

N29-127**December-2014****4th Year M.Sc., (CA & IT) (Integrated)****Operations Research****Time : 3 Hours]****[Max. Marks : 100****Instruction :** Graph and statistical table will be provided on request.1. Answer any **two** : **10 × 2 = 20**

- (a) A company manufactures two types of products A and B. Each product must go through two processes C and D. The details of the processing time for both products per unit are given below :

	Process C	Process D
Product A	800	1500
Product B	700	1200
Total Available time	56000	60000

Profit per unit of Product A and Product B is ₹ 350 and ₹ 500 respectively. How many units of Product A and Product B should be produced in order to maximize its profit ? Formulate it as an LPP and solve it graphically.

- (b) (i) Define feasible solution, Multiple Optimal Solution, unboundedness and infeasibility in context of LPP.

- (ii) Convert following Primal to Dual

$$\text{Max } Z = 2x_1 - 5x_2 + 6x_3$$

Subject to :

$$x_1 + x_2 + 3x_3 \leq 9$$

$$4x_1 - x_2 + 5x_3 \geq 15$$

$$x_1 + 3x_2 + x_3 = 7$$

$x_1, x_2 \geq 0, x_3$ is unrestricted in sign.

- (c) A Company manufactures tables and chairs. Each table and chair must be made entirely of either wood quality 1 or wood quality 2. A total of 225 board feet of wood quality 1 and 350 board feet of wood quality 2 are available. A table requires either 25 board feet of wood quality 1 or 35 board feet of quality 2. A chair requires either 10 board feet of quality 1 or 22 board feet of quality 2. Each table can be sold for ₹ 3500 and each chair can be sold for ₹ 800. Determine how can the company maximize its revenue. Use simplex method to solve this problem.

2. Answer any **two** : **10 × 2 = 20**

- (a) (i) Explain degeneracy in transportation problem and how to resolve it ?
 (ii) Mention briefly the advantages and disadvantages of NWCM, LCM and VAM.

- (b) A manufacturer of jeans is interested in developing an advertising campaign for four different age groups. The campaign can be conducted through TV, Radio and Magazines. Following table gives the estimated cost in paisa per exposure for each age group according to the medium employed. In addition exposure level possible in each media namely TV, Radio and Magazines are 40, 30 and 20 million respectively. The minimum exposure within the age group 13-18, 19-25, 26-35 and > 36 are 30, 25, 15 and 10 million respectively. The objective is to minimize the cost of obtaining the desired minimum exposure level in each age group.

**Estimated cost in Paisa per
exposure for each group**

Media	Age group			
	13 – 18	19 – 25	26 – 35	≥ 36
TV	12	7	10	10
Radio	10	9	12	10
Magazine	14	12	9	12

Formulate it as a transportation problem and find the optimal solution.

- (c) A company produces a particular product at three plants. Plant 1 can produce 150 units per week, Plant 2 can produce 200 units per week and Plant 3 can produce 150 units per week. Units of products are shipped to seven customers. The profit earned per unit depends the site where the unit is produced and on the customer who purchases the unit. Profit details in rupees are given below :

	Cust 1	Cust 2	Cust 3	Cust 4	Cust 5	Cust 6	Cust 7	Availability
Plant 1	60	89	91	104	81	76	92	150
Plant 2	64	79	97	102	73	77	78	200
Plant 3	85	76	68	101	67	82	69	150
Demand	55	70	50	75	65	95	90	

Obtain the optimum allocation.

3. Answer any **two** :

10 × 2 = 20

- (a) (i) Define unbalanced assignment problem and constrained assignment problem.
(ii) Formulate the LPP for assignment problem of assigning machine to job where cost of assignments of machines to job are given :

	Jobs				
	1	2	3	4	
Machines	1	12	14	10	9
	2	15	11	13	14
	3	6	7	8	11
	4	5	16	13	8

- (b) A large book publisher has five manuscripts that must be edited as soon as possible. Five editors can do this job. Estimated time of editing by each editor for different manuscripts are given below. Obtain the optimal assignment plan.

Manuscript	Editors				
	A	B	C	D	E
1	12	18	10	16	13
2	9	10	14	13	9
3	17	14	9	18	12
4	15	7	11	9	18
5	12	18	22	11	27

- (c) A marketing manager has 5 salesmen and there are 5 sales districts. The estimation made by the marketing manager for the sales per month (in 1000 rupees) for each salesman in each district is given below :

District	Salesmen				
	A	B	C	D	E
1	32	38	40	28	40
2	40	24	28	21	36
3	41	27	33	30	37
4	22	38	41	36	36
5	29	33	40	35	39

Find the best assignment of salesmen and district.

4. Answer any **two** : **10 × 2 = 20**

- (a) Consider the following details of a piping network which is used to transfer oil :
Develop a linear programming model to determine the maximum flow from Node 1 to Node 6.

Arc i – j	Flow		Arc i – j	Flow	
	f_{ij}	f_{ji}		f_{ij}	F_{ji}
1 – 2	20	–	3 – 4	13	–
1 – 3	25	–	3 – 5	10	8
2 – 3	5	10	4 – 5	15	–
2 – 4	9	4	4 – 6	30	–
2 – 5	15	–	5 – 6	25	–

- (b) A Company is planning to construct an automated two way conveyer system to move material between areas within its production unit. The cost of installing such conveyers between any two departments (in lakhs of ₹) is given below :

Department i to Department j	Cost (Lakh ₹)
1 – 2	6
1 – 3	7
1 – 5	9
1 – 7	11
1 – 8	12
2 – 4	8.5
2 – 5	7
3 – 5	7
3 – 6	9
3 – 9	13
4 – 5	9
4 – 8	6
4 – 9	5.5
4 – 10	7
5 – 6	6
5 – 7	8
5 – 8	9
6 – 7	3
7 – 8	7
8 – 9	7
8 – 10	8
9 – 10	7

Obtain the optimal plan for installing conveyer.

- (c) A truck must travel from node 1 to node 8. A variety of routes are available. Table below shows the distances between two nodes. Find the best path for the truck.

Arc	Distance (km)	Arc	Distance (km)
1 – 2	35	3 – 5	110
1 – 3	90	3 – 6	55
1 – 4	75	4 – 6	60
2 – 5	170	4 – 7	115
2 – 6	85	5 – 6	90
		5 – 8	35
		6 – 7	95
		6 – 8	125
		7 – 8	60

5. (a) A small maintenance project consists of the following jobs whose precedence relationships are given below : **10 × 2 = 20**

Job	1 – 2	1 – 3	2 – 3	2 – 5	3 – 4	3 – 6	4 – 5	4 – 6	5 – 6	6 – 7
Duration (days)	15	15	3	5	8	12	1	14	3	14

Draw the arrow diagram. Find the critical path and total project duration.

- (b) A small project is composed of seven activities, whose time estimates are listed below :

Activity	Estimated Duration (weeks)		
	Optimistic (a)	Most Likely (m)	Pessimistic (b)
1 – 2	1	1	7
1 – 3	1	4	7
2 – 4	2	2	8
2 – 5	1	1	1
3 – 5	2	5	14
4 – 6	2	5	8
5 – 6	3	6	15

- (i) Draw the project network
(ii) Find the expected project length
(iii) What is the probability that the project will be completed :
(A) 4 weeks earlier than expected
(B) Not more than 4 weeks later than expected.