(Time: 3 Hours)   [Total Marks : 80]

N.B:
1) **Question No. 1 is compulsory**
2) **Attempt any THREE questions from remaining**
3) **Figures to the right indicate full marks**
4) **Answers to questions should be grouped & written together**

Q1 a How do you detect an unbounded solution in the simplex procedure   5

    b How do you identify the presence of multiple optima in the simplex method?   5

    c The following table gives the sales potential when different number of salesman   10
       allocated to four cities. The management has decided that at least one salesman
       has to be assigned to any territory. Advice, how the salesmen should be deployed
       to maximize sales. What will be the maximum sales volume.

City	Sales with number of salesman						
	1	2	3	4	5	6	7
A	5	6	10	16	20	22	24
B	4	5	8	12	15	18	20
C	6	8	10	14	16	19	22
D	7	9	12	15	18	22	24

Q2 a Use two phase simplex method to solve following problem   10
       Maximize $Z = 5 X_1 - 4 X_2 + 3 X_3$

       Subject to the constraints $2X_1 + X_2 - 6 X_3 = 20$

       $6X_1 + 5 X_2 + 10 X_3 \leq 76$

       $8X_1 - 3 X_2 + 6 X_3 \leq 76$

       $X_1, X_2, X_3 \geq 0$

    b A small furniture factory manufactures tables and chairs. It takes 2 hours to   10
       assemble a table and 30 minutes to assemble a chair. 4 workers on the basis of a
       single 8 hur s shift per day carry out assembly. Customers usually buy 4 chairs with
       each table, meaning that factory must produce at most four times as many chairs
       as tables. The sale price is Rs 1500 per table and Rs. 500 per chair. Determine the
       daily production mix of chairs and tables that would maximize the total daily
       revenues to the factory and comment on the significance of the obtained solution.

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Q3 a Solve the following problem by Dual simplex method   10
Maximize $Z = -3X_1 - 2X_2$

$$X_1 + X_2 \geq 1$$

$$X_1 + X_2 \leq 7$$

$$X_1 + 2X_2 \geq 10$$

$$X_1, X_2 \geq 0$$

b Solve the following transportation problem   10

	R1	R2	R3	Supply
G1	8	3	5	20
G2	4	6	3	45
G3	6	8	4	30
G4	8	6	9	25
Demand	30	40	45	

Q4 a Determine the job sequence that minimizes the total processing time(in min) of the   10
following six jobs on three machines in the order M_1, M_2 and M_3

Job no.	J_1	J_2	J_3	J_4	J_5	J_6
M_1	22	18	20	14	20	18
M_2	4	12	6	12	14	8
M_3	12	10	6	16	4	18

b In a departmental store one cashier is there to serve the customers. And the   10
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.

Q5 a A company uses annually 50,000 units of an item each costing Rs. 1.20 Each order   10
costs Rs 45 and inventory carrying cost is 15% of the annual average inventory
value.
   a) Find economic order quantity EOQ
   b) If the company operates 250 days a year, the procurement time is 10 days
       and safety stock is 500 units, find reorder level, maximum, minimum and
       average inventory.

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b Find the mixed strategies for players A and B and also the value of the following   10
   game.

	B			
	3	2	4	0
A	3	4	2	4
	4	2	4	0
	0	4	0	8

Q6 a Best-ride airlines that operates seven days a week has the following timetable.   10
      Crews must have a minimum layover of 5 hours between flights. Obtain pairing of
      flights that minimizes layover time away from home. For any given pairing, the
      crew will be based at the city that results in the smaller layover. For each pair also
      mention the city where crew should be based.

Flight No.	Mumbai - Delhi		Flight No.	Delhi - Mumbai	
	Departure	Arrival		Departure	Arrival
101	8:00 am	9:00 am	1	7:00 am	8:00 am
102	9:00 am	10:00 am	2	8:00 am	9:00 am
103	12:00 noon	1:00 pm	3	1:00 pm	2:00 pm
104	5:00 pm	6:00 pm	4	6:00 pm	7:00 pm

b A manufacturer is offered two machines A and B.A is priced at Rs.5,000 and running   10
   costs are estimated as Rs.800 for each of the first five years, increasing by Rs.200
   per year in the sixth and subsequent years. Machine B which has the same capacity
   as A, costs Rs 2500 but will have running costs of Rs.1200 per year for six years,
   increasing by Rs.200 per year thereafter. If money is worth 9 % per year, which
   machine should be purchased? Assume scrap value to be negligible.

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