Seat No. : _____

AE-152

April-2015

T.Y. M.B.A., Integrated

Operations Research

Time : 3 Hours] **[Max. Marks : 100**

Instructions : (1) Graph will be providing on request.
(2) Non-programmable scientific calculator can be used.

1. (a) Explain the following : (any **one**) **10**
   (i) Write a note on the scope and methodology of operations research. Also explain briefly the main features of an operations research study.
   (ii) What is Linear Programming Problem ? Also comment on underlying assumption of Linear Programming Problem.

   (b) The ABC Electric Appliance Company produce two products : Refrigerators and TV. Production takes place in two separate departments. Refrigerators are produced in deptt-I and TV are produced in deptt-II. The company's two products are produced and sold on a weekly basis. The weekly production cannot exceed 25 refrigerators in deptt-I and 35 TVs in deptt-II, because of limited available facility in the two deptt. The company regularly employs a total of 60 workers in the two deptts. A refrigerator requires 2 man-weeks of labour, while a TV requires 1 man-week of labour. A refrigerator contributes a profit of ₹ 60 and a TV contributes a profit of ₹ 40. Formulate the problem as L.P. problem.
   Through the graphical solution find out how many units of refrigerators and TVs should the company produce to realize a maximum profit ? **10**

2. Solve the following : (any **two**) **20**
   (1) Find optimal solution of given L.P.P. using Simplex method
   Maximise $Z = 3x_1 + 2x_2$
   Subject to the constraints
   $$x_1 + x_2 \leq 4$$
   $$x_1 - x_2 \leq 2$$
   $$x_1, x_2 \geq 0$$

   (2) Find optimal solution of given L.P.P. using Dual simplex method :
   Maximise $Z = -2x_1 - 2x_2 - 4x_3$
   Subject to the constraints
   $$2x_1 + 3x_2 + 5x_3 \geq 2$$
   $$3x_1 + x_2 + 7x_3 \leq 3$$
   $$x_1 + 4x_2 + 6x_3 \leq 5$$
   $$x_1, x_2, x_3 \geq 0$$

(3) Food X contains 6 units of Vitamin A per gram and 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamins A per gram and 12 units of vitamin B per gram and costs 20 paise per gram. The daily minimum requirements of vitamin A and vitamin B is 100 units and 120 units respectively. Find the minimum cost of product mix by the Simplex method.

3. Solve the following : (any **two**) **20**

(1) Find the dual of following L.P.P. :

Minimise Z = $4x_1 + x_2$

Subject to the constraints

$$3x_1 + x_2 = 3$$
$$4x_1 + 3x_2 \geq 6$$
$$x_1 + 2x_2 \leq 3$$
$$x_1, x_2 \geq 0$$

(2) A company makes three products X, Y and Z out of three raw materials A, B and C. The number of units of raw materials required to produce one unit of the product is as given in the table below :

	X	Y	Z
A	1	2	1
B	2	1	4
C	2	5	1

The unit profit contribution of the products X, Y and Z is ₹ 40, 25 and 50 respectively. The number of units of raw materials available are 36, 60 and 45 respectively.

(i) Determine the product mix that will maximise the total profit.

(ii) From the final table of simplex method, write the solution to the dual and give the economic interpretation.

(3) Solve the problem :

Maximise Z = $5x_1 + 12x_2 + 4x_3$

Subject to the constraints

$$x_1 + 2x_2 + x_3 \leq 5$$
$$2x_1 - x_2 + 3x_3 = 2$$
$$x_1, x_2, x_3 \geq 0$$

(i) Discuss the effect of changing the requirements Vector from $\begin{bmatrix} 5 \\ 2 \end{bmatrix}$ to $\begin{bmatrix} 3 \\ 9 \end{bmatrix}$ on the optimal solution.

(ii) Which resources should be increased and how much to achieve the best marginal increase in the value of the objective function ?

4. Solve the following : (any **two**) **20**

(1) A product is produced by four factories A, B, C and D. The unit production costs in them are ₹ 2, ₹ 3, ₹ 1 and ₹ 5 respectively. Their production capacities are : Factory A – 50 units, B – 70 units, C – 30 units and D – 50 units. These factories supply the product to four stones, demands of which are 25, 35, 105 and 20 units respectively. Units transport cost in rupees from each factory to each stone is given in the table below :

		Stones			
		1	2	3	4
Factories	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each of the factories to each of the stones so that the total production and transportation cost is minimum.

(2) A company has factories of four different places, which supply warehouses A, B, C, D and E. Monthly factory capacities are 200, 175, 150 and 325 units respectively. Monthly warehouses requirements are 110, 90, 120, 230 and 160 units respectively. Unit shipping costs are given in the following table. The costs are in rupees :

		To				
		A	B	C	D	E
From	1	13	–	31	8	20
	2	14	9	17	6	10
	3	25	11	12	17	15
	4	10	21	13	–	17

Shipment from 1 to B and 4 to D is not possible. Determine the optimal distribution to minimize shipping costs.

(3) Solve the following transshipment problem to determine the optimal shipping schedule :

		Source		**Destination**			**Supply**
		S_1	S_2	D_1	D_2	D_3	
Source	S_1	0	80	10	20	30	100
	S_2	10	0	20	50	40	200
Destination	D_1	20	30	0	4	10	–
	D_2	40	20	10	0	20	–
	D_3	60	70	80	20	0	–
Demand		–	–	100	100	100	

5. Solve the following : (any **two**) **20**

(1) A manufacturer of complex electronic equipment has jut received a sizable contract and plans to sub-contract part of the job. He has solicited bids for 6 sub-contracts from 3 firms. Each job is sufficiently large and any firm can take only one job. The table below shows the bids as well as the cost estimates (in lakhs of rupees) for doing the job internally. Not more than three jobs can be performed internally.

		Job					
		1	2	3	4	5	6
	1	44	67	41	53	48	64
	2	46	69	40	45	45	68
	3	43	73	37	51	44	62
Firms	I_1	50	65	35	50	46	63
	I_2	50	65	35	50	46	63
	I_3	50	65	35	50	46	63

Find the optimal assignment that will result in minimum total cost.

(2) Find the least cost route for the following travelling salesman problem.

		To				
		A	B	C	D	E
	A	–	2	5	7	1
	B	6	–	3	8	2
From	C	8	7	–	4	7
	D	12	4	6	–	5
	E	1	3	2	8	–

(3) XYZ airline operating 7 days a week has given the following time table. Crew must have a minimum layover of 5 hours between flights. Obtain the pairing of flights that minimise lay over time away from home. For any given pairing the crew will be based at the city that results in the smaller layover.

Chennai – Mumbai			**Mumbai – Chennai**		
Flight No.	**Dept.**	**Arrival**	**Flight No.**	**Dept.**	**Arrival**
A_1	6 AM	8 AM	B_1	8 AM	10 AM
A_2	8 AM	10 AM	B_2	9 AM	11 AM
A_3	2 PM	4 PM	B_3	2 PM	4 PM
A_4	8 PM	10 PM	B_4	7 PM	9 PM