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

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: INDUSTRIAL ENGINEERING & MANAGEMENT **Duration: 3 hrs.**
Course Code: 20IM5DCOPR **Max Marks: 100**
Course: OPERATIONS RESEARCH **Date: 13.09.2023**

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

UNIT - I

1 a) List and Explain various phases involved in Operations research **06**

b) A parent has to please his two children on an evening ride. He is bound to buy toffees and fruits. To please his kids, he has to buy at least 6 toffees. For every 2 toffees he buys he should also purchase at least 1 fruit. The total number of items he buys should be such that sum of numbers of toffee and twice the number of fruits should be equal to or in excess of 16. The average cost of a toffee is 1 rupee whereas the average cost of a fruit is 3 rupees. How should he please his children and satisfy the purchase restrictions with least expenses to himself? Formulate as LPP and solve graphically. **14**

OR

2 a) *For the given Primal problem find its Dual* ? **06**

$$Min\, Z = 2X_1 + 3X_2 + 4X_3$$
$$ST$$
$$2X_1 + 3X_2 + 5X_3 \geq 3$$
$$3X_1 + X_2 + 7X_3 = 2$$
$$X_1 + 4X_2 + X_3 \leq 5$$
$$X_1, X_2, \geq 0 \; and \; X_3 \; is \; unrestricted$$

b) Find solution using dual simplex method. **14**
Maximize $Z = -2x_1 - x_2$
subject to the constraints
$3x_1 + x_2 \geq 3$
$-4x_1 - 3x_2 \leq -6$
$-x_1 - 2x_2 \leq -3$
and $x_1, x_2 \geq 0$

UNIT - II

3 a) List any 5 methods for finding Initial basic feasible solutions in transportation Model. **05**

b) A company has four factories P, Q, R and S which supply to three warehouses A, B, and C. the monthly Demand in tons at A, B and C is 120, 80 and 200 respectively, the monthly Production capacities in tons at factories P, Q, R and S is 60, 50, 140 and 50 respectively. The transportation cost in Rupees per ton is given in the matrix below. Using VAM, determine the transportation schedule that minimizes the total transportation cost. **15**

		A	B	C
Furnaces	P	4	3	7
	Q	5	8	4
	R	2	4	7
	S	5	8	4

OR

4 a) Differentiate between transportation and assignment problems. **05**

b) Five lecturers by experts are to be scheduled so as not to conflict with one another. The lecturers are to be delivered in afternoon on weekdays only else because of other closed schedules, some students will be found to keep out these lectures. The following table indicates the number of absentees lecturer-wise and day-wise. Schedule these lectures in such a way so as to minimize the total number of students forced to absent. **08**

	L1	**L2**	**L3**	**L4**	**L5**
Monday	3	2	3	9	10
Tuesday	11	5	9	10	2
Wednesday	1	3	8	2	4
Thursday	8	11	10	5	2
Friday	8	6	5	6	9

c) A salesman has to visit 5 cities A, B, C, D and E. the distances in 100's of km between the 5 cities are as follows. If the salesman starts from city C and has to come back to city C, which route should he select so that the total distance travelled is minimum. **07**

	A	**B**	**C**	**D**	**E**
A	M	7	6	8	4
B	7	M	8	5	4
C	6	8	M	9	7
D	8	5	9	M	8
E	4	6	7	8	M

UNIT - III

5 a) Explain various queue characteristics for solving queueing models. **05**

b) At an ATM of a Bank, 20 customers arrive on an average every 10 mins. The ATM can serve 5 customers in 2 mins. Determine: **08**

(a) Average number of customers in the system
(b) Average waiting time of customers in the queue
(c) Probability of more than 5 customers in the system.
(d) Idle time of the ATM.

c) A bank has two tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distribution for each deposits and withdrawals are exponential with mean service time 3 minutes per customer. Depositors are found to arrive in a Poisson fashion throughout the day with mean arrival rate 16 per hour. Withdrawers also arrive in a Poisson fashion with mean arrival rate of 14 per hour. What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits. **07**

UNIT - IV

6 a) List and explain some of the common errors while drawing the network **06**

b) A project consists of the following activities with their duration in days and the precedence relationship **10**

Activity	A	B	C	D	E	F	G	H
Precedence	-	A	A	B	C	B, C	D	E
Duration (days)	10	7	8	9	4	6	8	10

i) Draw the network for the above project
ii) Identify the critical path and duration of the project
iii) Calculate EST, EFT, LST, LFT, TF, FF & IF for each activity.

c) A R&D department is developing a product for its elite customers. From the analysis it has found that it takes 17 weeks with a variance of 9 weeks to complete the project. What is the probability that will require to complete in 22 days? **04**

UNIT - V

7 a) Two players independently select one of ‘mouse’, ‘cat’, ‘tiger’, and ‘elephant’ and simultaneously revel their choices. It is known that cat chases the mouse (for score 1), the tiger chases the cat (for score 2), the elephant chases the tiger (for score 3), and the mouse chases the elephant (for score 4). All other combinations yield zero score. Formulate the payoff matrix and determine the optimal strategies of the players. **08**

b) Find solution of n x 2 game theory problem using graphical method **12**

Player A\Player B	B1	B2
A1	1	-3
A2	3	5
A3	-1	6
A4	4	1
A5	2	2
A6	-5	0

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