U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

(An autonomous institution affiliated to VTU)

August 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 23ME4ESORE **Max Marks: 100**
Course: Operations Research

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	A fruit beverage company has two bottling plants, located at Mumbai and Nagpur. Each plant produces three drinks, Apple extract, Orange extract, and Lemonade. The number of bottles produced per day are shown in the table. Beverage | Plants at: Mumbai | Nagpur Apple extract | 1500 | 1500 Orange extract | 3000 | 1000 Lemonade | 2000 | 5000 A market survey indicates that during a month, there will be a demand of 20000 bottles of Apple extract, 40000 bottles of orange extract and 44000 bottles of lemonade. The operating cost per day for plants at Mumbai and Nagpur are 600 and 400 monetary units. For how many days each plant be run in the month so as to minimize the production cost, while still meeting the market demand? Formulate this problem as an LP model and solve it using graphical method.	*CO1*	*PO1* *PO2* *PO4*	**10**
	b)	Solve the problem given in 1 a) by simplex method.	*CO1*	*PO1* *PO2* *PO4*	**10**
		OR			
2	a)	Explain the applications of operations research in various fields.	*CO1*	*PO1*	**8**
	b)	An advertising agency wishes to reach two types of audiences - customers with annual income greater than one lakh rupees (target audience A) and customers with annual income of less than one lakh rupees (target audience B). The total advertising budget is Rs. 200000. One programme of TV advertising costs Rs. 50000. One programme of radio advertising costs Rs. 20000. For contract reasons, at least three programmes ought to be on	*CO1*	*PO1* *PO2* *PO4*	**12**

TV and the number of radio programmes must be limited to 5. Surveys indicate that a single TV programme reaches 450000 prospective customers in target audience A and 50000 in target audience B. One radio programme reaches 20000 prospective customers in target audience A and 80000 in target audience B. Determine the media mix so as to maximize the total reach.

UNIT - II

3 a) Write the dual of the given LP problem, *CO2* *PO1 PO2 PO4* **6**

Maximize $Z = 3x_1 + x_2 + 2x_3 - x_4$

Subject to $2x_1 - x_2 + 3x_3 + x_4 = 1$,

$x_1 + x_2 - x_3 + x_4 = 3$

and $x_1, x_2 \geq 0$ and x_3, x_4 are unrestricted in sign

b) Solve the given LP problem by dual simplex method, *CO2* *PO1 PO2 PO4* **14**

Maximize $Z = -3x_1 - 2x_2$

Subject to $x_1 + x_2 \geq 1$,

$x_1 + 2x_2 \geq 10$,

$x_1 + x_2 \leq 7$,

$x_2 \leq 3$,

and $x_1, x_2 \geq 0$

UNIT - III

4 a) A company has three production shops that supply a product to five warehouses. The cost of production varies from shop to shop and the cost of transportation from one shop to a ware house also varies. Each shop has s specific production capacity and each warehouse has certain amount of requirement. The costs of transportation are given below. *CO3* *PO1 PO2 PO4* **14**

		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	

The cost of manufacturing the product at different production shops are given below.

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.

b) Differentiate the transportation and assignment models. *CO1* *PO1* **6**

OR

5 a) A department of a company has five employees with five jobs to be performed. The time in hours that each employee takes to perform each job is given in the effectiveness matrix. *CO3* *PO1 PO2* **10**

			Employees							*PO4*	
				I	II	III	IV	V			
			A	10	5	13	15	16			
			B	3	9	18	13	6			
			Jobs C	10	7	2	2	2			
			D	7	11	9	7	12			
			E	7	9	10	4	12			
			How should the jobs be allocated, one per employee, so as to minimize the total man-hours?								
	b)	An ice-cream company has a distribution network at a city for distributing the ice-creams produced. There are four vendors located at different parts of the city who have to be supplied ice-creams every day. The following matrix displays the distances in kilometers between the company and the four vendors.							*CO3*	*PO1* *PO2* *PO4*	**10**
			TO								
				Company	Vendor A	Vendor B	Vendor C	Vendor D			
			Company	-	3.5	3	4	2			
			Vendor A	3.5	-	4	2.5	3			
			FROM Vendor B	3	4	-	4.5	3.5			
			Vendor C	4	2.5	4.5	-	4			
			Vendor D	2	3	3.5	4	-			
			What route should the company van follow so that the ice-creams are supplied before they melt down.								
			UNIT - IV								
6	a)	Two breakfast food manufacturers ABC, and XYZ are competing for an increased market share. The payoff matrix, shown below describes the increase in market share for ABC and decrease in market share for XYZ.							*CO4*	*PO1* *PO2* *PO4*	**10**
			ABC	XYZ							
				Give coupons	Decrease price	Maintain as it is	Increase Advertising				
			Give coupons	2	-2	4	1				
			Decrease price	6	1	12	3				
			Maintain as it is	-3	2	0	6				
			Increase Advertising	2	-3	7	1				
			Determine the optimal strategies for both the manufacturers and the outcome of the game.								
	b)	Find the sequence that minimizes the total time required in performing the following jobs on three machines in the order ABC. Processing times in hours are given in the following table:							*CO4*	*PO1* *PO2* *PO4*	**10**
			Jobs	1	2	3	4	5			
			Machine B	5	6	2	3	4			
			Machine A	8	10	6	7	11			
			Machine C	4	9	8	6	5			
			Also find the minimum total time to complete all jobs and the total waiting time for each machine.								

			UNIT - V			
	7	a)	A firm is considering the replacement of a machine, whose cost is Rs. 12, 200, and its scrap value is Rs. 200. From the experiences, the running costs are found to be as follows: Year: 1	2	3	4	5	6	7	8 Running Cost: 200	500	800	1200	1800	2500	3200	4000 When should the machine be replaced?	*CO5*	*PO1* *PO2* *PO4*	**8**
		b)	An electronic device has about 1000 number of a critical component. When a component fails, it is replaced at a cost of Re. 1. If all the components are replaced, the replacement cost drops to Re. 0. 35/-. Probability of failure of such components are given below. What is the optimal replacement plan? Time: 1	2	3	4	5	6 Total Probability: 0.03	0.10	0.30	0.70	0.85	1.00	*CO5*	*PO1* *PO2* *PO4*	**12**

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