PREFACE

The First chapter of this thesis entitled "A Study of Queuing Modeling techniques and their Applications in Communication Systems" is devoted to the introductory back ground of the topic in queuing system, classification, data communication and other issues directly related to the work. It is Erlang, a Danish mathematician, who was the founder of the queueing theory. In queue system the numbers of units / servers are available to provide the services for the customers who arrive at their own choice of time. The are served by one or more servers according to a given service discipline, the service time being randomly distributed and governed by some probabilistic laws and after being served the customers depart from the system.

The Second Chapter of this thesis is a collection of all such research work, which is available in the literature, and directly-indirectly correlates to our work. The concept of bulk queue was implied in the work of Erlang. The study of queue with bulk service is originated in 1954 by Bailey. Queues with bulk service are described as customers get service in batches in this chapter we have included various type of Interdependent queuing models.

The Third Chapter of the thesis is the important and main, as it include all four-research problems. The general motivation for the present research has been written briefly. The Details of each problem is as mentioned below:
In the Problem – I, It revels from the literature that queuing theory and network application have virtually exploded with analytical models for different networks. Such as for the telephone systems, the data transmission rates were some time not so easy to meet the damned, consequently, planning for special data network began earlier in Europe then it did in the United States. Since there was not yet a great demand for data services, planning was directed towards to meet the future data requirement. In this problem the response time analysis to the bulk arrival queue system in communication systems has been discussed. Graph theory plays an important role in modeling and analyzing several problem concerns with various aspects of networking field. Also graph theoretic modeling find extensive applications in queuing theory for the networking problems. The main aspect of the present model is service of the transmitter, which is assumed to be bulk. We obtain the path sets of the network, corresponding to each path, and then obtained the Mean Response Time. The method can be applied for the network of any size.

The title of the Problem – II is Graph and queuing theories have been recognized as some of the most powerful mathematical tools for making quantitative analysis in Computer Communication Networks. In the present paper, a model for mean response time is analyzed, which is based on these theories. The all path sets of Computer Communication Networks have been listed and the M\textsuperscript{y}/M/1 queue model is applied for response time analysis of each path set. A comparison amongst the mean response time for each path sets shown through tabular as well as graphical form has been given in the text of the body of the paper. The effect of arrival rate on the mean response time is also
discussed. The model suggested in this paper, would be helpful for the network designer in deciding data routing strategies.

In the Problem - III, This chapter consists of the queuing models $M/M/C/K/\infty$ with balking; reneging, and spares servers are available, customers arriving rate is $\lambda$. We takes $Y$ spares so that when a machine fails, a spare is immediately substituted for it, if it happen that all spars are use an are a breakdown occurs then the systems becomes short. When a machine is repaired then it becomes a spare (unless the system is short in which case the repaired machine goes immediately into service). We analyze the two cases of spares, first of them is $C \leq Y$ and the other is $C > Y$.

Kleinrock [117] had worked out on the truncated Poisson distribution for solving the problem $M/M/C/K/N$ for machine interference but without assumptions of balking, regaining or spares. Gross and Haris [87] discusses the system's $M/C/m/m$ with spares only an Medhi [134] treated the system $M/M/C/m/m$ without assumption of balking, reneging and spares. Showky [152] considered $M/M/C/K/N$ machine interferences model with balking, regaining and spares. With the development of technology of manufacturing, such as those found in computer and communication system, the efficiency of machine system is critical to overall competitiveness, many researchers have been worked on machine repair problem.

Gupta and Rao [89] derived a recursive method to compute the steady state probabilities personalities of $M/G/1$ machine interference model of Jain et. al. extended the work of Shawky [151] by including additional repairmen in case of long queue of failed units.
The main assumptions of present chapter are infinite source o infinite customers. Each with an arriving rate \( \lambda \), c servers are available, that service times are identically exponential random variables wit rate \( \mu \), also the system has finite storage room and also assume that we have Y spares on hand. So that when a machine fails, a share immediately substituted for it if it happens that all spares are used and a breakdown occurs, then system becomes short. When a machine is repaired, it then becomes a spare (unless the system is short in which case the repaired machine goes immediately into service.) Here we analyze the two cases of spares first of them is \( C \geq Y \) and \( C < Y \) and also discuss special cases.

In the Problem - IV, Queuing models provide the basic framework for efficient design and analysis of many practical situations. Along with several other assumptions it is customary to consider that the arrival and service process are independent .A queuing model in which arrivals and services are correlated is known as interdependent queuing model. In interdependent queuing model, Liney,D.Y. (1952)[123] analyzed a single server queuing model with recurrent input and arbitrary service times with that assumption the service time of the \( n^{th} \) customer and time interval between arrivals epochs are related by a linear function. The present chapter discusses a queue model of the type M/M/C where, queuing system with the assumption the arrival and service process of the system are correlated and follow a vibrate Poisson distribution. In the addition to this interdependence when ever queue size reaches a certain prescribed limit R, The arrival rate reduces from \( \lambda_0 \) to \( \lambda_1 \) and it continues with the reduce rate \( \lambda_1 \) as long as the number of customer in the queue is greater than some other prescribed integer \( r \) (0 \( \leq r \leq R \)) and when the system reaches \( r \), the arrival rate changes back to \( \lambda_0 \) and the same process is
repeated. This operating strategy is called controllable arrival rates with prescribed integer R and r.

In general waiting line of a queuing model increases due to slow serving rate or fast arriving rate. There are several research papers in which the service rate is controlled to decrease the queue length. Queuing models with controllable service rate have been discussed by Gray W, Wang P Scott, M and C.M. Wang P. Many years ago, Connolly and Hadidi (1969)[93] have studied the single server queuing model with that assumption the rate $S_n / T_n$ is constant for all $n$, where $S_n$ is the $n^{th}$ customer service time and $T_n$ in the time interval between $n^{th}$ and $(n+1)^{th}$ arrival epoch. Mitchel and Paulson (1979)[137] have considered and M/M/1 queuing system with an assumption that the inter arrival times separating the arrival from that of his predecessor and the customer service times follows a vibrate exponential distribution. Their analysis is based on simulation of the waiting time process. Conolly and Choo (1979)[43] have provided means for exact calculation of the waiting time for a generalized correlate queuing with exponential demand and service. Lengaris (1987)[122], Borst and Combe (1992)[29] have studied the busy period analysis of a correlated queue with exponential demand and service M.I. Aftab Begum and D. Maheswari (2002)[129] have studied the M/M/C interdependent queuing model with controllable arrival rate. Here we consider the arrival and a service process of the single server infinite capacity queuing system are correlated and follow a vibrate Poisson process having the joint probability mass function of the form

\[ x \]
\[ P(X_1 = x_1, X_2 = x_2; t) = e^{-(\lambda_1 + \mu - e)t} \]

\[
\sum_{j=0}^{\min(X_1, X_2)} (et)^j [\left(\lambda_1 - e\right)t]^{X_1 - j} \frac{[\left(\mu_t - e\right)t]^{X_2 - j}}{J!(X_1 - J)!(X_1 - J)!}
\]

With parameters \( \lambda_1 \) (I = 0,1), \( \mu \) as the mean arrival rate, mean service rate and mean dependence rate (covariance between the arrival and service processes) respectively. The operating strategy of the system is controllable arrival rate with prescribed integer \( R \) and \( r \).

In the Fourth Chapter, as we all know that research is an on going process and there is no last limit so that we have coin some of the new research problems, each are to be solved by the future researcher. Keeping these things in mind, the last chapter of this thesis contains the future scope of this research area and new research problem along with the suggestions for the researchers.

During the period of this research work some of the research papers have been presented in various seminar and conferences. And also some of research papers have been sent for the publication in various journals. A combined list of such papers has been mentioned in this chapter.

During this research work we have gone through large number of research papers, books, monographs, Ph. D. thesis etc. so that in the last of the thesis a list of in alphabetic order of such research material has been attached.