

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(MID SEMESTER EXAMINATION)

CLASS: BTECH  
BRANCH: P&IE

SEMESTER : III  
SESSION : MO/2025

SUBJECT: PE24203 OPERATIONS RESEARCH

TIME: 02 Hours

FULL MARKS: 25

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates
5. Read the questions carefully, answer only what is asked, no extra marks for extra steps.

- |  |    | CO | BL |    |              |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
|--|----|----|----|----|--------------|--------------|----|---|---|---|---|----|----|---|----|---|----|----|----|---|---|---|---|----|--------|----|---|---|----|--|--|--|--|
| <p>Q.1 Solve the following linear programming problem using graphical method. [5]</p> <p style="margin-left: 20px;"><i>Minimize:</i> <math>Z = 20x + 10y</math></p> <p style="margin-left: 20px;">Subjected to:</p> <p style="margin-left: 40px;"><math>3x + y \geq 30</math></p> <p style="margin-left: 40px;"><math>4x + 3y \geq 60</math></p> <p style="margin-left: 40px;"><math>x, y \geq 0</math></p>  |    | 1  | 3  |    |              |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| <p>Q.2 Consider the following linear programming problem. Develop the <b>initial simplex tubule</b> for the problem. What are the basic, and non-basic variables at this level? [3+1+1] 2 4</p> <p style="margin-left: 20px;">Also calculate the <math>C_j - Z_j</math> row.</p> <p style="margin-left: 20px;"><i>Maximize:</i> <math>Z = 2x_1 + 3x_2 + 4x_3</math></p> <p style="margin-left: 20px;">Subjected to:</p> <p style="margin-left: 40px;"><math>3x_1 + x_2 + 4x_3 \leq 600</math></p> <p style="margin-left: 40px;"><math>x_1 + 2x_2 + x_3 \geq 240</math></p> <p style="margin-left: 40px;"><math>2x_1 + 3x_2 + 3x_3 = 540</math></p> <p style="margin-left: 40px;"><math>x_1, x_2, x_3 \geq 0</math></p>   |    |    |    |    |              |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| <p>Q.3 Formulate the Dual of the following linear programming problem [5] 2 4</p> <p style="margin-left: 20px;"><i>Maximize:</i> <math>Z = 8x_1 + 6x_2 + 7x_3 + 10x_4</math></p> <p style="margin-left: 20px;">Subjected to:</p> <p style="margin-left: 40px;"><math>3x_1 + 2x_2 + 2.5x_3 + 4x_4 \leq 80</math></p> <p style="margin-left: 40px;"><math>25x_1 + 10x_2 + 7x_3 + 15x_4 \leq 250</math></p> <p style="margin-left: 40px;"><math>4x_1 - x_2 = 10</math></p> <p style="margin-left: 40px;"><math>x_3 \geq 5</math></p> <p style="margin-left: 40px;"><math>x_1, x_2, x_3, x_4 \geq 0</math></p>   |    |    |    |    |              |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| <p>Q.4 A company has 3 warehouses from which it needs to deliver its products to the four [5] 3 4<br/>retailers. The cost of transport from each warehouse (W's) to each retailer (R's) is provided in the following table. The table also contains the availability at the warehouses, and demand at the retailers. Use any of the Northwest corner rule, least cost method, and penalty cost method to identify a feasible solution to the problem. Also calculate the cost of the solution identified.</p> <table border="1" style="margin-left: 40px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th></th> <th>R1</th> <th>R2</th> <th>R3</th> <th>R4</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <th>W1</th> <td>8</td> <td>9</td> <td>6</td> <td>3</td> <td>18</td> </tr> <tr> <th>W2</th> <td>6</td> <td>11</td> <td>5</td> <td>10</td> <td>20</td> </tr> <tr> <th>W3</th> <td>3</td> <td>8</td> <td>7</td> <td>9</td> <td>19</td> </tr> <tr> <th>Demand</th> <td>25</td> <td>6</td> <td>8</td> <td>18</td> <td></td> </tr> </tbody> </table> |    | R1 | R2 | R3 | R4           | Availability | W1 | 8 | 9 | 6 | 3 | 18 | W2 | 6 | 11 | 5 | 10 | 20 | W3 | 3 | 8 | 7 | 9 | 19 | Demand | 25 | 6 | 8 | 18 |  |  |  |  |
|  | R1 | R2 | R3 | R4 | Availability |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| W1   | 8  | 9  | 6  | 3  | 18           |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| W2   | 6  | 11 | 5  | 10 | 20           |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| W3   | 3  | 8  | 7  | 9  | 19           |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| Demand   | 25 | 6  | 8  | 18 |              |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |
| <p>Q.5 Use modified distribution method (MODI) to find the optimal solution to the [5] 3 3<br/>transportation problem described in question no. 4 using the initial feasible solution identified. What is the cost difference between the optimal solution and the initial feasible solution?</p>  |    |    |    |    |              |              |    |   |   |   |   |    |    |   |    |   |    |    |    |   |   |   |   |    |        |    |   |   |    |  |  |  |  |