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School of Engineering Sciences & Technology
Supplementary Examination-2023

Paper Name: Operation Research
Time: 3 Hours
Note: Programmable calculator is not allowed.

Paper Code: BTCSE OE-23
Maximum Marks: 75

PART –A

(All questions are compulsory) **(7 X 5 = 35)**

S. No.	Questions	Marks	Course Outcome	Blooms Level
Q.1	Solve the following transportation problem (Vogel's Approximation Method). Warehouse→ / Factory↓ | A | B | C | W_4 | Capacity P | 2 | 3 | 5 | 1 | 7 Q | 7 | 3 | 4 | 6 | 9 R | 4 | 1 | 7 | 2 | 18 Requirement | 5 | 8 | 7 | 14 | 34	5	CO2	L3
Q.2	Write down the dual of the following LP problem: Max $Z = 3x_1 - 2x_2$, Subject to: $x_1 + x_2 \leq 5$, $-x_2 \leq -1$, $x_1 \leq 4, x_2 \leq 6$ and $x_1 \geq 0$, $x_2 \geq 0$.	5	CO4	L3
Q.3	Solve the following LPP Max $Z = x_1 + 2x_2$, Subject to: $x_1 + 2x_2 \leq 20$, $x_1 + x_2 \leq 16$, $x_1 \leq 8$ and $x_1 \geq 0$, $x_2 \geq 0$ by using any method.	5	CO2	L5
Q.4	A company produces two types of Hats. Each hat of the first type requires twice as much labour time as the second type. If all hats are of the second type only, the company can produce a total of 500 hats of day. The market limits daily sales of the first and second type to 150 and 250 hats. Assuming that the profits per that are Rs. 8 for type A and Rs. 5 for type B, formulate the problem as a linear programming model in order to determine the number of hats to be produced of each type so as to maximize the profit.	5	CO1	L5
Q.5	Construct graphical representation of the LPP Max $Z = x_1 + x_2$, Subject to: $2x_1 + x_2 \leq 10$, $x_1 + 2x_2 \leq 8$, $x_1 \leq 12$ and $x_1 \geq 0$, $x_2 \geq 0$. Hence, find its solution.	5	CO3	L3
Q.6	Consider the following payoff (profit) matrix: | | A | B | C | D | P | 7 | 12 | 19 | 22 | Q | 7 | 9 | 8 | 21 | R | 20 | 17 | 12 | 23 | S | 27 | 21 | 19 | 17 | Solve this using Hurwics criterion with $\alpha = 0.70$.	5	CO5	L3
Q.7	Bright bakery keeps stock of popular brand of cake. Previous experience indicates the daily demand as given here: | Demand | 0 | 10 | 20 | 30 | 40 | 50 | | Probability | 0.01 | 0.20 | 0.15 | 0.50 | 0.12 | 0.02 | Consider the following sequence of random numbers: 48, 71, 19, 51, 56, 77, 15, 14, 68, 09, using this sequence, simulate the demand for next 10 days. Find out the stock situation if the owner of the bakery decides to make 30 cakes every day. Also estimates the daily average demand for cakes on the basis of simulated data.	5	CO3	L5

PART – B

(Attempt any Four Questions out of Six) (4 X 10 = 40)

<table>
<tr><th>S. No</th><th>Questions</th><th>Marks</th><th>Course Outcome</th><th>Blooms Level</th></tr>
<tr><td>Q.1</td><td>Solve the following transportation problem.
<table>
<tr><td>Warehouse→ Factory↓</td><td>W_1</td><td>W_2</td><td>W_3</td><td>Factory Capacity</td></tr>
<tr><td>F_1</td><td>1</td><td>3</td><td>4</td><td>20</td></tr>
<tr><td>F_2</td><td>2</td><td>3</td><td>2</td><td>40</td></tr>
<tr><td>F_3</td><td>1</td><td>2</td><td>5</td><td>30</td></tr>
<tr><td>F_4</td><td>4</td><td>1</td><td>9</td><td>10</td></tr>
<tr><td>Warehouse Requirement</td><td>30</td><td>50</td><td>20</td><td>34</td></tr>
</table></td><td>10</td><td>CO3</td><td>L3</td></tr>
<tr><td>Q.2</td><td>Solve by using Big-M Method to the following LP problem: Max $Z = -x_1 - x_2$, Subject to: $x_1 + x_2 = 3$, $4x_1 + x_2 \geq 6$, $x_1 + x_2 \leq 4$, and $x_1 \geq 0$, $x_2 \geq 0$.</td><td>10</td><td>CO2</td><td>L3</td></tr>
<tr><td>Q.3</td><td>Five men are available to do five different jobs. Form past records, the time (in hours) that each man takes to do each job is known and given in the following table:
<table>
<tr><td></td><td>I</td><td>II</td><td>III</td><td>IV</td><td>V</td></tr>
<tr><td>A</td><td>3</td><td>10</td><td>2</td><td>11</td><td>1</td></tr>
<tr><td>B</td><td>6</td><td>7</td><td>9</td><td>8</td><td>1</td></tr>
<tr><td>C</td><td>5</td><td>12</td><td>13</td><td>15</td><td>1</td></tr>
<tr><td>D</td><td>1</td><td>0</td><td>16</td><td>3</td><td>1</td></tr>
<tr><td>E</td><td>18</td><td>4</td><td>14</td><td>17</td><td>1</td></tr>
</table>
Find the assignment of the men to jobs that will minimize the total time taken.</td><td>10</td><td>CO3</td><td>L3</td></tr>
<tr><td>Q.4</td><td>The utility data for a network are given below. Determine the total, free, independent and interfering floats and identify the critical path.
<table>
<tr><td>Activity</td><td>0-1</td><td>1-2</td><td>1-3</td><td>2-4</td><td>2-5</td><td>3-4</td><td>3-6</td><td>4-7</td><td>5-7</td><td>6-7</td></tr>
<tr><td>Duration</td><td>2</td><td>8</td><td>10</td><td>6</td><td>3</td><td>3</td><td>7</td><td>5</td><td>2</td><td>8</td></tr>
</table></td><td>10</td><td>CO3</td><td>L5</td></tr>
<tr><td>Q.5</td><td>Solve the LP problem (Using simplex method): Min $Z = x_1 + x_2 + x_3$, Subject to: $x_1 - x_2 + 3x_3 \leq 8$, $-2x_1 + 4x_2 \leq 14$, $-x_1 + 3x_2 + 2x_3 \leq 15$, and $x_1 \geq 0$, $x_2 \geq 0$, $x_3 \geq 0$</td><td>10</td><td>CO2</td><td>L3</td></tr>
<tr><td>Q.6</td><td>Consider a box office ticket window managed by a single server Customer arrives to purchase ticket according to Poisson input process with a mean rate of 30/hr. the time required to serve a customer has an ED with a mean of 90 seconds determine: (i) Mean queue length. (ii) Mean waiting time in the system. (iii) The probability of the customer waiting in the queue for more than 10min. (iv) The fraction of the time for which the server is busy.</td><td>10</td><td>CO1</td><td>L2</td></tr>
</table>

BL – Bloom's Taxonomy Levels (1- Remembering, 2- Understanding, 3- Applying,
4- Analyzing, 5- Evaluating, 6- Creating)

**********End of Paper**********