EXECUTIVE SUMMARY

The endeavour of this study is to analyze the emission and performance characteristics of a single cylinder; four stroke diesel engine using a Polanga biodiesel blends as fuel. The assortment of Polanga biodiesel is based on a widespread review of literature which indicated that this is relatively unexplored fuel for a diesel engine. The experimental investigation is followed by a computational study consisting of modelling using artificial neural network and optimization for forecasting the best possible emission and performance parameters constituents of the diesel engine. The experimental investigation is conducted on a Kirloskar make single cylinder, four stroke diesel engine using Polanga biodiesel blends with diesel as a test fuel. The exhaust emissions and performance characteristics are assessed by operating the diesel engine at altered predetermined fuel injection timings of 15, 19, 23, 27 and 31°bTDC and changed fuel injection pressures of 160 bar, 180, 200, 220 and 240 bar at varying load from zero to full load in steps of 20 percent increments. The exhaust emission constituents measured are unburnt hydrocarbons (UHC), carbon monoxide (CO), carbon dioxide (CO₂), smoke opacity and oxides of nitrogen (NOx). The performance parameters are brake specific fuel consumption (BSFC), brake thermal efficiency (BTE) and exhaust gas temperature (EGT). The experimental study accomplished provides a very large number of results. But, it is impossible to select the input parameters such as injection timing, injection pressure and blend for obtaining best exhaust emissions and performance and from the diesel engine. Hence, an appropriate computational study is required to be carried out to meet the goal of finding the best grouping of the input parameters under different specific priorities. ANN is used to obtain the output parameters using different input parameters. ANN
modelling is a very complex technique which is capable of modelling different functions and processes. In this study, ANN modelling is developed using the neural network feature of MATLAB (R2010a).

After then developed ANN model is validated using a different set of input conditions. The selected input variables are: Engine fuel injection timing of 17, 21, 25, 29°bTDC, 100% engine load (3.5Kw.), Polanga biodiesel blend B25 and fuel injection pressure of 180 bar for variable injection timing model. For variable fuel injection pressure model the selected input variables are: fuel injection timing of 23°bTDC, full engine load (3.5Kw.), Polanga biodiesel blend B25 at different fuel injection pressure of 170, 190, 210 and 230 bar. The results obtained through the developed models are compared with those obtained experimentally. The percentage error for all the parameters lies between in the range of 0.47 to 4.58. Also the variation in error for all the parameters is negligible. The mean percentage error for Engine performance parameters BTE, BSFC and EGT are ±1.85, ±2.35 and ±2.57 % respectively. On the other side mean percentage error for Engine emission parameters UHC, NOx, CO₂ and CO are ±1.78, ±2.57, ±2.79 and ±2.56 % respectively. The mean percentage error for variable fuel injection timing is ±2.39% and for variable fuel injection pressure is ±2.17%. Thus this ANN model depicts the Engine performance and emission parameters quite efficiently and hence can be used as an assessment tool for single cylinder diesel engine when using Polanga based biodiesel as a test fuel.

After ANN modelling has found the best working tool for diesel engine, after then best Engine operating conditions from the point of view of minimizing BSFC, maximising BTE, EGT and proportion of emission from exhaust gas is need to required. Thus, multi-objective optimization of Engine exhaust emission and engine
performance characteristics is carried out to find optimum fuel injection timing, fuel injection pressure and Polanga biodiesel blend percentage at full engine load using genetic algorithm (GA) technique for single cylinder Kirlosker make test diesel engine. MATLAB genetic algorithm (GA) toolbox is used for optimization in this study. From this study, it can be observed that B20 Polanga blend shows performance characteristic closest to diesel fuel with all respects. At higher fuel injection timing particularly of 28°bTDC should be the mode of operation when the diesel engine is fuelled with Polanga biodiesel blends. Also, higher fuel injection pressure of 226 bars is preferable for Polanga biodiesel blends due to its relatively higher viscosity of test fuel. The exhaust emission assessment shows that the Polanga biodiesel blend B40 gives least harmful exhaust emissions amongst all the Polanga biodiesel blends. Further, at a higher injection timing of 31°bTDC and injection pressure of 240 bars reasonably reduction of exhaust emissions is observed for B40 blend. The optimal solution for performance parameters is obtained by fuel injection timing 24°bTDC, 233 bar fuel injection pressure and B27 Polanga biodiesel blend. For exhaust emission constituents, one of the optimal solutions is obtained by 19°bTDC fuel injection timing, 231 bar fuel injection pressure and B19 biodiesel blend. Finally optimal solution when different weightages to engine performance and emission parameters is assigned then output are: fuel injection timing 25°bTDC, 235 bar injection pressure and B31 Polanga biodiesel blend.