1. Define a network.
2. Define free float.
3. Define CPM.
4. Define Total float.
5. What are the queue disciplines generally followed in a queueing system?
6. Define PERT.
7. Write down the difference between CPM and PERT.
8. What are the queue disciplines generally followed in a queueing system?
9. What is the idle time for the server in the single server infinite queue model?
10. Write down the formula for finding the expected number of customers in the system in the queueing model with Poisson arrival rate and exponential departure rate of single server and infinite queue length.
11. Write down the formula for finding the expected number of customers in the queue in the queueing model with Poisson arrival rate and exponential departure rate of single server and infinite queue length.
12. Write down the formula for finding the expected waiting time of customers in the system in the queueing model with Poisson arrival rate and exponential departure rate of single server and infinite queue length.
13. Write down the formula for finding the expected waiting time of customers in the queue in the queueing model with Poisson arrival rate and exponential departure rate of single server and infinite queue length
14. Define traffic intensity.
15. Define an activity.
16. What is the probability of queue length being greater than the number of customers n?
17. Define an event.
18. Define a dummy activity.
19. What is the probability that the waiting time of a customer exceeds time t?
20. The activity data for a project is given below:

Activity :	(1-2)	(1-3)	(1-4)	(2-5)	(2-6)	(3-6)	(4-7)	(5-7)	(6-7)
Optimistic time :	5	18	26	16	15	6	7	7	3
Pesimistic time :	10	22	40	20	25	12	12	9	5
Most likely time :	8	20	33	18	20	9	10	8	4

Determine the following:
a) expected task times and variances.
b) the earliest and latest expected times to reach each node.
c) the critical path and
d) the various paths and its project duration.
21. Tasks A, B, C,…, H, I constitute a project. The precedence relationships are

$$A < D;\ A < E;\ B < F;\ D < F;\ C < G;\ C < H;\ F < I;\ G < I.$$

Draw a network to represent the project and find the minimum time of completion of the project when time, in days, of each task is as follows:

Task :	A	B	C	D	E	F	G	H	I
Time :	8	10	8	10	16	17	18	14	9

Also identify the critical path.
22. Construct the network diagram having the following constraints.

$$A < D, E;\ \ B, D < F;\ \ C < G;\ \ \ B, G < H;\ \ \ F, G < I$$

Find also minimum time of completion of each task as follows.

Task	A	B	C	D	E	F	G	H	I

Time	23	8	20	16	24	18	19	4	10

Determine the critical path.

23. A civil engineering firm has to bid for the construction of a dam. The activities and their time estimates are given below:

Activity :	(1-2)	(2-3)	(2-4)	(2-8)	(3-5)	(4-6)	(5-9)	(7-9)	(8-9)
Optimistic time :	14	14	13	16	15	13	14	16	14
Most likely time :	17	18	15	19	18	17	18	20	16
Pessimistic time :	25	21	18	28	27	21	20	41	22

Determine the following:

a) expected task times and variances.

b) the earliest and latest expected times to reach each node.

c) the critical path and

d) the various paths and its project duration.

24. Customers arrive at a one-man barber shop according to a Poisson process with a mean interval 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 spends in the queue?

25. Arrivals at a telephone booth are considered to be Poisson with an average time of 12 minutes between one arrival and the next. The length of the phone call is assumed to be distributed exponentially with mean 4 minutes.

i) Find the average number of persons waiting in the system.

ii) What is the probability that a person arriving at the booth will have to wait in the queue?

iii) What is the average length of the queue, that forms from time to time?

26. A grocery store has a single cashier. It is known that the customers arrive at the rate of 20 customers per hour. The average number of customers that can be processed by the cashier is 25 per hour. Assume that the arrivals are Poisson and the service time is exponentially distributed. Find i) probability that the cashier is idle.

ii) Average number of customers in the queue.

iii) Average number of customers in the system.

iv) Average time a customer spends in the queue.

v) Average time a customer spends in the system.

28. If people arrive to purchase cinema tickets at the average rate of 6 per minute, it takes an average of 7.5 seconds to purchase a ticket. If a person arrives 2 minutes before the picture starts and if it takes exactly 1.5 minutes to reach the correct seat after purchasing the ticket.

i) Can he expect to be seated for the start of the picture?

ii) How early must he arrive in order to be 99% of sure of being seated for the start of the picture?