Assignment 3 (M&C 22-23)
BTech 5th Semester Stochastic Processes (MC 303)

1. Derive the distribution function of the sum of n identically and independently distributed exponential random variables each with parameter λ and find the probability distribution for the number of renewals in the interval (0, t].

2. Find the expected number of renewals by time t when the inter - renewal times between two successive renewals are independently distributed as

   (i)Uniform with parameter *a*,
   (ii) Standard normal,
   (iii) Erlang distribution with parameters *m* and λ.

3. Using the distribution function of the waiting time until the nth renewal, solve the so-called *spare part problem*: How many spare parts are absolutely necessary for making sure that the renewal process can be maintained over the interval (0, t] with probability 1- α ? Assume the distribution of the recurrence cycles and other parameters of your choice.

4. Mention the various types of
   (i) Queue Disciplines with one example in each case.
   (ii) Customer Behaviors like: Balking, Reneging, Collusion and Jockeying.

5. In a classical loss model M/M/c/c, if the call arrival rate is 2 per minute and on the average if a subscriber occupies a line for 3 minutes, then in case of a 7 lines telephone exchange find
   (i) probability of customer loss,
   (ii) mean number of busy channels.

6. Find the distribution of the waiting time in the queue in case of M/M/1 model. In case arrival and service rates are equal find the mean and variance of the waiting time in the queue in steady state.

7. In case of M/M/1/N model, where N is the maximum capacity of the system, if the arrival rate is 2 units per minutes, the average service time is 2 minutes and N = 5, then find

   (i) the probability that a customer is not allowed to join the system,
   (ii) mean number of customers in the system,
   (iii) if the mean service time reduces to 0.5 minutes, then what's the probability distribution of the customers in the system ?

8. Design a situation which results in a specific queuing model. Check for the existence of its steady state solutions. If the system is in working mode from 9 AM to 5 PM, find

   (i) expected number of idle periods and the mean duration of each idle period,
   (ii) expected number of customers served between 9 AM to 5 PM.
