U.S.N.										

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

Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 20IM6DEAOR **Max Marks: 100**
Course: Advanced Operations Research **Date: 17.07.2023**

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)	Solve the following LPP using two phase method Min Z = $5x_1 + 2x_2 + 10x_3$ subject to $x_1 - x_3 \leq 10$ $x_2 + x_3 >= 10$ and $x_1, x_2, x_3 >= 0$	*CO1* *CO4*	*PO2*	**10**
	b)	Solve the following LPP by Revised simplex method. Max Z = $x_1 + x_2 + 3x_3$ subject to $3x_1 + 2x_3 + X_3 \leq 3$ $2x_1 + x_2 + 2X_3 \leq 2$ and $x_1, x_2, x_3 >= 0$	*CO1* *CO4*	*PO2*	**10**
		OR			
2	a)	What is the significance of sensitivity analysis in managerial decision making?	*CO5*	*PO2*	**04**
	b)	A manufacture produces four products A B C and D by using two types of machines i.e. lathe and milling machines. The times required on the two machines to manufacture one unit of each of the four products, the profit/unit and total time available on the two types of machines per day are given table below: Determine: (i) The number of units of the various products to be produced for maximizing profit. (ii) The effect of changing the profit per unit of product A and B to Rs.10 and 30 respectively. (iii) The effect of changing the total time available per day on the two M/c to 3500 and 5500 minutes respectively.	*CO5*	*PO2* *PO4*	**16**

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			<table><tr><td>M/c</td><td>Time required/ unit A B C D</td><td>Total time available per day(minutes)</td></tr><tr><td>Lathe</td><td>4 9 7 10</td><td>5500</td></tr><tr><td>Milling M/c</td><td>2 1 3 20</td><td>3500</td></tr><tr><td>Profit/unit Rs.</td><td>15 25 25 65</td><td></td></tr></table>			
			UNIT - II			
3	a)	Solve the following IPP Max $Z = x_1 + x_2$ subject to $3x_1 + 2x_2 \leq 5$ $X_2 \leq 2$ and $x_1, x_2, x_3 >= 0$ and Integers	*CO1* *CO4*	*PO2*	**10**
	b)	A travelling salesman has to visit five cities. He wishes to start from a particular city, visit each city only once and then return to his starting point. The travelling cost of each city from a particular city is given below. <table><tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr><tr><td>A</td><td>-</td><td>2</td><td>5</td><td>7</td><td>1</td></tr><tr><td>B</td><td>6</td><td>-</td><td>3</td><td>8</td><td>2</td></tr><tr><td>C</td><td>8</td><td>7</td><td>-</td><td>4</td><td>7</td></tr><tr><td>D</td><td>12</td><td>4</td><td>6</td><td>-</td><td>5</td></tr><tr><td>E</td><td>1</td><td>3</td><td>2</td><td>8</td><td>-</td></tr></table>How should the jobs be allocated, one per employee, so as to minimize the total man-hours using branch and bound technique?	*CO1* *CO4*	*PO2*	**10**
		UNIT - III			
4	a)	How do you classify queuing models?	*CO2*	*PO2*	**04**
	b)	Explain **M / G / 1 and M / D / 1** queuing models. Show under what condition **M / G / 1** queuing model can be reduced to M / D / 1 model.	*CO2*	*PO2*	**04**
	c)	At certain health-care, patients arrive at a mean rate of 4 per hour and they are checked by doctor at a mean rate of 5 per hour. The Centre feels that service times have some unspecified positive skewed unimodal two tailed distribution with standard deviation of 0.05 hour.	*CO1* *CO4*	*PO2*	**12**

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			Determine: 1) The queue characteristics for the health care Centre. 2) How much the assumption of exponential service times would distort these values?			
			OR			
5	a)		Explain the following: (i) Convex function (ii) Concave function (iii) Kuhn Tucker necessary conditions	*CO1*	*PO1*	**10**
	b)		Solve the NLPP $Max\ f(x) = 10x_1 + 25x_2 - 20x_1^2 - x_2^2 - 4x_1x_2$ *Subject to* $x_1 + 2x_2 \leq 10$ $x_1 + x_2 \leq 9$ $x_1, x_2 \geq 0$	*CO1* *CO4*	*PO2*	**10**
			UNIT - IV			
6	a)		The project consists of following cost and time estimates. Perform crash analysis to determine optimal time and cost for the project. Indirect expenses are Rs. 2800 per day. Activity | 1 – 4 | 1 – 2 | 2 – 3 | 2 – 4 | 2 – 5 | 5 – 6 | 4 – 3 | 3 - 6 Normal Time | 10 | 8 | 5 | 6 | 8 | 5 | 0 | 12 Normal Cost | 20000 | 15000 | 8000 | 11000 | 9000 | 5000 | 0 | 3000 Crash Time | 7 | 6 | 4 | 4 | 5 | 4 | 0 | 8 Crash Cost | 30000 | 20000 | 14000 | 15000 | 15000 | 8000 | 0 | 4000	*CO1* *CO4*	*PO2*	**10**
	b)		A network with the following activity durations and manpower requirement is given. Analyze the project form point of view of resource to bring out the necessary steps involved in the analysis and smoothing of resources. Activity | A | B | C | D | E | F | G | H Duration (days) | 4 | 7 | 3 | 3 | 2 | 2 | 2 | 3 Predecessors | - | - | A | A | B | B | D, E | F, G Crew Size | 4 | 2 | 2 | 4 | 6 | 3 | 3 | 4 i) Draw the network diagram & determine the critical path ii) Determine the optimal allocations so that the crew size cannot exceed 6	*CO1* *CO4*	*PO4*	**10**

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			UNIT - V			
	7	a)	Determine whether the Markovian chain is regular or not? $P=\begin{bmatrix} 0 & 0.7 & 0 & 0.3 \\ 0.5 & 0 & 0.5 & 0 \\ 0 & 0.7 & 0 & 0.3 \\ 0.5 & 0 & 0.5 & 0 \end{bmatrix}$	*CO1*	*PO2*	**04**
		b)	Explain how a stochastic process can be applied for random walking with absorbing barriers	*CO1*	*PO2*	**04**
		c)	A salesman territory consists of three cities A, B & C. He never sells in the same city on successive days. If he sells in city A, then next day he sells in city B. However, if he sells in city B or C, then the next day he is twice as likely to sell in city A. Formulate the above as Markov chain and determine: (i) Transition diagram (ii) In the equilibrium condition, how often does he sells in each city?	*CO1* *CO4*	*PO2*	**12**

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