14854
MCA 4th Semester Examination
Operational Research
MCA-403

Time : 3 Hours  Max. Marks : 60

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C and D and all the subparts of the questions in section E.

SECTION - A

1. Solve, Maximize
   
   \[ Z = 5x_1 - 2x_2 + 3x_3 \]

   subject to constraints
   
   \[ 2x_1 + 2x_2 - x_3 \geq 2 \]
   
   \[ 3x_1 - 4x_2 \leq 3 \]
   
   \[ x_2 + 3x_3 \leq 5 \text{ and } x_1, x_2 \geq 0 \] (12)

2. Use two phase simplex method to maximize \( Z = 5x_1 + 3x_2 \)

   subject to constraints
   
   \[ 2x_1 + x_2 \leq 1 \]
   
   \[ x_1 + 4x_2 \geq 6 \text{ and } x_1, x_2 \geq 0 \] (12)

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[P.T.O.]
3. The following table lists the jobs of a network along with their time estimates

<table>
<thead>
<tr>
<th>Jobs:</th>
<th>1-2</th>
<th>1-3</th>
<th>2-4</th>
<th>3-4</th>
<th>4-5</th>
<th>5-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimistic time:</td>
<td>2</td>
<td>9</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Pessimistic time:</td>
<td>14</td>
<td>15</td>
<td>17</td>
<td>8</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Most likely time:</td>
<td>5</td>
<td>12</td>
<td>14</td>
<td>5</td>
<td>6</td>
<td>17</td>
</tr>
</tbody>
</table>

(a) Draw the network.

(b) Calculate the expected duration of each activity.

(c) Find critical path. (12)

4. Use duality to solve the following linear programming problem

Maximize \( Z = 2x_1 + x_2 \)

Subject to \( x_1 + 2x_2 \leq 10 \)
\( x_1 + x_2 \leq 6 \)
\( x_1 - x_2 \leq 2 \)
\( x_1 - x_2 \leq 1 \) and \( x_1, x_2 \geq 0 \) (12)

SECTION - C

5. Determine a basic feasible solution to the following transportation problem

<table>
<thead>
<tr>
<th>O</th>
<th>( D_1 )</th>
<th>( D_2 )</th>
<th>( D_3 )</th>
<th>( D_4 )</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>O(_1)</td>
<td>6</td>
<td>1</td>
<td>9</td>
<td>3</td>
<td>70</td>
</tr>
<tr>
<td>O(_2)</td>
<td>11</td>
<td>5</td>
<td>2</td>
<td>8</td>
<td>55</td>
</tr>
<tr>
<td>O(_3)</td>
<td>10</td>
<td>12</td>
<td>4</td>
<td>7</td>
<td>90</td>
</tr>
</tbody>
</table>

Requirement 85 35 50 45 (12)
6. (a) What is a balanced transportation problem? What are its applications? (6)
(b) What is a stepping stone transportation problem? (6)

SECTION - D

7. Solve the game whose pay off matrix is given by

<table>
<thead>
<tr>
<th>Player A</th>
<th>B₁</th>
<th>B₂</th>
<th>B₃</th>
<th>B₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>5</td>
<td>-10</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>A₂</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>A₃</td>
<td>8</td>
<td>7</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>A₄</td>
<td>3</td>
<td>4</td>
<td>-1</td>
<td>4</td>
</tr>
</tbody>
</table>

(12)

8. (a) What are types of inventory? Why they are maintained? Explain the various costs related to inventory. (6)
(b) Describe briefly the EOQ concept. What are its limitations? Discuss. (6)

SECTION - E

9. (a) Briefly describe the advantages of operational research.
(b) What is the use of MODI method?
(c) State the rule of dominance in game theory.
(d) What is significance of float in C.P.U.?
(e) Give an example of first come, last served.
(f) State two applications of a linear programming.
(g) What is a critical path?
(h) Explain ABC analysis. (8 × 1½ = 12)