Reliability Engineering has been extensively developed over the years, since World War II with a significant contribution by defense personnel. This resulted in developing much more reliable products / services. Today it has gained much importance among practicing Engineers and Researchers. By blending Reliability concepts in all phases of the product life cycle from proposal to manufacture, it has become easy to manufacture Cost effective systems that perform better.

The Reliability of a System can be maximized subject to the resource constraint, to determine the optimum number of redundant Components for each stage, when the Reliability of each Component is known. In other situation, the Reliability of the System can be maximized subject to the resource constraint to determine the Reliabilities of the Components in the System, when the number of redundant units in each stage is known.

In literature many techniques are available to solve the problems in these two situations. K.B.MISRA [1972] developed a simple algorithm for the solution of redundant optimization problem. B. P. LIENTZ [1974] applied a stochastic Method of allocation of components by using the Method of implicit enumeration to maximize the system Reliability subject to Cost constraint for the given component Reliability value. D.W. McLEAVEY [1976] used the implicit enumeration technique for solving Reliability Optimization Problems.
A thorough investigation of literature on Reliability maximization of Redundant Systems clearly reveal the fact that many researchers outlined the System Reliability maximization problems derived using different techniques with a basic important Cost constraint under consideration. The literature regarding optimization of Integrated Reliability Models for Redundant Systems with Multiple Constraints is scanty in nature, that a few authors mentioned that the system could be optimized with multiple constraints on Weight, Volume, Size etc., apart from the basic Cost constraint.


So far as the literature on maximization of System Reliability problems are concerned, the researchers opined that optimization problems can be handled with multiple constraints also but to the best of the knowledge of the researcher the optimization of Integrated Reliability Models for Redundant Systems with Multiple Constraints are not reported.
STATEMENT OF THE PROBLEM:

Integrated Reliability Model refers to the determination of the number of components, component Reliabilities, stage Reliabilities and the system Reliability where in the problem considers both the unknowns that is the component Reliabilities and the number of components in each stage for the given Cost constraint to maximize the System Reliability. So far in literature the Integrated Reliability Models are optimized using Cost constraint alone where there is an established truth between Cost and Reliability.

The novel aspect of this Thesis is to optimize a class of Integrated Reliability Models for Redundant Systems with Weight and Volume as additional constraints apart from the basic Cost constraint. The author in this Thesis also makes an attempt to negotiate the impact of Weight, Volume (apart from Cost) as constraints in optimizing the Redundant Systems under consideration for the selected mathematical functions. Though Cost has direct relation in maximizing System Reliability, the analysis of the Thesis is an effort to explain the hidden fact of the impact of Weight and Volume as constraints in optimizing the Reliability of a Redundant System presents a novel beginning in the mentioned area of research.

The Integrated Reliability Models for Redundant Systems with Cost, Weight and Volume as constraints for three mathematical functions are considered for the proposed work. The author tries to establish the naked truth that these models are handy with high application value particularly in the case of Integrated Reliability Models for redundant systems with Series – Parallel Configurations, perhaps best suited for Parallel – Series Configuration whenever the Cost of the system is very low.
CHAPTER WISE SUMMARY:

The Thesis is presented in five substantive chapters. The brief summary of the Thesis followed in the sequel outlining the contents chapter by chapter. The CHAPTER ONE introduces the basic definitions on the different types of the Reliability Systems and their applications with different approaches to maximize the Reliability of the System. The problem of Integrated Reliability Models for Redundant Systems is discussed by presenting various types of models with their applications, which is the core interest of this Thesis work.

The Reliability optimization has attracted many researchers since 1960 due to its critical importance in various kinds of Systems. From later part of 1970’s many researchers contributed their mite in the different fields of Reliability Engineering, which paved the way for better and better manufacturing process, and the SECOND CHAPTER is devoted to present a comprehensive survey of literature on System Reliability Optimization. F.A. TILLMAN et al (1977) and W. KUO and V.R. PRASAD [2000] presented a fascinating overview of System Reliability Optimization Models and care has been exercised to present the available scanty literature on Integrated Reliability Models for Redundant Systems.

To study and optimize the Integrated Reliability Models for Redundant Systems with multiple constraints is considered accounting Cost, Weight and Volume as constraints, for the mathematical function \[ r_j = \left[ \frac{c_j}{b_j} \right]^{\frac{1}{a_j}} \] where in the results are established. To establish the results, Integrated Reliability Models for Redundant System for the specified
mathematical function, Lagrangean Multiplier Method is applied, calculating the number of Components in each stage, its Component Reliabilities and corresponding stage Reliability are derived in real value numbers. The analysis are applied for the other two mathematical functions namely

\[ c_j = a_j \exp \left( \frac{b_j}{1 - r_j} \right) \quad \& \quad r_j = \frac{\Pi}{2} \tan^{-1} \left( \frac{c_j}{b_j} \right)^{1/d_j} \]

which are commonly used in many practical applications in the field of Reliability Engineering is presented in CHAPTER THREE.

The CHAPTER FOUR is devoted to optimize the Integrated Reliability Models for Redundant Systems with Multiple Constraints using Dynamic Programming Approach by establishing the three models, which are considered in Chapter Three by presenting the apt Case Problems.

The CHAPTER FIVE presents the conclusions drawn from the present study and the results of the models under investigation clearly conclude the importance of such optimization Methods in real life problems, which are handy in application. The results of this Thesis support the researchers’ statement of the problem concurring that these Models are particularly of high application value for any Redundant Systems with multiple constraints.