9.1 Conclusion

In the thesis, the following ten different industrial based models have been investigated and it is concluded that:

- In model-I, the various reliability measures of the system in which three units are connected to each other in mixed configuration and one of the unit is of the type 1-out-of-2: G, is investigated and it concluded that, a better maintenance/repair policy is necessary for making a system available for a long time with an efficient production/output.

- In model-II, a structure which consist two substructures, one of them is 2-out-of-3: F type, is investigated. Compared with the work done by [45, 46], this model discussed $k$-out-of-$n$ structure with human error which is an essential factor in context of the failure of any system and shows the importance of human error in context of $k$-out-of-$n$: F structure.

- Compared with the work done by [47], model-III investigated a system which is a combination of $k$-out-of-$n$: F and parallel subsystems with common cause failure, electrical failure, human failure is studied and it is concluded that the system is equally sensitive with respect to common cause failure, electrical failure and human failure, also MTTF of the system is more sensitive with respect to electrical failure.

- The different sections of a paper mill were investigated by the authors [61, 62, 101 and 112] in the past. Compared to these, model-IV investigated a paper mill as a whole for evaluating its various performance measures with the power supply degradation concept and concluded that the system’s MTTF is lowest with respect to head box and press part failure and highest with respect to dryer failure.

- Compared to the work done by Khanduja [69] for screening unit of a paper plant, model-V investigated screening unit, digester unit, opener, knotter and washing unit of a paper plant simultaneously and found better results for all these units in context of reliability indices which are not founded earlier. In findings, the system reliability is lowermost sensitive with respect to the failure rate of digester and screening system,
uppermost with respect to the failure rate washing system, which indicates that the system is more reliable if we focus more on these units.

- In model-VI, the coal handling unit of a thermal power plant is considered. Thermal power plant were also investigated by [64, 74, and 104], compared to these, this model found that system reliability is much more sensitive with respect to simultaneous failure rate of one unit of wagon tripler and one unit of conveyor. Also, the MTTF of the system is highly sensitive again with respect to simultaneous failure rate of one unit of wagon tripler and one unit of conveyor.

- In model-VII, the casting process under stochastic modeling is examined and concluded that the MTTF of casting process is highest with respect to the failure rate of shrinkage and blowholes and the lowest with respect to the failure rate of cold shut. Also, its reliability is more sensitive with respect to failure rates of mould shift, shrinkage & blowholes.

- In model-VIII, an industrial system under multi state failures and standby redundancy with human error and catastrophic failure is investigated. Similar model was also discussed [28, 34] but they did not consider catastrophic failure and human error simultaneously in the system which can exist in every system. It was founded that system reliability is more sensitive with respect to human error and catastrophic failure. Also, the MTTF of the system is highly sensitive with respect to human error.

- In model-IX, a Marine power plant for evaluating its various reliability characteristics is investigated. Compared to the work done by Kumar et al. [114], this model investigated MPP with the help of Markov process and supplementary variable technique and found some more reliability characteristics for the same which was not founded by [114], and concluded that the reliability as well as MTTF of the MPP is highly sensitive with respect to the failure rate of DSB.

- Performance assessment and reliability analysis of a sugar mill is done in model-X. Compared to the work done by Kumar et al. [61] for calculating availability analysis of feeding system of a sugar mill, here, author investigated not only the feeding system, but also evaporation and crystallization system of a sugar mill. On the basis of the analysis, one can say that the failure rate of bagasse carrying system has not much impact on the production and MTTF is much sensitive with respect to the failure rate of sub parts of feeding system (cutting and crusher system).
It asserts that the finding of this thesis is very helpful for concerned system/plant management for improving systems performance and reliability.

9.2 Future Work

In future, one can extend this research work for more complex industrial systems as well as simple system for improving their production and expected profit. Also, more complex systems can be solved by modern technique like soft computing technique, machine learning technique etc. to evaluate other important characteristics of the system through which they can:

- Find mean time to repair for the systems.
- Reduce various failure/repair rates.
- Identify right cause to system failure.
- Improve operating conditions.
- Optimize running cost and maximize profit.
- Adopt right maintenance policy.