[Time: Three Hours]   [Marks:80]
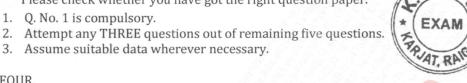
Please check whether you have got the right question paper.

N.B: 1.   Q. No. 1 is compulsory.
         2.   Attempt any THREE questions out of remaining five questions.
         3.   Assume suitable data wherever necessary.

Q.1   Attempt any FOUR.   5*4=20

a)   There are seven jobs , each of which has to go through the machines A and B in the order AB.
     Processing times in hours are as follows:

Job	1	2	3	4	5	6	7
Machine A	3	12	15	6	10	11	9
Machine B	8	10	10	6	12	1	3

Determine the sequence of these jobs that will minimize the total elapsed time.

b)   Generate a sequence of random numbers (at least five) using following data:
     m=100, seed value =57, a =35, b = 42

c)   Write the dual of the following primal LP problem:
     Max. Z= $2X_1+5X_2+6X_3$
     S.T
     $5X_1+6X_2-X_3 \leq 3$;
     $-2X_1+X_2+4X_3 \leq 4$;
     $X_1-5X_2+3X_3 \leq 1$;
     $-3X_1-3X_2+7X_3 \leq 6$;
     $X_1, X_2, X_3 \geq 0$

d)   Define and explain briefly: free float, total float, independent float and critical path.

e)   Explain mini-max and maxi-min criterion with an example(as applied to game theory)

f)   Use simplex method to solve:
     Max. Z= $80X_1+120X_2$
     S.T.
     $X_1+X_2 \leq 9$
     $20X_1+50X_2 \leq 360$
     $X_1,X_2, \geq 0$

Q.2   a)   A company has two grades of inspectors 1 and 2, the members of which are to be assigned for a   10
           quality control inspection. It is required that at least 2000 pieces be inspected per 8 hour day.
           Grade 1 inspectors can check pieces at the rate of 40 per hour, with an accuracy of 97%. Grade
           2 inspectors check at the rate of 30 pieces per hour with an accuracy of 95%. The wage rate of
           Grade 1 inspector is Rs 5 per hour while that of a grade 2 inspector
           is Rs 4 per hour. An error made by an inspector costs Rs 3 to the company. There are only 9
           Grade 1 inspectors and 11 grade 2 inspectors available to the company. The company wishes to
           assign work to the available inspectors so as to minimize the total cost of inspection. Formulate
           this problem so as to minimize the daily inspection cost.

TURN OVER

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b) Solve by Two Phase Method   10

Minimize $Z = 2X_1 - 5X_2 + X_3$

Subject to

$$X_1 + 3X_2 + 2X_3 \geq 15$$
$$X_1 - 2X_3 \leq 3$$
$$X_2 + X_3 = 6$$
$$X_1, X_2 \geq 0$$

Q.3 a) A steel company has three open hearth furnaces and five rolling mills. The transportation costs   10
(Rs. Per quintal) for shipping steel from furnaces to rolling mills are given in the following
table:

	M1	M2	M3	M4	M5	Supply
F1	4	2	3	2	6	8
F2	5	4	5	2	1	12
F3	6	5	4	7	7	14
Demand	4	4	6	8	8	

What is the optimal shipping schedule?

b) A department of a company has five employees with five jobs to be performed. The time in   10
hours that each man takes to perform each job is given in the effectiveness matrix.

		Employees				
		I	II	III	IV	V
	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
Jobs	D	7	11	9	7	12
	E	7	9	10	4	12

How should the jobs be allocated, one per employee, so as to minimize the total man-hours?

Q.4 a) The data collected in running a machine, the cost of which is Rs.60,000/-, are given below: 10

Year	1	2	3	4	5
Resale value(Rs.)	42000	30000	20400	14400	9650
Cost of spares(Rs.)	4000	4270	4880	5700	6800
Cost of labor.(Rs.)	14000	16000	18000	21000	25000

Determine the optimum period for replacement of the machine.

b) In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that   10
the inter-arrival time follows an exponential distribution and the service time (the time taken
to hump a train) distribution is also exponential with an average of 36 minutes. Calculate:
expected queue size (line length)
Probability that the queue size exceeds 10.
If the input of trains increases to an average of 33 per day, what will be the change in the above
values of i and ii.

Q.5 a) Solve the following game whose payoff matrix is given below: 10

		Player B			
		B_1	B_2	B_3	B_4
	A_1	3	2	4	0
Player A	A_2	3	4	2	4
	A_3	4	2	4	0
	A_4	0	4	0	8

TURN OVER

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b) Determine the values of u_1, u_2, and u_3, so as to :   10
Maximize $Z= u_1.u_2.u_3$
Subject to the constraints
$u_1+u_2+u_3 = 10$,
$u_1, u_2, u_3 \geq 0$.

Q.6 a) A firm has a single channel service station with the following arrival and service time   10
probability distributions:

Inter-arrival time (min.)	Probability	Service time (min.)	Probability
10	0.10	5	0.08
15	0.25	10	0.14
20	0.30	15	0.18
25	0.25	20	0.24
30	0.10	25	0.22
		30	0.14

The customer's arrival at the service station is a random phenomenon and time between the arrivals varies from 10 to 30 minutes. The service time varies from 5 to 30 minutes. The queuing process begins at 10 a.m. and proceeds nearly 8 hours. An arrival immediately goes to the service facility if it is free. Otherwise it waits in a queue. The queue discipline is first come first served. If the attendant's wages are Rs 10 per hour and the customer's waiting time costs Rs 15 per hour, then would it be an economical proposition to engage a second attendant. Use simulation technique.

b) The following activities are associated with a project: 10

Activities	1-2	1-3	2-4	3-5	4-6	5-6	6-7	5-7	7-8
Optimistic time	5	18	26	16	15	6	7	7	3
Pessimistic 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. Construct the network diagram.
b. Expected activity time and variance.
c. Earliest and latest completion times of each event.
d. The critical path.
e. The probability scheduled time of completing the project is 2 weeks earlier than expected duration.

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