



CBCS SCHEME

22MBA24

USN

Second Semester MBA Degree Examination, June/July 2023 Operations Research

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any **FOUR** full questions from Q.No.1 to Q.No.7.
 2. Question No. 8 is compulsory.
 3. Calculators are allowed. Use of Z-table is permitted.
 4. M : Marks , L: Bloom's level , C: Course outcomes.

			M	L	C																																		
Q.1	a.	What is Operations Research?	3	L1	CO1																																		
	b.	A manufacturer produces two models M_1 and M_2 of a product. Each unit of model M_1 requires 4 hrs of grinding and 2 hrs of polishing. Each unit of model M_2 requires 2 hrs of grinding and 5 hrs of polishing. The manufacturer has 2 grinders each of which works for 40 hrs a week. There are 3 polishers each of which works for 60 hrs per week. Profit of model M_1 is Rs.300 per unit and profit of model M_2 is Rs.400 per unit. The manufacturer has to allocate his production capacity so as to maximize his profit. Formulate LPP.	7	L3	CO2																																		
	c.	A foreman wants to process four different jobs on 3 machines : a shaping machine, a drilling machine and tapping machine. The sequence of the operations being shaping-drilling-tapping. Decide the optimal sequence for the four jobs to minimize the time elapsed and find the total idle time. The processing time in minutes is as given in the table. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th rowspan="2">Jobs</th> <th colspan="3">Machines</th> </tr> <tr> <th>Shaping</th> <th>Drilling</th> <th>Tapping</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>13</td> <td>3</td> <td>18</td> </tr> <tr> <td>2</td> <td>18</td> <td>8</td> <td>4</td> </tr> <tr> <td>3</td> <td>8</td> <td>6</td> <td>13</td> </tr> <tr> <td>4</td> <td>23</td> <td>6</td> <td>8</td> </tr> </tbody> </table>	Jobs	Machines			Shaping	Drilling	Tapping	1	13	3	18	2	18	8	4	3	8	6	13	4	23	6	8	10	L2	CO3											
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4	23	6	8																																				
Q.2	a.	What are the applications of LPP in management?	3	L1	CO1																																		
	b.	Enumerate on the scope of operation research.	7	L2	CO1																																		
	c.	Solve the following transportation problem to maximize the profit by least cost method. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th rowspan="2">Source</th> <th colspan="4">Destination</th> <th rowspan="2">Supply</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>15</td> <td>51</td> <td>42</td> <td>33</td> <td>23</td> </tr> <tr> <td>2</td> <td>80</td> <td>42</td> <td>26</td> <td>81</td> <td>44</td> </tr> <tr> <td>3</td> <td>90</td> <td>40</td> <td>66</td> <td>60</td> <td>33</td> </tr> <tr> <td>Demand</td> <td>23</td> <td>31</td> <td>16</td> <td>30</td> <td></td> </tr> </tbody> </table>	Source	Destination				Supply	A	B	C	D	1	15	51	42	33	23	2	80	42	26	81	44	3	90	40	66	60	33	Demand	23	31	16	30		10	L3	CO2
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3	90	40	66	60	33																																		
Demand	23	31	16	30																																			
Q.3	a.	What is an Assignment problem?	3	L1	CO2																																		

	<p>b. For the following pay-off matrix of Company X, find the solution of the game by principle of dominance.</p> <p style="text-align: center;">Company Y</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>P</th> <th>Q</th> <th>R</th> <th>S</th> </tr> </thead> <tbody> <tr> <th>A</th> <td>6</td> <td>-2</td> <td>4</td> <td>1</td> </tr> <tr> <th>B</th> <td>6</td> <td>1</td> <td>12</td> <td>3</td> </tr> <tr> <th>C</th> <td>-3</td> <td>-2</td> <td>-2</td> <td>6</td> </tr> <tr> <th>D</th> <td>2</td> <td>-3</td> <td>7</td> <td>7</td> </tr> </tbody> </table> <p style="text-align: left; margin-left: 20px;">Company X</p>		P	Q	R	S	A	6	-2	4	1	B	6	1	12	3	C	-3	-2	-2	6	D	2	-3	7	7	7	L2	CO3			
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D	2	-3	7	7																												
	<p>c. Use graphical method to solve the following LPP :</p> <p>Min $z = 20x + 10y$</p> <p>Subject to constraints :</p> <p style="margin-left: 20px;">$x + 2y \leq 40$</p> <p style="margin-left: 20px;">$3x + y \geq 30$</p> <p style="margin-left: 20px;">$4x + 3y \geq 60$</p> <p style="margin-left: 20px;">where $x, y \geq 0$</p>	10	L3	CO2																												
Q.4	a. What do you understand by "work-break down" structure?	3	L1	CO4																												
	b. Enumerate on the differences between PERT and CPM.	7	L2	CO4																												
	c. Solve the travelling salesman problem by using the data given : $C_{12} = 20, C_{13} = 4, C_{14} = 10, C_{23} = 5, C_{34} = 6, C_{25} = 10, C_{33} = 6, C_{45} = 20$, where $C_{ij} = C_{ji}$ and there is no route between cities i and j if a value of C_{ij} is not known.	10	L3	CO2																												
Q.5	a. What is 'Project control phase' in project management?	3	L1	CO4																												
	b. Enumerate on the different criteria of decision making under uncertainty.	7	L2	CO3																												
	<p>c. The precedence relation and other information are given in the table below,</p> <p>(i) Draw a network diagram to represent the project.</p> <p>(ii) Find the critical path.</p> <p>(iii) Find the total floats available on non-critical activities.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Sl. No.</th> <th>Activity</th> <th>Predecessor</th> <th>Duration (Days)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>A</td> <td>-</td> <td>7</td> </tr> <tr> <td>2</td> <td>B</td> <td>-</td> <td>13</td> </tr> <tr> <td>3</td> <td>C</td> <td>A</td> <td>10</td> </tr> <tr> <td>4</td> <td>D</td> <td>A</td> <td>17</td> </tr> <tr> <td>5</td> <td>E</td> <td>B</td> <td>3</td> </tr> <tr> <td>6</td> <td>F</td> <td>D, E</td> <td>26</td> </tr> </tbody> </table>	Sl. No.	Activity	Predecessor	Duration (Days)	1	A	-	7	2	B	-	13	3	C	A	10	4	D	A	17	5	E	B	3	6	F	D, E	26	10	L4	CO4
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6	F	D, E	26																													
Q.6	a. Why is job sequencing important?	3	L1	CO3																												
	b. Briefly explain the steps involved in decision-making process.	7	L2	CO3																												
	<p>c. Solve the following game graphically,</p> <p style="text-align: center;">Player B</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> </tr> </thead> <tbody> <tr> <th>Player A</th> <td>1</td> <td>5</td> <td>5</td> <td>0</td> <td>-1</td> <td>8</td> </tr> <tr> <td></td> <td>2</td> <td>8</td> <td>-4</td> <td>-1</td> <td>6</td> <td>-5</td> </tr> </tbody> </table>		1	2	3	4	5	Player A	1	5	5	0	-1	8		2	8	-4	-1	6	-5	10	L4	CO3								
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Q.7	a. What is Degeneracy in transportation problem?	3	L2	CO2																																																			
	b. Solve the assignment problem. <table border="1" data-bbox="347 320 866 495"> <tr> <td></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td>A</td> <td>85.3</td> <td>90</td> <td>87.5</td> <td>82.4</td> <td>89.1</td> <td>91.3</td> </tr> <tr> <td>B</td> <td>78.9</td> <td>84.5</td> <td>99.4</td> <td>80.4</td> <td>89.3</td> <td>88.4</td> </tr> <tr> <td>C</td> <td>82.0</td> <td>31.3</td> <td>28.5</td> <td>66.5</td> <td>80.4</td> <td>109.7</td> </tr> <tr> <td>D</td> <td>84.3</td> <td>34.6</td> <td>86.2</td> <td>83.3</td> <td>85.0</td> <td>85.5</td> </tr> </table>		1	2	3	4	5	6	A	85.3	90	87.5	82.4	89.1	91.3	B	78.9	84.5	99.4	80.4	89.3	88.4	C	82.0	31.3	28.5	66.5	80.4	109.7	D	84.3	34.6	86.2	83.3	85.0	85.5	7	L3	CO3																
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	c. The time estimates for various activities in a construction project are given below : <table border="1" data-bbox="496 600 1078 1043"> <thead> <tr> <th colspan="4">Time estimates (months)</th> </tr> <tr> <th>Activity</th> <th>Optimistic time (t_e)</th> <th>Most likely time (t_m)</th> <th>Pessimistic time (t_p)</th> </tr> </thead> <tbody> <tr> <td>1 - 2</td> <td>10</td> <td>12</td> <td>16</td> </tr> <tr> <td>2 - 3</td> <td>2</td> <td>8</td> <td>36</td> </tr> <tr> <td>2 - 4</td> <td>1</td> <td>4</td> <td>5</td> </tr> <tr> <td>2 - 6</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td>3 - 5</td> <td>8</td> <td>12</td> <td>20</td> </tr> <tr> <td>4 - 5</td> <td>15</td> <td>18</td> <td>30</td> </tr> <tr> <td>4 - 6</td> <td>3</td> <td>5</td> <td>8</td> </tr> <tr> <td>5 - 7</td> <td>2</td> <td>4</td> <td>8</td> </tr> <tr> <td>6 - 7</td> <td>6</td> <td>9</td> <td>12</td> </tr> <tr> <td>7 - 8</td> <td>4</td> <td>6</td> <td>14</td> </tr> </tbody> </table> (i) Draw Network diagram. (ii) Calculate the expected time for each activity. (iii) Determine critical path. (iv) What is the probability that the project will be finished in 4 years? (v) What is the probability that the project will be finished in 55 months?	Time estimates (months)				Activity	Optimistic time (t_e)	Most likely time (t_m)	Pessimistic time (t_p)	1 - 2	10	12	16	2 - 3	2	8	36	2 - 4	1	4	5	2 - 6	2	3	4	3 - 5	8	12	20	4 - 5	15	18	30	4 - 6	3	5	8	5 - 7	2	4	8	6 - 7	6	9	12	7 - 8	4	6	14	10	L4	CO4			
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Q.8	Case Study: Given below is a table taken from the solution process of transportation problem. <table border="1" data-bbox="496 1350 1228 1592"> <thead> <tr> <th colspan="2"></th> <th colspan="4">Warehouse</th> <th></th> </tr> <tr> <th colspan="2"></th> <th>W₁</th> <th>W₂</th> <th>W₃</th> <th>W₄</th> <th>Capacity</th> </tr> </thead> <tbody> <tr> <th rowspan="4">Factories</th> <th>To</th> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>From</th> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <th>F₁</th> <td>10</td> <td>8</td> <td>7</td> <td>12</td> <td>5000</td> </tr> <tr> <th>F₂</th> <td>12</td> <td>13</td> <td>6</td> <td>10</td> <td>6000</td> </tr> <tr> <th>F₃</th> <td>8</td> <td>10</td> <td>12</td> <td>14</td> <td>9000</td> </tr> <tr> <th>Demand</th> <td>7000</td> <td>5500</td> <td>4500</td> <td>3000</td> <td>20,000</td> </tr> </tbody> </table> Answer the following questions : (i) Solve the transportation problem by VAM and check the optimality by MODI method. (ii) Is this solution optimal? If not, find the optimal solution? (iii) Does the problem have alternate optimal solution? If yes, give another optimal solution.			Warehouse							W ₁	W ₂	W ₃	W ₄	Capacity	Factories	To						From						F ₁	10	8	7	12	5000	F ₂	12	13	6	10	6000	F ₃	8	10	12	14	9000	Demand	7000	5500	4500	3000	20,000	10 7 3	L4	CO2
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OPERATIONS RESEARCH

1. a) Operations Research

"A scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control."

(3)

b) Applications of OR

- > Game theory
- > Decision theory
- > Queuing theory
- > Inventory models
- > Simulation
- > Dynamic programming
- > Simulation process
- > Network scheduling

covering the points
3 marks and 4
marks for explanation.

(7)

max. $Z = 2,400$

$x_1 = 100$, $x_2 = 90$

5 marks for graph &
5 marks for solution

(10)

2. a) Basic Feasible Solution

It is a solution with a minimal set of non-zero variables.

(3)

Programmes	Programmes	Time
1	100 C	80
2	A	80
3	B	140
		300
Total min. Time		300

(1)

(7)

Operations Research models

- Transportation
- Simulation
- Queuing model
- Network techniques
- Game theory
- Linear programming

3 marks for writing points and 7 marks for explanation

10

Assignment problem

It is a fundamental combinatorial optimization problem.

3

$$UAM = 2300 \text{ Rs.}$$

7

Linear programming models

Assumptions:

- constraints and the objective function.
- parameters are vary as per magnitude
- optimal value based on certain available problem

Limitation:

- All relations are linear then it may not hold good in all the situations.
- All the constraints and coefficients are mentioned in linear programming with certainty
- we can't compute the solution manually if number of variables or constraints are very large.

3

2

pure strategy and mixed strategy
 A mixed strategy is an assignment of a probability to each pure strategy.

3

b) min. cost = B 19.
 $12 + 10 + 2 - 5 = 19.$

7

c) NW CM = B 210
 LCM = B. 280

12

5. a) network Analysis Structure representing a group of objectives and relationship between them.
 meaning needs to be written.

3

b) V (Value of Game) = 12.

7

c) Maximin = 3,00,000
 Replace = 3,00,000 } 5 marks for each.

5

6. a) objectives of scheduling
- > making efficient use of labor.
 - > increasing the profit
 - > increasing the %.
 - > improving the service level

3

b) Steps in decision-making process

- > identify the decision
- > Gather relevant info.
- > identify the alternatives
- > evidence
- > choose among alternatives
- > Take action
- > Review your decision & its consequences. (3)

identify the decision
 5 marks & explanation
 5 marks

6

6. Job sequencing

3	2	4	1	5
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Total time = 45 hours

Idle time: 3 B = 7 hours

3 C = 8 hours

(10)

7. Simulation
It is a method of solving decision making problems by designing, constructing and manipulating a model of the real system.

(8)

8. Question is incomplete.

(7)

9. Question is incomplete.

(10)

8.9 Question is incomplete.

(10)

10.
$$\text{Max. } Z = 5x_1 + 4x_2 + 5x_3$$

$$1500x_1 + 1800x_2 + 1200x_3 \leq 6$$

$$100x_1 + 80x_2 + 1250x_3 \leq 5$$

$$x_1, x_2, x_3 \geq 0.$$

222

(10)

ANSWER OF SCHEME & SOLUTION

(4)