E/L/TX

Reg. No: 23'27BBJ 0043

VIT® Vellore Institute of Technology

Final Assessment Test – November 2024

Course: CBS1008 - Operations Research

Class NBR(s): 5123 / 5127 Slot: E1

Time: Three Hours Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions

(10 X 10 = 100 Marks)

1. A company owns mines; mine A produces 1 tonne of high grade ore, 3 tonnes of medium grade ore and 5 tonnes of low grade ore each day and mine B produces 2 tonnes of each of the three grades of ore, each day. The company needs 80 tonnes of high grade ore, 160 tonnes of medium grade ore and 200 tonnes of low grade ore. If it cost ₹200.00 per day to work each mine find the number of days each mine has to be operated for producing the required output with minimum total cost by formulating a LPP for the problem and solve graphically. **[10]**

2. Solve the LPP by Big-M method **[10]**

Minimize $z = 4x_1+2x_2$

Subject to, $3x_1+x_2 \geq 27$

$x_1+x_2 \geq 21$

$x_1+2x_2 \geq 30$

$x_1, x_2 \geq 0$

3. ABC Limited has three production shops that supply a product to five warehouses. The cost of production varies from shop to shop and cost of transportation from one shop to a warehouse also varies. Each shop has a specific production capacity and each warehouse has certain amount of requirement. The costs of transportation are given below: **[10]**

		Warehouse					
		I	II	III	IV	V	Supply
Shop	A	6	4	4	7	5	100
	B	5	6	7	4	8	125
	C	3	4	6	3	4	175
	Demand	60	80	85	105	70	400

The cost of manufacturing the product at different production shops is

Shop	Variable Cost	Fixed cost
A	14	7000
B	16	4000
C	15	5000

Find the optimum quantity to be supplied from each shop to different warehouses at the minimum total cost by using MODI Method.

4. The head of the departments has five jobs J_1, J_2, J_3, J_4, J_5 and five subordinates M_1, M_2, M_3, M_4, M_5. The number of hours each man do take to perform each job is as follows: **[10]**

	M_1	M_2	M_3	M_4	M_5
J_1	1	3	2	3	6
J_2	2	4	3	1	5
J_3	5	6	8	4	6
J_4	3	1	4	2	2
J_5	1	5	6	5	3

Use the Hungarian method of optimal assignment of jobs to the subordinates so as to minimize the total time of all the jobs. Is the solution obtained by you unique? If not, work out an alternative solution and calculate the total cost implied by it.

5. Solve the LPP by Gomory's cutting plane method **[10]**

Maximize $z = 2x_1+2x_2$

Subject to, $5x_1+3x_2 \leq 8$

$x_1+2x_2 \leq 4$

$x_1, x_2 \geq 0$ and are integers.

6. Solve the following IPP using the Branch and Bound method: **[10]**

Maximize $z = 7x_1+9x_2$

Subject to, $-x_1+3x_2 \leq 6$

$7x_1+x_2 \leq 35$

$0 \leq x_1, x_2 \leq 7$

and x_1, x_2 are integers.

7.a) The production manager of a company wants to schedule a week's production run for two products P_1 and P_2, each of which requires the labour and materials as shown below: **[10]**

Product		
	P_1	P2
Labour Hours	2	4
Material M_1 (kg)	4	5
Material M_2 (kg)	5	4

The weekly availability of resources is limited to 600 labour hours, 1000 kg of material M_1 and 1200 kg of M_2. The unit profit for P_1 and P_2 is ₹20 and ₹32, respectively.

Products P_1 and P_2 are, in fact, new models and are replacements of the older ones which have been discontinued very recently. The manager would like to maximise profit but he is equally concerned with maintaining workforce of the division at nearly constant level in the interest of employee morale. The workforce, which consists of people engaged in production, sales, distribution, peons and other general staff, consisted of 108 persons in all. From a detailed study, it is known that production of one unit of P_1 would maintain 0.3 person in the workforce, while one unit of P_2 would maintain 0.75 person.

Had the production manager been considering only maximising profit, without regard to maintaining the workforce, he would do so by producing 167.67 units of P_1, and 66.67 units of P_2 (this can be checked by solving the problem as an LPP).

On the basis of the available capacity, this would yield a profit equal to $167.67 \times 20 + 66.67 \times 32$ or ₹5486.67. However, this would maintain 100.3 people in the workforce. The manager feels that probably he could increase the workforce requirement to desired level by accepting somewhat lower profit. In keeping with this, the following two goals are established: a profit of ₹5400 per work and a workforce of 108 persons. Formulate this as a goal programming problem.

OR

7.b) A manufacturing firm produces two types of product - A and B. According to past experience, production of either Product A or Product B requires an average of one hour in the plant. The plant has a normal production capacity of 400 hours a month. The marketing department of the firm reports that because of limited market, the maximum number of Product A and Product B that can be sold in a month are 240 and 300 respectively. The net profit from the sale of Product A and Product B are ₹800 and ₹400 respectively. The manager of the firm has set the following goals arranged in the order of importance (preemptive priority factors). **[10]**

P_1: He wants to avoid any underutilization of normal production capacity.

P_2: He wants to sell maximum possible units of Product A and Product B. Since the net profit from the sale of Product A is twice the amount from that of Product B, the manager has twice, as much desire to achieve sales for Product A as for Product B.

P_3: He wants to minimize the overtime operation of the plant as much as possible.

Formulate a goal programming problem for this and solve it graphically.

8. A city is served by two cable TV companies, BestTV and CableCast. Due to their aggressive sales tactics, each year 40% of BestTV customers switch to CableCast; the other 60% of BestTV customers stay with BestTV. On the other hand, 30% of the CableCast customers switch to BestTV. **[10]**

The two states in this example are BestTV and CableCast.

(i) Express the information above as a transition matrix which displays the probabilities of going from one state into another state.

(ii) For the transition matrix for market shares for subscribers to two cable TV companies suppose that today 1/4 of customers subscribe to BestTV and 3/4 of customers subscribe to CableCast. After 1 year, what percent subscribe to each company? And

(iii) Suppose instead that today of 80% of customers subscribe to BestTV and 20% subscribe to CableCast. After 1 year, what percent subscribe to each company?

9. The four possible states of a student in a music festival are S = {"dancing", "at a concert", "at the bar", "back home"}. Let us assume that the student changes state during the festival according to the following transition matrix: **[10]**

$$P = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1/2 & 0 & 1/2 & 0 \\ 1/4 & 1/4 & 1/4 & 1/4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Draw the Markov chain using a transition graph for above transition matrix.

10.a) Solve the game problem reducing into 2×2 problem using the dominance property [10]

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 4 & 2 & 0 & 2 & 1 \\ 4 & 3 & 1 & 3 & 2 \\ 4 & 3 & 4 & -1 & 2 \end{bmatrix}$$

OR

10.b) Solve the game graphically [10]

	Player B	
$P_1 \rightarrow$	−4	3
	−7	1
Player A	−2	−4
	−5	−2
	−1	−6

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	q_1	q_2
p_1		
p_2		
p_3		
p_n		

$a_{11}\,p + a_{21}(1-p)$