CHAPTER – 6
CONCLUSIONS

5.1 Summary and Conclusions:

‘Optimization’ quite often is associated almost exclusively with the use of mathematical techniques to model and analyze decision problems and these mathematical and stochastic models are usually tailored to fit into specific real life problems. A known fact is that it is difficult to conceive a model that reflects the reality as close as possible and simultaneously simple for analysis. For this reason, different models each representing one or more problem situations are developed. During the past three decades a substantial body of literature has been developed on reliability models.

Until recently not much of work is reported on integrated reliability models and in particular on the integrated reliability models for redundant systems. Almost all the models that are reported primarily considered cost as the basic constraint in order to optimize the reliability of a system. Further to the best knowledge of the author the integrated
reliability models for redundant systems with multiple constraints (i.e. cost, weight, volume etc.,) are not reported, which prompted to consider a class of integrated reliability models with redundancy where multiple constraints are considered to optimize the models under consideration, which is perhaps a novel beginning in the mentioned area of research.

Primarily the basic concepts of reliability systems with different types with their applications and also the different methods to maximize the reliability of a system are detailed in first chapter.

Second chapter is completely devoted for a comprehensive literature survey of the basic models, which authenticates that only scanty literature is available on the integrated reliability models. The survey work is carried out on optimization techniques for system reliability models by classifying the models under system configuration, optimization techniques and by the structure of the optimization problems. The survey of literature authenticates that a very few research papers advocated the fact that integrated reliability models for redundant systems with multiple constraints can be studied and this prompted the author to initiate the work in this direction.

In third chapter the integrated reliability models for redundant systems with multiple constraints for the four commonly used mathematical functions are established by using Lagrangian method approach where component reliabilities \(r_j\) and the number of components \(x_j\) in each stage are treated as unknowns. The system reliability \(R_s\) is to be maximized for the given cost, weight and volume by determining the component reliabilities \(r_j\) and the number of
components required for each stage \( x_j \). The system considered in this series-parallel system with multiple constraints on cost, weight and volume and by applying the Lagrangian method, the different characteristics of the model namely component reliabilities \( r_j \), number of components \( x_j \), stage reliabilities \( R_j \) and the system reliability \( R_s \) are established for the given cost, weight and volume constraints.

At this stage a bottleneck is observed as the number of components required at each stage \( x_j \), is found to be in real value numbers, which is practically infeasible for real life applications. The author rounded off the values of \( x_j \) to the nearest integer and recalculated the characteristics of the models. The procedure leads to the inference that by rounding off the values of \( x_j \), the system reliability \( R_s \) is increased as there is increase in the cost of the system and this analogy is found in all the four case problems. The rounding off the values of \( x_j \) may not be in the passion of a sound analytic procedure and hence the author processes alternative procedures to optimize the integrated reliability models i.e., integer programming and heuristic approach, which are detailed in chapter four and five.

The integrated reliability models for redundant systems with multiple constraints for the four mathematical functions that are considered in chapter three are analyzed by applying the integer programming in chapter four. For the analysis purpose the values of the component reliabilities \( r_j \), are taken from Lagrangian method approach as input to carry out the integer programming analysis and this procedure is adopted for the four integrated reliability models under
The advantage of integer programming is that the number of components required for each stage \((x_j)\) directly gives an integer value along with the other values of the parameters, which is very convenient for practical implementation for the real life problems.

The integrated reliability models for redundant systems with multiple constraints for the four mathematical functions that are considered in chapter three are analyzed by applying the heuristic approach in chapter five. For the analysis purpose the values of the component reliabilities \(r_j\), are taken from Lagrangian method approach as input to carry out the heuristic approach analysis and this procedure is adopted for the four integrated reliability models under study. The advantage of this heuristic approach is that the number of components required for each stage \((x_j)\) directly gives an integer value along with the other values of the parameters, which is very convenient for practical implementation for the real life problems.

6.2 Scope for future work:

The Author in this work proposed a class of integrated reliability models for redundant systems with multiple constraints as a beginning in the mentioned area of research and initiated the optimizing the system reliability for the said models under two different approaches and the results reported in the work is highly useful for the reliability design engineers for successful implementation for the models which helps to produce high reliable and quality goods and the models are established for the series-parallel reliable configuration systems. These models can also be further investigated for different mathematical functions of
interest and can be applied for parallel-series configuration systems, where the application of these models for such systems will be feasible only when the cost of the system is very low. The author is of the opinion that the stated problem can be investigated under the scope of study.

REFERENCES