ABSTRACT

Retrial queueing system are characterised by the feature that a customer who finds all servers busy upon arrival is obliged to leave the service area and to repeat his demand after some random time. Between retrials, a blocked customer remains in a retrial group called orbit. The retrial queues have wide practical use in telephone systems and computer communication networks: auto repeat facilities in telephone networks, local area networks, and carrier sense multiple access protocol, etc. This study discusses retrial queueing models with feedback, server breakdown, collision, with control policy on vacation in continuous and discrete time. The proposed models of this research work have been theoretically developed and numerically justified.

The thesis starts with introductory concepts of retrial queues. It also presents a brief survey of some relevant existing research work on retrial queues.

In the proposed work, six different retrial queueing models have been analysed. For all the models various performance measures, some special cases and particular cases are discussed. Numerical illustrations are also provided for all the models.

A single server non- Markovian retrial queue with two phase of service, modified J - vacation and closedown times is analysed first. If the primary call, on arrival finds the server busy, then becomes impatient and leaves the system with probability $1-\alpha$ and with probability α it enters into an orbit. The server provides preliminary First Essential Service (FES) to the primary arriving calls or calls from the retrial group. After completing the first essential service the server provides Second Optional Service (SOS) with

probability β. After completion of first essential service without request for second optional service or at the completion of second optional service and whenever the orbit is empty the server performs close down job. After closedown job, the server leaves for a vacation of random length. After a vacation when the server returns, if no customer appear in the orbit the server leaves again for another vacation of same length. Such pattern continues until the server finds at least one customer is recorded in the orbit or completed J number of vacations in succession. At a vacation completion epoch, if the server finds at least one customer in the orbit or the server completed J vacation, the server remains idle and waits for new primary arrivals or arrivals from the orbit.

Then a discrete- time Geo/G/1 retrial queue with starting failures, second optional service and single vacation is analysed. The arriving customer who finds the server busy leaves the service area and join the orbit to try again for their request later. The retrial time follows a general distribution. An arriving customer who finds the server idle must turn on the service station. If the server is activated successfully with probability 'θ', the customer gets his service immediately; Otherwise, if the server is started unsuccessfully with complementary probability θ, the server is sent to repair immediately and the customer must join the orbit. The server provides a first essential service to all the arriving customers either from orbit or from main pool. After the completion of First Essential Service (FES), the customer may request for Second Optional Service (SOS) with probability 'α' or leaves the system with the complementary probability '$\bar{\alpha}$ '. At the service completion of FES without request for SOS, or at a service completion of SOS, if the orbit is empty, then the server avails a single vacation; otherwise the server remains in the system to serve the customer from the orbit or new arrivals.

A Discrete- time Geo/G/1 retrial queues with general retrial times, modified J- vacation policy and collision is presented in the next chapter. At the arrival epoch if the server is idle, then the arriving customer begins its service immediately. Otherwise, the arriving customer collides with the customer in service resulting in both being shifted to the orbit. After the collision, the server becomes idle. Whenever the orbit is empty, the server takes a vacation. At a vacation completion epoch, if the orbit size is zero, the server leaves for another vacation. This pattern continues until the server has taken a maximum number of J vacations, and then the server remains idle in the system to serve the customers from the main pool or from retrial group.

Then the analytical treatment of a discrete- time single server retrial queue with general retrial times, multiple vacations and state dependent arrivals is discussed. Here the arrival rates are different when the system is idle and busy or on vacation. If the server is busy or on vacation at the arrival epoch, the customers join the orbit to repeat the request later. On the other hand, if the server is idle, then the arriving customer begins its service immediately. The customers in the orbit try for service when the server is idle. At a service completion epoch, if the number of customers in the orbit is zero, the server goes for vacation repeatedly until at least one customer is found in the orbit. At a vacation completion epoch, if there is at least one customer found in the orbit, then the server remains idle in the system to render service for customers either from the main pool or from the retrial group. The primary arrival rate is p_1 when the server is idle and the primary arrival rate is p_2 when the server is busy or on vacation.

A single server discrete- time retrial queue with general retrial times and working vacation is analysed in the next chapter. If the server is busy at the arrival time, the customer joins the orbit to repeat its request later. On the other hand, if the server is idle, then the arriving customer begins its service immediately. As soon as the system becomes empty, the server begins a working vacation. In vacation models, during vacation time the server will not serve any customer. However, in the case of working vacation models, the arriving customers are served with a rate lower than the regular service rate during the vacation period. If the slow service is completed prior to the end of vacation, then the server avails the remaining vacation. On the other hand, if the service time is extended beyond the vacation time, the server switches to regular service rate and becomes idle after service completion. In these type of models the server works with different service rates rather than completely stopping service during a vacation. After completing a vacation, the server stays idle in the system until a customer arrives from the main pool or from the orbit.

Further, a discrete time Geo/G/1 feedback retrial queue with non-persistent customers, J- vacation policy and setup time is proposed. This chapter deals with a single server discrete time feedback retrial queue and follows general retrial times. Here the customers are non-persistent and the server avails J – vacation policy and does the setup work before he becomes idle. There is no waiting space in the system. Hence, the arriving customer gets its service immediately when the server is idle. Suppose if the server is busy, then the arriving customer becomes impatient and leaves the system with probability α and with probability α, enter into the orbit. If the orbit size is zero at a service completion epoch, the leaving customer may request for re-service (feedback) with probability θ; or with the probability θ the server does the secondary job (vacation). If there is at least one customer in the orbit at the service completion epoch, the server does the setup job with the probability θ and becomes idle. At a secondary job completion epoch, if the number of customers in the orbit is zero, the server avails a vacation. At a vacation completion epoch, if the orbit size is zero, the server leaves for another vacation of same length. This pattern continues until the server has taken a maximum number of J vacations, and then the server becomes idle.

Finally, the important features of the proposed models have been highlighted. A summary of major contribution of this research work and the possible directions for future work are also presented.