1. Define deterministic finite state automaton.

2. Define language of NFA.

3. construct a FSM M over A={a, b} which accepts those words from A such that of a's is even and the number of b's is divisible by 3.

4. Define transition function.

5. Consider the DFA $D = (\{q_0, q_1, q_2, q_3\},\ \{a, b\},\ \delta,\ q_0,\ \{q_1\})$ where δ is given by

	a	b
$\rightarrow\ q_0$	q_1	q_2
$*\ q_1$	q_3	q_0
q_2	q_2	q_2
q_3	q_2	q_2

Represent this by transition diagram. Does the DFA accept the string aabba?

6. Write the formula for effective arrival rate λ' for (M/M/C): (k/FIFO) queue.

7. For $(M/M/1)$: $(\infty/FIFO)$ model, what is the probability of a customer will be idle, If $\lambda = 8$ per hour and $\mu = 5$ minutes?

8. Write four characteristics of a queuing system.

9. What is the queue disciplines followed in general in a queuing model?

10. Write the formula for expected waiting time in the queue for $(M/M/C)$: $(N/FIFO)$ queue model.

11. Define non - deterministic finite state automaton.

12. Define language of DFA.

13. construct a FSM M over A={a, b} which accepts those words from A such that a's and b's that begins with ab or ends with ab or both.

14. Define extended transition function.

15. Consider the DFA $D = (\{q_0, q_1, q_2, q_3\},\ \{a, b\},\ \delta,\ q_0,\ \{q_1\})$ where δ is given by

	0	1
$\rightarrow\ q_0$	q_1	q_2
$*\ q_1$	q_3	q_0
q_2	q_2	q_2
q_3	q_2	q_2

Represent this by transition diagram. Does the DFA accept the string 00110?

16. Write the formula for effective arrival rate λ' for $(M/M/C)$: $(\infty/FIFO)$ queue.

17. State little's formula.

18. For $(M/M/1)$: $(\infty/FIFO)$ model, what is the probability of a customer will be idle, If $\lambda = 8$ per hour and $\mu = 12$ per hour?

19. What are the classifications of queuing models?

20. Write the formula for expected queue length for $(M/M/C)$: $(N/FIFO)$ queue model.

21. A one – person barber shop has 6 chairs to accommodate people waiting for haircut. Assume customers who arrive when all 6 chairs are full, leave without entering the barber shop. Customers arrive at the average rate of 3 per hour and spend an average of 15 minutes in the barber shop. Then find the (i) the probability a customer can get directly into the barber chair upon arrival (ii) expected number of customers waiting for haircut.

22. In a railway marshalling yard, goods train arrive at a rate of 30 trains per day. Assuming that inter arrival time and the service time distribution follows an exponential distribution with an average of 30 minutes. Calculate the following

i) The mean queue size

ii) the probability that queue size exceeds 10

iii) if the input of the train increases to an average of 33 per day, what will be the changes in (i) and (ii).

23. A super market has two girls ringing up sales at the counters. If the service time for each customer is exponential with mean 4 minutes and if people arrive in a Poisson fashion at the counter at the rate of 10 per hour, then calculate

i) the probability of having to wait for service.

ii) the expected percentage of idle time for each girl.

iii) if a customer has to wait find the expected length of his waiting time.

24. Consider the DFA whose transition function is given by the following table.

	0	1
$\rightarrow q_0$	q_2	q_1
q_1	q_3	q_0
$*q_2$	q_0	q_3
q_3	q_1	q_2

Find the state where the DFA is at after processing the string 110001 using the extended transition function.

25. Convert to the DFA the following NFA

	0	1
$\rightarrow p$	$\{p, q\}$	$\{p\}$
q	$\{r\}$	$\{r\}$
r	$\{s\}$	$\emptyset$
$*s$	$\{s\}$	$\{s\}$

26. Customers arrive at a one – men barber shop according to a Poisson process with a mean enter arrival time of 20 minutes. Customers spend an average of 15 minutes in the barber chair. If an hour is used as a unit of time, then

i) What is the probability that a customer need not wait for a hair cut?

ii) What is the expected number of customers in the barber shop and in the queue?

iii) How much time can a customer expected to spend in the barber shop?

iv) Find the average time that the customer expected to spend in the queue?

27. A telephone exchange has two long distance operators. The telephone company finds that during the peak load, long distance calls arrive in a Poisson fashion at an average of 15 per hour. The length of service on these calls is approximately exponentially distributed with mean length 5 minutes. What is the probability that a subscriber will have to wait for his long distance call during the peek hours of the day?

28.Consider the DFA whose transition function is given by the following table.

	a	b
$\rightarrow q_0$	q_2	q_1
q_1	q_3	q_0
$*\, q_2$	q_0	q_3
q_3	q_1	q_2

Find the state where the DFA is at after processing the string bbaaab using the extended transition function.

29. A stenographer has 5 persons for whom she performs stenographic work. Arrival rate is Poisson and service time is exponential. Average arrival rate is 4 per hour with an average service time of 10 minutes. Find

i) the average waiting time of an arrival

ii) the average length of waiting line

iii) the average time on arrival spent in the system.

30. Construct a deterministic finite automaton accepting T(m) where m has the following state table (1 is the starting state and 4 is the only final state).

	a	b
1	2	3
2	2	2, 4
3	_	4
4	4	4