B.E. Sem. VIII (Mech.)
June – 2009
Operations Research

1 1 JUN 2009

Time : 3 Hours]

[Max. Marks : 100

Instructions : (1) Attempt **all** questions.
(2) Figures to the right indicate the full marks.
(3) Assume additional data if necessary.
(4) Use graph paper for graphical solution.

1. A garment manufacturing company has 4 manufacturing units and 4 sales locations. The cost of production per unit garment at manufacturing unit is as under : **18**

Manufacturing Unit	A	B	C	D
Cost (Rs.)	100	150	200	250

The sales price per unit garment at sales location is as under.

Sales location	P	Q	R	S
Sales Price (Rs.)	300	350	325	350

The other cost and the transportation cost per unit garment from manufacturing unit to sales location is as shown in the following matrix.

		Sales Location			
		P	Q	R	S
	A	25	25	50	75
Manufacturing Unit	B	50	25	75	25
	C	25	50	25	50
	D	75	75	50	25

The data related to production capacity of the manufacturing units and demand of sales locations is as under.

Production capacity	A	B	C	D
(Units)	25	50	50	25
Demand	P	Q	R	S
(Units)	50	25	50	25

Formulate the problem as transportation problem and decide the distribution plan for the company so as to make optimal profit at the sales location.

1

P.T.O.

2. (a) What is degeneracy in simplex method ? How can it be resolved ? **18**

(b) A chemical compound requires minimum 80, 60 and maximum 90 units of ingredients A, B and C respectively. Three types of chemicals are available in market containing these ingredients as under.

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Ingredient Content

(Units/Unit of chemical)

Chemical	A	B	C	Cost (Rs./Unit)
1	1	2	1	300
2	3	2	1	300
3	1	1	2	500

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Formulate the problem as linear programming problem and solve it.

3. (a) Use Big-M method to solve the following : **16**

Minimize $Z = 3x_1 + 8x_2$

S.t.
$$x_1 + x_2 = 200$$
$$x_1 + 0x_2 \le 80$$
$$0x_1 + x_2 \ge 60$$
$$x_1 \ \& \ x_2 \ge 0$$

(b) Graph the following inequalities and show the solution space :
$$-x_1 + 2x_2 \ge 100$$
$$-3x_1 + 4x_2 \le 300$$
$$4x_1 + 6x_2 \le 600$$
$$x_1 \ \& \ x_2 \ge 0$$

OR

(a) Use two phase method to solve the following :

Maximize $Z = 5x_1 + 10x_2$

S.t.
$$2x_1 + x_2 \le 6$$
$$x_1 + 2x_2 = 6$$
$$x_1 + x_2 \ge 4$$
$$x_1 \ \& \ x_2 \ge 0$$

(b) Construct the dual of the following primal problem and solve it.

Maximum $Z = 3x_1 + 2x_2$

S.t.
$$2x_1 + x_2 \le 5$$
$$x_1 + x_2 \le 3$$
$$x_1 \ \& \ x_2 \ge 0$$

2

4. There are six subjects to teach the students and five professors are available. Each professor is capable to teach any one of the six different subjects. The class preparation time in hours for different subjects varies from professor to professor and is given in the following matrix.   **16**

		Subject					
		S_1	S_2	S_3	S_4	S_5	S_6
	P_1	12	10	15	22	18	8
	P_2	10	18	25	15	16	12
Professor	P_3	11	10	3	8	5	9
	P_4	6	14	10	13	13	12
	P_5	8	12	11	7	13	10

Using assignment technique determine which subject should be given to the visiting professor, if each professor can be assigned only one subject and visiting professor can be called for any subject.

OR

A manufacturing company has four machines and has to produce four parts, one part on each machine. The cost of producing each part on different machine is as shown in the following matrix.

		Machine			
		M_1	M_2	M_3	M_4
	P_1	12	9	11	13
	P_2	8	8	9	6
Part	P_3	14	16	21	13
	P_4	14	15	17	12

The company plans to add a new machine in the present facility by replacing one of the present machines. The cost to produce each part on the new machine is as shown below.

Part	P_1	P_2	P_3	P_4
Cost (Rs.)	11	7	15	10

Using assignment technique determine :

(i) Should the company add the new machine ?

(ii) It yes, which machine should be replaced ?

5. (a) Discuss the reasons for replacement of an equipment. **16**

(b) The maintenance and resale value per year of a machine whose purchase price is Rs. 7,000 is given below :

Year	1	2	3	4	5	6	7	8
Maintenance Cost (Rs.)	900	1,200	1,600	2,100	2,800	3,700	4,700	5,900
Resale Value (Rs.)	4,000	2,000	1,200	600	500	400	400	400

Find out when should the machine be replaced ?

OR

(a) Discuss the replacement policy for items whose running cost increases with time but value of money changes with constant rate during the period.

(b) A firm has purchased an equipment in Rs. 10,000. The operating and maintenance costs are about Rs. 2,500 per year for the first two years and then go up by approximately Rs. 1,500 per year. When the equipment should be replaced if the discount rate is 10% per year ?

6. (a) Describe the basic queuing process. **16**

(b) Name the various elements of queuing system.

(c) The machines in production shop breakdown at an average of 2 per hour. The non-productive time of any machine costs Rs. 30 per hour. If the cost of repairman is Rs. 50 per hour and the repair rate is 3 per hour. Calculate

(i) Number of machines not working at any point of time.

(ii) Average time that a machine is waiting for the repairman.

(iii) Cost of non-productive time of the machine operator.

(iv) Expected cost of system per hour.

OR

(a) Give the classification of Games.

(b) Describe the terminology used in two persons zero sum games.

(c) Calculate the value of game if the payoff matrix for a particular competitive situation is as under

$$
A \begin{array}{c} \\ I \\ II \\ III \end{array}
\begin{array}{ccc}
 & & B \\
 & I \quad II \quad III \\
\left[\begin{array}{ccc}
7 & 6 & 3 \\
-2 & 2 & -3 \\
5 & 9 & 7
\end{array}\right]
\end{array}
$$