



Second Semester MBA Degree Examination, June/July 2025  
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. M : Marks, L: Bloom's level, C: Course outcomes.

			M	L	C																														
Q.1	a.	Explain the scope of Operation Research.	3	L2	CO1																														
	b.	Examine the various types of Decision making environment.	7	L4	CO2																														
	c.	A company has 3 production facilities S <sub>1</sub> , S <sub>2</sub> and S <sub>3</sub> with production capacity of 7, 9 and 18 units (in 100s) per week of a product respectively. these units are to be shipped to four warehouses D <sub>1</sub> , D <sub>2</sub> , D <sub>3</sub> and D <sub>4</sub> with requirement of 5, 6, 7 and 14 units (in 100s) per week, respectively. The transportation costs (in Rs) per units between factories to warehouses are given in the below table :  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th></th> <th>D<sub>1</sub></th> <th>D<sub>2</sub></th> <th>D<sub>3</sub></th> <th>D<sub>4</sub></th> <th>Capacity</th> </tr> </thead> <tbody> <tr> <td>S<sub>1</sub></td> <td>19</td> <td>30</td> <td>50</td> <td>10</td> <td>07</td> </tr> <tr> <td>S<sub>2</sub></td> <td>70</td> <td>30</td> <td>40</td> <td>60</td> <td>09</td> </tr> <tr> <td>S<sub>3</sub></td> <td>40</td> <td>08</td> <td>70</td> <td>20</td> <td>18</td> </tr> <tr> <td>Demand</td> <td>05</td> <td>08</td> <td>07</td> <td>14</td> <td>34</td> </tr> </tbody> </table> Formulate the transportation problem on Least Cost method in order to find initial basic feasible solution to the transportation problem.		D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	Capacity	S <sub>1</sub>	19	30	50	10	07	S <sub>2</sub>	70	30	40	60	09	S <sub>3</sub>	40	08	70	20	18	Demand	05	08	07	14	34	10	L6	CO2
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Q.2	a.	Demonstrate the rules to determine saddle point.	3	L2	CO3																														
	b.	Explain the advantages and disadvantages of Linear programming.	7	L2	CO2																														
	c.	Explain the various decision criteria that can be used to make a choice under the state of uncertainty.	10	L4	CO2																														
Q.3	a.	What is float? Point out the different types of floats.	3	L1	CO4																														
	b.	Describe the differences between assignment and travelling salesman problem.	7	L3	CO3																														
	c.	Evaluate the models used in Operations Research.	10	L4	CO1																														
Q.4	a.	What are the phases on OR?	3	L1	CO1																														

	b.	A dairy firm has 3 plants located in a state. The daily milk production at each plant is as follows : Plant 1 = 6 million litres ; Plant 2 = 1 million litres ; Plant 3 = 10 million litres. Each day the firm must fulfill the needs of its four distribution centers. The minimum requirement of each center is as follows : Distribution centre 1 – 7 million litres Distribution centre 2 – 5 million litres Distribution centre 3 – 3million litres Distribution centre 4 – 2 million litres Cost (in hundreds of rupees) of shipping one million litres from each plant to each distribution centre is given in the following table :  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th rowspan="2">Plant</th> <th colspan="4">Distribution center</th> </tr> <tr> <th>D<sub>1</sub></th> <th>D<sub>2</sub></th> <th>D<sub>3</sub></th> <th>D<sub>4</sub></th> </tr> </thead> <tbody> <tr> <td>P<sub>1</sub></td> <td>2</td> <td>3</td> <td>11</td> <td>7</td> </tr> <tr> <td>P<sub>2</sub></td> <td>1</td> <td>0</td> <td>6</td> <td>1</td> </tr> <tr> <td>P<sub>3</sub></td> <td>5</td> <td>8</td> <td>15</td> <td>9</td> </tr> </tbody> </table> Find the initial basic feasible solution for given problem by using Vogel's Approximation Method, North West Corner Rule.	Plant	Distribution center				D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	P <sub>1</sub>	2	3	11	7	P <sub>2</sub>	1	0	6	1	P <sub>3</sub>	5	8	15	9	7	L1	CO3																								
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	c.	ABC Ice Cream Company has a distribution depot in Greater Kailash Part I for distributing ice – cream in South Delhi. There are four Vendors located in different parts of South Delhi (call them A, B, C & D) who have to be supplied ice – cream every day. The following matrix displays the distances (in kilometers) between the depot and the four Vendors.  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2"></th> <th colspan="4">To</th> </tr> <tr> <th rowspan="2">From</th> <th></th> <th>Depot</th> <th>Vendor A</th> <th>Vendor B</th> <th>Vendor C</th> <th>Vendor D</th> </tr> </thead> <tbody> <tr> <td></td> <td>Depot</td> <td>-</td> <td>3.5</td> <td>3</td> <td>4</td> <td>2</td> </tr> <tr> <td></td> <td>Vendor A</td> <td>3.5</td> <td>-</td> <td>4</td> <td>2.5</td> <td>3</td> </tr> <tr> <td></td> <td>Vendor B</td> <td>3</td> <td>4</td> <td>-</td> <td>4.5</td> <td>3.5</td> </tr> <tr> <td></td> <td>Vendor C</td> <td>4</td> <td>2.5</td> <td>4.5</td> <td>-</td> <td>4</td> </tr> <tr> <td></td> <td>Vendor D</td> <td>2</td> <td>3</td> <td>3.5</td> <td>4</td> <td>-</td> </tr> </tbody> </table> What route should the company van follow so that the total distance travelled is minimized?			To				From		Depot	Vendor A	Vendor B	Vendor C	Vendor D		Depot	-	3.5	3	4	2		Vendor A	3.5	-	4	2.5	3		Vendor B	3	4	-	4.5	3.5		Vendor C	4	2.5	4.5	-	4		Vendor D	2	3	3.5	4	-	10	L4	CO3
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Q.5	a.	What do you understand by "Events" in network?	3	L2	CO4																																																
	b.	A company management and the labour union are negotiating a new 3 year settlement. Each of these has four strategies. I : Hare & aggressive bargaining      II : Reasoning & Logical approach III : Legalistic strategy                  IV : Conciliatory approach  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th rowspan="2">Union Strategies</th> <th colspan="4">Company Strategies</th> </tr> <tr> <th>I</th> <th>II</th> <th>III</th> <th>IV</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>20</td> <td>15</td> <td>12</td> <td>35</td> </tr> <tr> <td>II</td> <td>25</td> <td>14</td> <td>8</td> <td>10</td> </tr> <tr> <td>III</td> <td>40</td> <td>2</td> <td>10</td> <td>5</td> </tr> <tr> <td>IV</td> <td>-5</td> <td>4</td> <td>11</td> <td>0</td> </tr> </tbody> </table> What strategy will the two sides adopt? Also determine the value of the game. (Apply the rule of Saddle Point).	Union Strategies	Company Strategies				I	II	III	IV	I	20	15	12	35	II	25	14	8	10	III	40	2	10	5	IV	-5	4	11	0	7	L4	CO3																			
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	c.	Find the sequence that minimizes the total elapsed time required (T) in completing the following jobs. Each job is processed in the order ABC. Also calculate T.	10	L4	CO2																																																																						
		<table border="1"> <tr> <td>Job</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> <tr> <td>Machines</td> <td>10</td> <td>8</td> <td>12</td> <td>6</td> <td>9</td> <td>11</td> <td>9</td> </tr> <tr> <td>A</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B</td> <td>6</td> <td>4</td> <td>6</td> <td>5</td> <td>3</td> <td>4</td> <td>2</td> </tr> <tr> <td>C</td> <td>8</td> <td>7</td> <td>5</td> <td>9</td> <td>10</td> <td>6</td> <td>5</td> </tr> </table>	Job	1	2	3	4	5	6	7	Machines	10	8	12	6	9	11	9	A								B	6	4	6	5	3	4	2	C	8	7	5	9	10	6	5																																	
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Q.6	a.	What is degeneracy in transportation?	3	L2	CO4																																																																						
	b.	Describe the guidelines on Linear Programming Model Formulation.	7	L4	CO2																																																																						
	c.	<p>A company has four manufacturing plants and five warehouses. Each plant manufactures the same product, which is sold at different prices in each warehouse area. The cost of manufacturing and cost of raw materials are different in each plant due to various factors. The capacities of the plants are also different in each plant due to various factors. The capacities of the plants are also different. The relevant data is given to the following table :</p> <table border="1"> <tr> <th rowspan="2">Item</th> <th colspan="4">Plant</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> <tr> <td>Manufacturing Cost (Rs) per unit</td> <td>12</td> <td>10</td> <td>8</td> <td>8</td> </tr> <tr> <td>Raw materials cost (Rs) per unit</td> <td>8</td> <td>7</td> <td>7</td> <td>5</td> </tr> <tr> <td>Capacity per unit time</td> <td>100</td> <td>200</td> <td>120</td> <td>80</td> </tr> </table> <p>The company has 5 warehouses. The sale prices, transportation costs and demands are given in the following table :</p> <table border="1"> <tr> <th rowspan="2">Warehouse</th> <th colspan="4">Transaction Cost per unit</th> <th rowspan="2">Sale price</th> <th rowspan="2">Demand per unit (Rs)</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> <tr> <td>A</td> <td>4</td> <td>7</td> <td>4</td> <td>3</td> <td>30</td> <td>80</td> </tr> <tr> <td>B</td> <td>8</td> <td>9</td> <td>7</td> <td>8</td> <td>32</td> <td>120</td> </tr> <tr> <td>C</td> <td>2</td> <td>7</td> <td>6</td> <td>10</td> <td>28</td> <td>150</td> </tr> <tr> <td>D</td> <td>10</td> <td>7</td> <td>5</td> <td>8</td> <td>34</td> <td>70</td> </tr> <tr> <td>E</td> <td>2</td> <td>5</td> <td>8</td> <td>9</td> <td>30</td> <td>90</td> </tr> </table> <p>i) Formulate this problem as a transportation problem in order to maximize profit. ii) Find the solution using VAM method.</p>	Item	Plant				1	2	3	4	Manufacturing Cost (Rs) per unit	12	10	8	8	Raw materials cost (Rs) per unit	8	7	7	5	Capacity per unit time	100	200	120	80	Warehouse	Transaction Cost per unit				Sale price	Demand per unit (Rs)	1	2	3	4	A	4	7	4	3	30	80	B	8	9	7	8	32	120	C	2	7	6	10	28	150	D	10	7	5	8	34	70	E	2	5	8	9	30	90	10	L4	CO2
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Q.7	a.	What do you understand by PERT & CPM?	3	L2	CO4																																																																						
	b.	Summarize the characteristics of Operation Research.	7	L2	CO1																																																																						

	c.	<p>A food products company is contemplating the introduction of a revolutionary new product with new packaging or replacing the existing product in much higher price (S<sub>1</sub>). It may even make a moderate change in the composition of the existing product, with a new packaging at a small increase in price (S<sub>2</sub>), or may make a small change in the composition of the existing product, backing it with the word 'New' and a negligible increase in price (S<sub>3</sub>). The three possible states of nature of events are i) high-increase in sales (N<sub>1</sub>) ii) no change in sales (N<sub>2</sub>) and iii) decrease in sales (N<sub>3</sub>). The marketing department of the company worked out the profits in terms of yearly net profits for each of the strategies of 3 events (expected sales). This is represented in the following table :</p> <table border="1"> <tr> <th rowspan="2">Strategies</th> <th colspan="3">States of Nature</th> </tr> <tr> <th>N<sub>1</sub></th> <th>N<sub>2</sub></th> <th>N<sub>3</sub></th> </tr> <tr> <td>S<sub>1</sub></td> <td>7,00,000</td> <td>3,00,000</td> <td>1,50,000</td> </tr> <tr> <td>S<sub>2</sub></td> <td>5,00,000</td> <td>4,50,000</td> <td>0</td> </tr> <tr> <td>S<sub>3</sub></td> <td>3,00,000</td> <td>3,00,000</td> <td>3,00,000</td> </tr> </table> <p>Which strategy should the concerned executive choose on the basis of i) Maximin criterion ii) Maximax criterion.</p>	Strategies	States of Nature			N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	S <sub>1</sub>	7,00,000	3,00,000	1,50,000	S <sub>2</sub>	5,00,000	4,50,000	0	S <sub>3</sub>	3,00,000	3,00,000	3,00,000	10	L5	CO2								
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Q.8	a.	<p>Solve the following LP problem graphically Maximise <math>Z = -x_1 + 2x_2</math> Subject to the constraints i) <math>x_1 - x_2 \geq -1</math> ii) <math>-0.5x_1 + 2x_2 \leq 2</math> and <math>x_1, x_2 \geq 0</math>.</p>	10	L5	CO2																											
	b.	<p>An assembly is to be made form 2 parts X and Y. Both parts must be turned on a lathe. Y must be polished, whereas X need not be polished. The sequence of activities together with their predecessors is given below :</p> <table border="1"> <tr> <th>Activity</th> <th>Description</th> <th>Predecessor Activity</th> </tr> <tr> <td>A</td> <td>Open work order</td> <td>-</td> </tr> <tr> <td>B</td> <td>Get material for X</td> <td>A</td> </tr> <tr> <td>C</td> <td>Get material for Y</td> <td>A</td> </tr> <tr> <td>D</td> <td>Turn X on lathe</td> <td>B</td> </tr> <tr> <td>E</td> <td>Turn Y on lathe</td> <td>B, C</td> </tr> <tr> <td>F</td> <td>Polish Y</td> <td>E</td> </tr> <tr> <td>G</td> <td>Assemble X &amp; Y</td> <td>D, F</td> </tr> <tr> <td>H</td> <td>Pack</td> <td>G</td> </tr> </table> <p>Draw a network diagram for the project.</p>	Activity	Description	Predecessor Activity	A	Open work order	-	B	Get material for X	A	C	Get material for Y	A	D	Turn X on lathe	B	E	Turn Y on lathe	B, C	F	Polish Y	E	G	Assemble X & Y	D, F	H	Pack	G	10	L5	CO4
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