IAT -2

Part -A

1. Define Balking,reneging and jockeying
2. What are the characteristics of a queuing system.
3. State Little’s formula for a ( *M* / *M* / 1) : (*K* / *FIFO* ) queuing model.
4. Suppose that customers arrive at a Poisson rate of one per every 12 minutes and that the service time is exponential at a rate of one service per 8 minutes. What is the average number of customers in the system?
5. What do the letters in the symbolic representation (*a* / *b* / *c* ) : (*d* / *e* ) of a queueing model represent?
6. Arrival rate of telephone calls at a telephone booth is according to poisson distribution with an average time of 9 minutes between two consecutive arrivals. The length of a telephone call is assumed to be an exponentially distributed with mean 3 minutes. Determine the probability t.hat a person arriving at the booth will have to wait.
7. State chapman kolmogorov theorem.
8. Find the transition probability matrix of the process represented by the state transition diagram.



1. Mention various types of Random processes.
2. Consider the random process (𝑡)=cos (𝜔𝑡+𝜃) where 𝜔 is a real constant and 𝜃 is a uniform variable in (0,𝜋/2). show that X(t) is not wss.

Part – B

1. Customer arrive at a one man barber shop according to a poisson process with a mean inter arrival time of 20 min. customers spend an average of 15 minutes in the barber chair. The service time is exponentially distributed. If an hour is used as a unit of time, then

* what is the probability that a customer need not wait for a haircut??
* What is the expected number of customers in the barber shop and in the queue?
* How much time can customer expect to spend in the barber’s shop?
* What is the average time customers spend in the queue?
* Estimate the fraction of the day that the customer will be idle?
* What is the probability that there will be 6 or more customers?
* Estimate the percentage of customers who have to wait prior to getting into the barber chair.

2. A petrol station has one petrol pump. The cars arrive for service according to a poisson process at a rate 0.5 cars per minute and the service time for each car follows the exponential distribution with rate of 1 car per minute compute:

1. The probability that the pump station is idle.

2. The probability that 10 or more cars are in the system.

3. The mean number, 𝐿𝑆 of cars in the system.

4.The mean waiting time 𝑊𝑞, in the queue and the mean waiting time, 𝑊𝑆, iin the system.

3. There are 3 typists in an office. Each typist can type an average of 6 letters per hour. If letters arrive for being typed at the rate of 15 letters per hour.

**(a).**What fraction of the time all the typists will be busy?

**(b).** What is the average number of letters waiting to be typed?

**(c).** What is the average time a letter has to spend for waiting and for being typed?

**(d).** What is the probability that a letter will take longer than 20 minutes waiting to be typed and being typed?

4. A supermarket has 2 girls attending to sales at the counters. If the service time for each customer is exponential with

mean 4 min. and if people arrive in Poisson fashion at the rate of 10 per hour,

a) What is the probability that a customer has to wait for service?

b) What is the expected percentage of idle time for each girl?

c) If the customer has to wait in the queue, what is the expected length of his waiting time?

5. A one person barber shop has 6 chairs to be accommodate people waiting a haircut. Assume that the customers who arrive when all the 6 chairs are full leave without entering the barber shop. Customers arrive at the rate of 3 pere hour and spend an average of 15 minutes in the barber chair. Compute (1). P0 (2). Lq (3). P7 (4). Ws.

6. Patients arrive at a clinic according to Poisson distribution at a rate of 30 patients per hour. The waiting room does not accommodate more than 14 patients.Examination time per patient is exponential with mean rate of 20 per hour. a) Find the effective arrival rate at the clinic.

b) What is the probability that an arriving patient will not wait?

c) What is the expected waiting time until a patient is discharged from the clinic?

7. A car servicing station ha s2 bays where service can be offered simultaneously. Because of space limitation, only 4 cars are accepted for servicing. The arrival pattern is poisson with 12 cars per day. The service time in both the bays is exponentially distributed with 𝜇=8 cars per bay per day. Find the average number of cars in the service station, the average number of cars waiting for service.

8. Derive the formula for Ls , Lq , Ws and Wq for (M/M/1): ( ∞/FIFO).

9. At a port there are 6 unloading berths and 4 unloading crews. When all the berths are full, arriving ships are diverted to an overflow facility 20 kms down the river. Tankers arrive according to a poisson process with a mean of 1 every 2 hour. It takes for an unloading crew, on the average, 10 hour to unload a tanker, the unloading time following an exponential distribution. Find

(a). How long tankers are at the port on the average?

(b).How long does a tanker spend at the port on the average?

(c). What is the average arrival rate at the overflow facility?

10. Derive probability distribution of Poisson process and hence find its mean, variance, auto covariance, auto correlation function.

11. Customers arrive at a one window drive-in bank according to Poisson distribution with mean 10 per hour. Service time per customer is exponential with mean 5 minutes. The space is front of window, including that for the serviced car can accommodate a maximum of three cars. Others cars can wait outside this space.

1. What is the probability that an arriving customer can drive directly to the space in front of the window?

2. What is the probability that an arriving customer will have to wait outside the indicated space?

3. How long is an arriving customer expected to wait before being served?

12. Consider a markov chain {𝑋𝑛:𝑛=0,1,2….} having state spaces S = {1, 2, 3} and one step TPM P=(1).draw a transition diagram. (2). Is the chain irreducible? Explain. (3). Is the state – 2 ergodic? justify your answer .

13. A salesman territory consists of three cities A, B and C. He never sells in the same city on successive days. If he sells in city-A, then the next day he sells in city-B. However if he sells in either city-B or city-C, the next day he is twice as likely to sell in city-A as in the other city. In the long run how often does he sell in each of the cities?

14. A random process X(t) is defined by 𝑋(𝑡)=𝐴𝑐𝑜𝑠𝑡+𝐵𝑠𝑖𝑛𝑡,−∞<𝑡<∞ where A & B are independent random variables each of which has a value -2 with probability 1/3 and a value 1 with probability 2/3 such that X(t) is a WSS.