flow rate of water was varied from 0.075 to 0.135 m³/min and the frontal air velocity was varied from 2.5 m/s to 7.5 m/s. A total of 24 sets of air and water flow rate combinations were tested, and the temperature and pressure drops of the air and water were acquired. Using these experimental results, the influence of the overall heat transfer performance of the heat exchanger due to the effects of the mass flow rate of water in the tube side was investigated. The experimental results showed that the increase in the air velocity has a greater influence in increasing the overall heat transfer coefficient, than the effect due to the increase in the mass flow rate of water. Further, at a lower air velocity, the air side heat transfer resistance is dominant, and hence, the increase in the mass flow rate of water has a negligible effect in increasing the heat transfer rate. However, the increase in the mass flow rate of water has a greater influence in increasing the heat transfer at higher velocities of air.

Also, the measured pressure and temperature drops across the heat exchanger were used to evaluate the air side Fanning friction $f$ and Colburn $j$ factors. These experimental Fanning friction factor $f$ and Colburn $j$ factors were compared with some of the existing correlations available in the open literature. It is observed that there is a large deviation between the experimental results and the results obtained from the existing correlations.
This is because most of these correlations were developed by using the data generated from different research works, where there may be variations in the geometrical parameters. Further, in all these correlations, all the geometrical and flow parameters were not considered. In some situations, the variations of some parameters that were omitted in the correlations have a very significant effect in influencing the heat transfer and pressure drop characteristics. Under such circumstances, these correlations fail to predict the performance accurately.

A numerical analysis was also carried out, using Fluent software (a general purpose computational fluid dynamics simulation tool) for three chosen data from the experiments. The numerical results of the air-side temperature drop, pressure drop, average heat transfer co-efficient and the $f$ and $j$ factors were compared with the experimental values. A good agreement between the experimental and numerical results validates the present computational methodology. Also, the local variation of the flow properties, such as temperature and velocity along the chosen vertical lines on the mid vertical plane of the computational domain, and the local variation of the velocity magnitude along the mid horizontal line on the same vertical plane were found out.
In the present study, the effects of the variation of some of the important geometrical parameters on the heat transfer and pressure drop performance of the present heat exchanger (test radiator) were analysed. The important geometrical parameters considered in this analysis were the fin pitch, transverse tube pitch, longitudinal tube pitch, louver pitch and louver angle. During the analysis, the air velocity was varied from 3.5 to 7.5 m/s. This analysis was done numerically, using a commercial software (a general purpose computational fluid dynamics simulation tool). The parametric analysis carried out with various geometrical dimensions revealed, that the fin pitch of 1.5 mm, transverse tube pitch of 9.6 mm, longitudinal tube pitch of 28 mm, louver pitch of 1.2 mm and louver angle of 26° provided the optimal performance, considering both the aspects of pressure drop and heat transfer. Based on the results of the parametric analysis, the correlations for $f$ and $j$ are also developed and presented in the thesis.