U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCORE **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)	Define OR. Explain the phases of OR.	*CO1*	*PO1*	**08**
	b)	A manufacturer of a line of patent medicines is preparing a production plan on medicines A and B. There are sufficient ingredients available to make 20,000 bottles of A and 40,000 bottles of B, but there are only 45,000 bottles into which either of the medicines can be filled. Furthermore, it takes 3 hours to prepare enough material to fill 1000 bottles of A and 1 hour to prepare enough material to fill 1000 bottles of B and there are 66 hours available for this operation. The profit is Rs. 8 per bottle of A and Rs.7 per bottle of B. Formulate this problem as L.P.P to maximize the profit and solve graphically to determine the maximum profit.	*CO1*	*PO2*	**12**
		OR			
2	a)	Define the following (i) Slack and surplus variable (ii) Basic feasible solution (iii) Unbounded solution	*CO1*	*PO1*	**08**
	b)	Show that there is an unbounded solution to the following LPP, Max Z $=4x_1+x_2+3x_3+5x_4$, STC $4x_1-6x_2-5x_3-4x_4 >=-20$, $-3x_1-2x_2+4x_3+ x_4 <=10$, $-8x_1-3x_2+3x_3+2x_4 <=20$, $X_1, x_2, x_3, x_4 >=0$	*CO2*	*PO2*	**12**
		UNIT - II			
3		Write the dual of the primal problem given and solve. Primal Problem : Max Z= $5x_1+20x_2$ $5x_1+2x_2 \leq 20$ $x_1+2x_2 \leq 8$ $x_1+6x_2 \leq 12$ $x_1, x_2 = 0$	*CO2*	*PO2*	**20**

			OR			
	4	a)	Use the revised simplex method to solve the following LP problems: Maximize $Z = x_1 + x_2 + 3x_3$ subject to the constraints (i) $3x_1 + 2x_2 + x_3 \leq 3$, (ii) $2x_1 + x_2 + 2x_3 \leq 2$ and $x_1, x_2, x_3 \geq 0$	*CO2*	*PO2*	**15**
		b)	A company wishes to get at least 160 million 'audience exposures' the number of times one of the advertisements is seen or heard by a person. Because of the nature of the product the company wants at least 60 million month and at least 80 million of the exposures to involve persons between 18 and 40 years of age. The relevant information pertaining to the two advertising media under consideration—magazine and television is given below: **Magazine** / **Television** Cost per advertisement (Rs. thousand): 40 / 200 Audience per advertisement (million): 4 / 40 Audience per advertisement with monthly income over Rs. 10,000 (million): 3 / 10 Audience (per advertisement) in the age group 18–40 (million): 8 / 10 The company wishes to determine the number of advertisements to be released each in magazine and television so as to keep the advertisement expenditure to the minimum. Formulate this problem as a LP problem. And write the 'dual' of this problem.	*CO2*	*PO2*	**05**
			UNIT - III			
	5	a)	Solve the following TP to determine the optimum transportation schedule. D: A 8, B 12, C 9; E: A 10, B 9, C 11; F: A 7, B 4, C 10; G: A 6, B 7, C 8; supply: A 50, B 40, C 30; Demand: 25, 32, 40, 23	*CO2*	*PO2*	**12**
		b)	Explain Degeneracy in Transportation problem.	*CO2*	*PO1*	**08**
			OR			

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<tr><td></td><td>6</td><td>a)</td><td>A salesman has to visit five cities A,B,C,D and E. The distance (in hundred Km) between the five cities is as follows:
<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>7</td><td>6</td><td>8</td><td>4</td></tr><tr><td>B</td><td>7</td><td>-</td><td>8</td><td>5</td><td>6</td></tr><tr><td>C</td><td>6</td><td>8</td><td>-</td><td>9</td><td>7</td></tr><tr><td>D</td><td>8</td><td>5</td><td>9</td><td>-</td><td>8</td></tr><tr><td>E</td><td>4</td><td>6</td><td>7</td><td>8</td><td>-</td></tr></table>Which route should he select so that the total distance travelled is minimized?</td><td>CO1</td><td>PO2</td><td>12</td></tr>
<tr><td></td><td></td><td>b)</td><td>Differentiate between Transportation and Assignment problems.</td><td>CO1</td><td>PO1</td><td>08</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>A book binder has one printing press and one binding machine and the manuscripts of a number of different books. The time (in hours) required to perform the printing and binding operation for each book is shown below. Determine the order in which the books should be processed in order to minimize the total time required to turn out all the books. Determine makespan time and idle time of both machines.
<table><tr><td>Books</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Printing time</td><td>30</td><td>120</td><td>50</td><td>20</td><td>90</td><td>110</td></tr><tr><td>Binding time</td><td>80</td><td>100</td><td>90</td><td>60</td><td>30</td><td>10</td></tr></table></td><td>CO3</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Players A and B play a game in which each player has three has three coins 20p, 25p and 50p. Each of them selects a coin without the
knowledge of the other player. If the sum of the values of the coins is an even number, A wins B’s coin. If the sum is an odd number, B wins A’s coin.
(i) Develop a payoff matrix with respect to player A.
(ii) Find the optimal strategies for the players.
What is the value of the game?</td><td>CO3</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>a)</td><td>Using the graphical method, calculate the minimum time needed to process jobs 1 and 2 on five machines A, B, C, D and E, i.e. for each machine find the job that should be done first. Also, calculate the total time needed to complete both jobs.
<table><tr><td></td><td></td><td colspan="5">Machines</td></tr><tr><td rowspan="2">Job 1</td><td>Sequence</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr><tr><td>Time (hrs)</td><td>6</td><td>8</td><td>4</td><td>12</td><td>4</td></tr><tr><td rowspan="2">Job 1</td><td>Sequence</td><td>B</td><td>C</td><td>A</td><td>D</td><td>E</td></tr><tr><td>Time (hrs)</td><td>10</td><td>8</td><td>6</td><td>4</td><td>12</td></tr></table></td><td>CO3</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>In a game of matching coins with two players, suppose A wins one unit of value when there are two heads, wins nothing when there are two tails and losses 1/2 unit of value when there is one head and one tail. Determine the payoff matrix, the best strategies for each player and the value of the game to A.</td><td>CO3</td><td>PO2</td><td>10</td></tr>
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<tr><td></td><td></td><td></td><td colspan="3">UNIT - V</td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>The cost of a machine is Rs 6100 and its scrap value is only Rs 100. The maintenance costs are found from experience to be as follows:
<table>
<tr><td>Years</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>Maintenance Cost (Rs)</td><td>100</td><td>250</td><td>400</td><td>600</td><td>900</td><td>1250</td><td>1600</td><td>2000</td></tr>
</table>
When should the machine be replaced?</td><td>CO4</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Find the cost per period of individual replacement policy of an installation of 300 light bulbs, given the following:
Cost of replacing an individual bulb is Rs. 2
Conditional probability of failure is given below:
<table>
<tr><td>Week No.</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Conditional probability of failure</td><td>0</td><td>0.1</td><td>0.3</td><td>0.7</td><td>1.0</td></tr>
</table></td><td>CO4</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">OR</td><td></td><td></td></tr>
<tr><td></td><td>10</td><td>a)</td><td>A pipeline is due for repairs. The repair would cost Rs 10,000 and would last for three years. Alternately, a new pipeline can be laid at a cost of Rs 30,000, which would for 10 years. Assuming the cost of capital to be 10 per cent and ignoring salvage value, which alternative should be chosen?</td><td>CO4</td><td>PO2</td><td>06</td></tr>
<tr><td></td><td></td><td>b)</td><td>A company is considering the purchase of a new machine at Rs 15,000. The economic life of the machine is expected to be 8 years. The salvage value of the machine at the end of the life will be Rs 3,000. The annual running cost is estimated to be Rs 7,000.
(a) Assuming an interest rate of 5 per cent, determine the present worth of future costs of the proposed machine.
(b) Compare the new machine with the presently-owned machine that has an annual operating cost of Rs 5,000 and cost of repair Rs 1,500 in the second year, with an annual increase of Rs 500 in the subsequent years of its life.</td><td>CO4</td><td>PO2</td><td>14</td></tr>
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