1.11 Author's Contribution

This dissertation presents the analysis of some single server queueing models with certain combinations of single arrival, bulk arrival, single service, bulk service, server failures and server vacations.

Chapter two is devoted for the investigation of "Poisson bulk arrival queueing model with time and operation dependent server failures". The server is subjected to time and operation dependent failures and arrival rate depends on the up and down state of server. The time to failure is exponentially distributed and repair times follow general distribution. The failure rate depends on whether the server is idle or busy, and the repair time depends on whether the failure occurred during the idle or busy period of the server. The probability generating function of the steady state system size is obtained at customer departure epoch, using embedded Markov chain technique. The probability generating function of the steady state system size at an arbitrary time is obtained, using level crossing method. Expressions for expected system size, expected length of busy and idle periods are derived. Numerical illustration is presented.

Chapter three contains the analysis of "M/G(a,b)/1 queueing system with time and operation dependent server failures ". The customers arrive singly and service is done according to general bulk service rule. As per this rule, the server will start a service, if there are atleast 'a' customers in the queue. If there are fewer, he waits for the queue length to reach 'a' and then serves a group of size 'a'. If after a departure or repair completion epoch during idle period, the queue length ξ is atleast 'a', a group of size min(ξ, b) (where $b \geq a$) is served . Service time is independent of the group size. The server is subjected to time and operation dependent failures and arrival rate depends on the up and down state of server. The time to failure is exponentially distributed and repair time follows general distribution. The failure rate depends on whether the server is idle or busy and the repair time depends on whether the failure occurred during the idle or busy period of the server. The probability generating function of the steady state system size at customer departure epoch is obtained, using embedded Markov chain technique. The probability generating function of the steady state system size at an arbitrary time is obtained, using level crossing method. Expressions for expected system size, expected length of busy and idle periods are derived. Numerical solution for particular values of parameters is also presented.

In chapter four, "Poisson bulk arrival queueing model with general bulk service and multiple vacations" is considered. After completing a service, if the queue length is less than 'a', the server leaves for a vacation. When he returns, if the queue length is still less than 'a', he leaves for another vacation and so on, until he finally finds atleast 'a' customers waiting for service. After a vacation, if the server finds 'a' or more customers in the system say ξ, then he serves a batch of min (ξ, b) customers, where $b \geq a$. Using supplementary variables technique, the probability generating function of the steady state queue size at an arbitrary time is obtained. Expressions for expected queue length, expected length of busy and idle periods are derived. A cost model for the queueing system is discussed. Numerical illustration is presented.

Chapter five is devoted for the analysis of "$M^x/G(a,b)/1$ queueing model with multiple vacations and setup time and threshold - policy". Two queueing models with different threshold policies to start the setup process are considered. In Model I, after completing a service, if the queue length is ξ, where $\xi < a$, then the server takes the vacation according to the following procedure. If the queue length ξ is less than the threshold value 'd', he leaves for a vacation. When he returns from the vacation, if the queue length is still less than 'd', he leaves for another vacation and so on, until he finally finds atleast 'd' customers waiting for service. After a service, if the queue length ξ is such that $d \leq \xi < a$, then the server avails a single vacation. After a vacation, if the queue length is atleast 'd', then the server requires a setup time R to start the service. After setup time, if the server finds 'a' or more customers, then he serves according to general bulk service rule, otherwise he remains in the system till the queue length reaches 'a'. Model II differs from Model I in that, after a service if the queue length is less than 'a', the server avails multiple vacations till the queue length reaches N ($N \geq b \geq a$). After a vacation, if the queue length is atleast N, then the server requires a setup time R to start the service. After the setup time, he starts service with a batch of 'b' customers, since atleast 'b' customers will be waiting in the system. The probability generating function of the steady state queue size at an arbitrary time is obtained, using supplementary variables technique. Expressions for expected length of queue, busy period and idle period are obtained. A cost model is discussed. Numerical illustration is presented. Corresponding results for "$M^x/G(a,b)/1$ queueing model with multiple vacations and setup time" are deduced as a particular case of the Model I by substituting 'd' equal to 'a'.

Chapter six is devoted for the analysis of "$M^x/G(a,b)/1$ queueing system with multiple vacations and repair of service station on request by a leaving batch of customers". It is assumed that whenever a leaving batch of customers is dissatisfied with the low quality of service rendered, they may complain and request that the station be adjusted to its proper level of service. The leaving batch of customers may request for repair of service station with probability π and it is assumed that more than one request will never be made by the same batch. After the repair time or service completion without request for repair, if the queue length is less than 'a', the server avails multiple vacations till the queue length reaches 'a'. After a vacation or a service completion without request for repair or a repair completion, if the server finds atleast 'a' customers waiting for service, he serves according to general bulk service rule. Using supplementary variables technique, the probability generating function of the steady state queue size at an arbitrary time is obtained. Expressions for expected length of queue, busy period and idle period are obtained. A cost model is developed. Numerical illustration is presented.

Chapter seven contains the analysis of "$M^x/G(a,b)/1$ queueing system with multiple vacations of alternate type". After a service, if the queue length is less than 'a', the server leaves for a vacation of type V_1 with cumulative distribution function $V_1(.)$. After returning from vacation type V_1, if still the queue length is less than 'a', he leaves for another vacation of type V_2 with cumulative distribution function $V_2(.)$. The server takes vacations V_1 and V_2 alternately, until he finds, on returning from a vacation, atleast 'a' customers waiting for service. After a vacation, if the server finds ξ ($\xi \geq a$) customers in the system, then he serves a batch of min (ξ, b), customers, where $b \geq a$. Using supplementary variables technique, the probability generating function of the steady state queue size at an arbitrary time is obtained. Expressions for expected queue size, expected length of busy and idle periods are derived. A cost model is developed. Numerical solution for particular values of parameters of the model is presented.

In chapter eight, an application for a production line system is discussed. A numerical model is analysed to illustrate how the management of flow line system can use the results discussed in chapters four, five, six and seven to make the decision regarding the threshold value 'a' of bulk service rule to minimise the total average cost.

In the last chapter, a brief discussion about the work done, what is achieved, what is not possible to achieve and suggestions for further work is presented.