CONCLUSIONS

With the increasing complexity of the modern electronic equipments, the large scale communication systems and the computer communication networks, the awareness in the problem of reliability analysis and optimization has increased. As the systems become larger in size, the reliability analysis becomes more difficult and most of the existing algorithms for the reliability evaluation become prohibitive.

In Chapter-2 of this thesis, an attempt has been made to overcome this problem of reliability evaluation in complex systems. A system is considered in the form of its probabilistic graph or reliability logic diagram which is then decomposed or partitioned through an appropriate cutset into two subgraphs. The connection matrix multiplication and node removal methods of path enumeration are then concurrently applied, in order to obtain the conditional success events in the form of Boolean functions. These Boolean functions are then transformed to the corresponding probabilistic functions in order to obtain the final terminal reliability expression. This proposed technique is efficient, general and can be computerized. By solving a set of typical examples, it is observed that this method yields quite accurate results.

Most of the existing techniques of reliability evaluation consider the system a success, if all the elements
of any s-t path are operating successfully and ignore the capacity of various components of the system. However, this assumption is not true, since any element of a practical system (for example a communication system, CCN, telephone network, power distribution system, chemical system, transport system, etc.) is capable of allowing only a limited amount of information content to pass through them but the system is termed a 'success' only if at least a minimum permissible capacity is passed from the source to the terminal node.

In Chapter-3 of this thesis, this aspect of reliability analysis under the capacity constraint is considered. A system is now said to be in the state of success only if a set of its elements (or communication links) are allowing the required information content to be communicated from the source to the sink node. It is not considered sufficient to have all the elements contained in any of s-t paths operative. A systematic procedure has been evolved for determining the successful states for the purpose of reliability evaluation. The method is implemented on a DEC-20 system using FORTRAN IV.

Sometimes the computing system is such, that it is advantageous to work with cutsets rather than paths. Therefore, another algorithm is developed which is based upon the cutset approach. This method gives an expression of the terminal reliability using less memory space.

In the large scale computer communication networks, the various computing systems or terminals or interface
message processors (IKPs) are geographically situated at different locations and have different facilities available. It is so, because it is not economical to have similar systems at different places, instead the resources of the various systems are being shared optimally by some or all systems.

One of the fundamental design considerations of a CCN, is the availability of at least one communication path between any pair of nodes. It is also important to design the maximally cost effective system, if the cost of installation of various links in their pre-assigned topology is known. In Chapter-4 of this thesis, an optimal link allocation algorithm is suggested which gives the maximum terminal reliability under the condition that the total permissible cost of installing the links is limited. This heuristic technique of obtaining the maximum s-t reliability solution, is evolved under two different practical situations.

One of the other measures of reliability is the overall reliability or the Global availability, in which the system is considered reliable only if there is a possibility of communication amongst all node pairs of the network or in other words, when one is interested in not permitting the service disruption between any pair of nodes rather than the disruption of service in some specific node pair of the network.

In the Chapter-5 of this thesis, a new technique is developed for optimal link allocation scheme to achieve
maximum overall reliability, subject to the maximum permissible cost of installing the various links in their pre-assigned topological locations. The costs of establishing various links and their corresponding reliabilities are of course assumed known. Evaluation of the overall reliability of a CCN requires much more computational effort as compared to that of the evaluation of terminal reliability. Since for overall reliability evaluation, one is to determine all the spanning trees, which by itself is quite time consuming. In this thesis, a simple algorithm for determining all the spanning trees is also presented, which takes less computation time than many of the existing algorithms.

The suggested methods of obtaining the maximum terminal and overall reliability, subject to the cost constraint, have another significant advantage, over other methods i.e., if the budgetary resources are enhanced later, the same system design can be supplemented for the optimization of the system reliability by installing more communication links rather than redesigning the whole system.