

ASSIGNMENT-02 (Unit 5)
Department of Mechanical Engineering
Faculty of Engineering and Technology, University of Lucknow
OPERATION RESEARCH (ME-6051)
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Q. 01. Define project management. What are the phases of project management? Explain each in brief.

Q. 02. What are the guidelines for the network construction? Differentiate between CPM and PERT.

Q. 03. The following table shows the job of network along with their time estimates. Draw the project network and calculate the length and variance of the critical path.

Job	1-2	1-3	2-4	3-4	4-5	3-5
Optimistic time	2	9	5	2	6	8
Most likely time	5	12	14	5	6	17
Pessimistic time	4	15	17	8	12	20

Q. 04. Activities, precedence relationship with activity and duration of activity in days, for a project is given in the following table. Construct a CPM Network for the project, and compute free float for each activity.

Activity	a	b	c	d	e	f	g	h	i
Immediate predecessor	-	-	-	a	c	b	b	d, f	g, h
Duration	12	12	25	13	15	14	10	8	6

Q. 05. The following table shows the job of network along with their time estimates. Draw the project network and find the probability that the project is completed in 40 days.

Job	1-2	1-6	2-3	2-4	3-5	4-5	6-5	5-8	7-8
a (days)	1	2	2	2	7	5	5	3	8
m (days)	3	1	2	5	4	6	7	8	1
b (days)	2	5	1	4	5	8	5	5	1

Q. 06. A project consists of 4 activities. Their logical relationship and time taken is given along with crash time and cost details. If the indirect cost is Rs. 2000/- per week, find the optimal duration and optimal cost.

Activity	Predecessor	Normal		Crash	
		Time in days	Cost in Rs/-	Time in days	Cost in Rs/-
A	-	4	4,000	2	12,000
B	A	5	3000	2	7500
C	A	7	3600	5	6000
D	B	4	5000	2	10000

Q. 07. Given below are network data and time–cost trade off data for small maintenance work.

Job	Predecessor	Normal		Crash	
		Time in days	Cost in Rs/-	Time in days	Cost in Rs/-
A	-	3	50	2	50
B	-	6	140	4	60
C	-	2	50	1	30
D	A	5	100	2	40
E	C	2	55	2	-
F	A	7	115	5	30
G	B, D	4	100	2	70

Assume that the indirect cost including the cost of lost production and associated costs to be as given below:

Project duration in days	2	11	10	9	8	7
Indirect Cost in Rs.	900	820	740	700	660	620

Work out the minimum total cost for various project duration and suggest the duration for minimum total cost.

Q. 08. The manager of a company wants to apply crashing for the following project by spending an additional amount not exceeding Rs. 2,000. Offer your suggestion to the manager.

Activity	Predecessor	Normal		Crash	
		Time in weeks	Cost in Rs/-	Time in weeks	Cost in Rs/-
A	-	20	8000	19	10000
B	-	15	16000	14	19000
C	A	22	13000	20	14000
D	A	17	7500	15	9000
E	B	19	4000	18	5000
F	C	28	3000	27	4000
G	D, E	25	12000	24	13000

Q. 09. The arrivals at a telephone booth are considered to be following Poisson law of distribution with an average time of 10 minutes between one arrival and the next. Length of the phone call is assumed to be distributed exponentially with a mean of 3 minutes.

- (a) What is the probability that a person arriving at the booth will have to wait?
- (b) What is the average length of queue that forms from time to time?
- (c) The telephone department will install a second booth when convinced that an arrival would expect to wait at least three minutes for the phone. By how much must the flow of arrivals be increased in order to justify a second booth?

Q. 10. If in a period of 2 hours, in a day (8 to 10 am), trains arrive at the yard every 16 minutes but the service time continues to remain 40 minutes, then calculate, for this period:

- (a) The probability that the yard is empty .
- (b) The average no of trains in the system, on the assumption that the line capacity of the yard is only limited to 3 trains.

Q. 11. In a departmental store one cashier is there to serve the customers. And the customers pick up their needs by themselves. The arrival rate is 9 customers for every 5 minutes and the cashier can serve 10 customers in 5 minutes. Assuming Poisson arrival rate and exponential distribution for service rate, find:

- (a) Average number of customers in the system.
- (b) Average number of customers in the queue or average queue length.
- (c) Average time a customer spends in the system.
- (d) Average time a customer waits before being served.

Q. 12. A product manufacturing plant at a city distributes its products by trucks, loaded at the factory warehouse. It has its own fleet of trucks plus trucks of a private transport company. This transport company has complained that sometimes its trucks have to wait in line and thus the company loses money paid for a truck and driver of waiting truck. The company has asked the plant manager either to go in for a second warehouse or discount prices equivalent to the waiting time. The data available is:

Average arrival rate of all trucks = 3 per hour, Average service rate is = 4 per hour.

The transport company has provided 40% of the total number of trucks. Assuming that these rates are random according to Poisson distribution, determine:

- (a) The probability that a truck has to wait?
- (b) The waiting time of a truck that has to wait,
- (c) The expected waiting time of company trucks per day.