PVP 20

Code: 20ME2701A

IV B.Tech - I Semester – Regular / Supplementary Examinations
OCTOBER 2024

OPERATIONS RESEARCH
(Common for ALL BRANCHES)

Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level CO – Course Outcome

			BL	CO	Max. Marks
		UNIT-I			
1		Find the optimum solution to the following LPP using Big M method. Maximize, $Z = 4x + 5y$ Subject to $2x + 4y \leq 8$ $x + 3y \geq 9$ both x and y are ≥ 0.	L4	CO1	14 M
		OR			
2	a)	Solve the following LP problem by using graphical method. Maximize, $Z = 2x_1 + x_2$ Subjected to $x_1 + 2x_2 \leq 10$ $x_1 + x_2 \leq 6$ $x_1 - x_2 \leq 2$ $x_1 - 2x_2 \leq 1$ $x_1, x_2 \geq 0$	L4	CO1	12 M

<table>
<tr><td></td><td>b)</td><td>Write the phases in building operations research model.</td><td>L1</td><td>CO1</td><td>2 M</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td>3</td><td colspan="2">A company needs to distribute its products from 3 manufacturing plants to 5 retail stores. The goal is to minimize the transportation cost while meeting the demand of each store. The transportation cost per unit from each plant to each store is as follows (Rs. x1000):
<table>
<tr><th></th><th>Store 1</th><th>Store 2</th><th>Store 3</th><th>Store 4</th><th>Store 5</th><th>Capacities (Units)</th></tr>
<tr><td>Plant A</td><td>4</td><td>2</td><td>3</td><td>2</td><td>6</td><td>8</td></tr>
<tr><td>Plant B</td><td>5</td><td>4</td><td>5</td><td>2</td><td>1</td><td>12</td></tr>
<tr><td>Plant C</td><td>6</td><td>5</td><td>4</td><td>7</td><td>3</td><td>14</td></tr>
<tr><td>Requirement (Units)</td><td>4</td><td>4</td><td>6</td><td>8</td><td>8</td><td></td></tr>
</table>
What is the optimal transportation cost?</td><td>L4</td><td>CO2</td><td>14 M</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>4</td><td>a)</td><td>A computer centre has 3 expert programmers. The centre wants 3 application programmes to be developed. The head of the computer centre, after studying carefully the programmes to be developed, estimates the computer time in hours required by the experts for the application programmes as follows.
<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">Programmers</td></tr>
<tr><td>Rajesh</td><td>Rafi</td><td>Robert</td></tr>
<tr><td rowspan="3">Programs</td><td>Alpha</td><td>6</td><td>3</td><td>5</td></tr>
<tr><td>Beta</td><td>5</td><td>9</td><td>2</td></tr>
<tr><td>Gama</td><td>5</td><td>7</td><td>8</td></tr>
</table>
How should the programmes be allocated, one per programmer, so as to minimize the total time of developing the programmes?</td><td>L4</td><td>CO2</td><td>10 M</td></tr>
</table>

<table>
<tr><td></td><td>b)</td><td>How do balanced and unbalanced assignment problems differ in terms of their structure and solution methods?</td><td>L2</td><td>CO2</td><td>4 M</td></tr>
<tr><td colspan="6">UNIT-III</td></tr>
<tr><td>5</td><td>a)</td><td>The arrival rate of customers at a banking counter follows Poisson distribution with a mean of 45 per hour. The service rate of the counter clerk also follows Poisson distribution with a mean of 60 per hour. Find (i) the probability of having 0 customers in the system, (ii) average number of customers waiting in the queue and (iii) average waiting time of customers in the system.</td><td>L4</td><td>CO3</td><td>10 M</td></tr>
<tr><td></td><td>b)</td><td>Describe any two customer behaviors in queuing theory.</td><td>L2</td><td>CO3</td><td>4 M</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>6</td><td colspan="3">Consider the following 3 machines and 5 jobs flow shop problem. Check whether Johnson’s rule can be extended to this problem. If so, what is the schedule and the corresponding makespan?
<table>
<tr><th>Job</th><th>Machine 1</th><th>Machine 2</th><th>Machine 3</th></tr>
<tr><td>1</td><td>11</td><td>10</td><td>12</td></tr>
<tr><td>2</td><td>13</td><td>8</td><td>20</td></tr>
<tr><td>3</td><td>15</td><td>6</td><td>15</td></tr>
<tr><td>4</td><td>12</td><td>7</td><td>19</td></tr>
<tr><td>5</td><td>20</td><td>9</td><td>7</td></tr>
</table></td><td>L4</td><td>CO3</td><td>14 M</td></tr>
<tr><td colspan="6">UNIT-IV</td></tr>
<tr><td>7</td><td>a)</td><td>Describe ‘dominance property’ and its usefulness in game theory.</td><td>L2</td><td>CO3</td><td>4 M</td></tr>
</table>

<table>
<tr><td></td><td>b)</td><td>Solve the following game using dominance principle:
<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="4">Company B</td></tr>
<tr><td>I</td><td>II</td><td>III</td><td>IV</td></tr>
<tr><td rowspan="4">Company A</td><td>I</td><td>3</td><td>2</td><td>4</td><td>0</td></tr>
<tr><td>II</td><td>3</td><td>4</td><td>2</td><td>4</td></tr>
<tr><td>III</td><td>4</td><td>2</td><td>4</td><td>0</td></tr>
<tr><td>IV</td><td>0</td><td>4</td><td>0</td><td>8</td></tr>
</table></td><td>L4</td><td>CO3</td><td>10 M</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>8</td><td colspan="3">A firm is considering replacement of equipment by new equipment whose first cost is Rs. 1750 and the scrap value is negligible at any year. Based on the experience, it is found that the maintenance cost is zero during the first year and it increases by Rs. 100 every year thereafter. When should the equipment be replaced if, interest rate = 10%.</td><td>L4</td><td>CO3</td><td>14 M</td></tr>
<tr><td colspan="6">UNIT-V</td></tr>
<tr><td>9</td><td colspan="3">Annual demand for sunflower refined oil in Amaravati Mess is 25,000 liters. Ordering cost is Rs. 2,000 per order. Inventory carrying cost is 25% of the purchase price/liter/year. The price breakups are shown below. Find the optimal order size.
<table>
<tr><td>Quantity</td><td>Price (in Rs.) per liter</td></tr>
<tr><td>$0 \leq Q_1 < 5000$</td><td>100</td></tr>
<tr><td>$5000 \leq Q_2$</td><td>90</td></tr>
</table></td><td>L4</td><td>CO4</td><td>14 M</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>10</td><td colspan="3">Demonstrate the application of simulation in solving any one of the mechanical engineering problems of your choice.</td><td>L4</td><td>CO4</td><td>14 M</td></tr>
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