# CBCS SCHEME

USN

22MBA24

## Second Semester MBA Degree Examination, June/July 2023

## Operations Research

Time: 3 hrs. Max. Marks: 100

**Note: 1.** ***Answer any FOUR full questions from Q.No.1 to Q.No.7.***
***2. Question No. 8 is compulsory.***
***3. Calculators are allowed. Use of Z-table is permitted.***
***4. M : Marks , L: Bloom's level , C: Course outcomes.***

| | | | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | What is Operations Research? | 3 | L1 | CO1 |
| | b. | A manufacturer produces two models $M_1$ and $M_2$ of a product. Each unit of model $M_1$ requires 4 hrs of grinding and 2 hrs of polishing. Each unit of model $M_2$ requires 2 hrs of grinding and 5 hrs of polishing. The manufacturer has 2 grinders each of which works for 40 hrs a week. There are 3 polishers each of which works for 60 hrs per week. Profit of model $M_1$ is Rs.300 per unit and profit of model $M_2$ is Rs.400 per unit. The manufacturer has to allocate his production capacity so as to maximize his profit. Formulate LPP. | 7 | L3 | CO2 |
| | c. | A foreman wants to process four different jobs on 3 machines : a shaping machine, a drilling machine and tapping machine. The sequence of the operations being shaping-drilling-tapping. Decide the optimal sequence for the four jobs to minimize the time elapsed and find the total idle time. The processing time in minutes is as given in the table. | 10 | L2 | CO3 |

| Jobs | Machines | | |
|---|---|---|---|
| | Shaping | Drilling | Tapping |
| 1 | 13 | 3 | 18 |
| 2 | 18 | 8 | 4 |
| 3 | 8 | 6 | 13 |
| 4 | 23 | 6 | 8 |

| | | | M | L | C |
|---|---|---|---|---|---|
| Q.2 | a. | What are the applications of LPP in management? | 3 | L1 | CO1 |
| | b. | Enumerate on the scope of operation research. | 7 | L2 | CO1 |
| | c. | Solve the following transportation problem to maximize the profit by least cost method. | 10 | L3 | CO2 |

| Source | Destination | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | Supply |
| 1 | 15 | 51 | 42 | 33 | 23 |
| 2 | 80 | 42 | 26 | 81 | 44 |
| 3 | 90 | 40 | 66 | 60 | 33 |
| Demand | 23 | 31 | 16 | 30 | |

| | | | M | L | C |
|---|---|---|---|---|---|
| Q.3 | a. | What is an Assignment problem? | 3 | L1 | CO2 |

<table>
<tr><td></td><td><b>b.</b></td><td>For the following pay-off matrix of Company X, find the solution of the game by principle of dominance.<br>Company Y<br>Company X
<table>
<tr><td></td><td>P</td><td>Q</td><td>R</td><td>S</td></tr>
<tr><td>A</td><td>6</td><td>$-2$</td><td>4</td><td>1</td></tr>
<tr><td>B</td><td>6</td><td>1</td><td>12</td><td>3</td></tr>
<tr><td>C</td><td>$-3$</td><td>$-2$</td><td>$-2$</td><td>6</td></tr>
<tr><td>D</td><td>2</td><td>$-3$</td><td>7</td><td>7</td></tr>
</table></td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td><b>c.</b></td><td>Use graphical method to solve the following LPP :<br>Min $z = 20x + 10y$<br>Subject to constraints :<br>$x + 2y \le 40$<br>$3x + y \ge 30$<br>$4x + 3y \ge 60$<br>where x, y $\ge 0$</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td><b>Q.4</b></td><td><b>a.</b></td><td>What do you understand by "work-break down" structure?</td><td>3</td><td>L1</td><td>CO4</td></tr>
<tr><td></td><td><b>b.</b></td><td>Enumerate on the differences between PERT and CPM.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td><b>c.</b></td><td>Solve the travelling salesman problem by using the data given :<br>$C_{12} = 20$, $C_{13} = 4$, $C_{14} = 10$, $C_{23} = 5$, $C_{34} = 6$, $C_{25} = 10$, $C_{33} = 6$, $C_{45} = 20$, where $C_{ij} = C_{ji}$ and there is no route between cities i and j if a value of $C_{ij}$ is not known.</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td><b>Q.5</b></td><td><b>a.</b></td><td>What is 'Project control phase' in project management?</td><td>3</td><td>L1</td><td>CO4</td></tr>
<tr><td></td><td><b>b.</b></td><td>Enumerate on the different criteria of decision making under uncertainty.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td><b>c.</b></td><td>The precedence relation and other information are given in the table below,<br>(i) Draw a network diagram to represent the project.<br>(ii) Find the critical path.<br>(iii) Find the total floats available on non-critical activities.
<table>
<tr><td>Sl. No.</td><td>Activity</td><td>Predecessor</td><td>Duration (Days)</td></tr>
<tr><td>1</td><td>A</td><td>-</td><td>7</td></tr>
<tr><td>2</td><td>B</td><td>-</td><td>13</td></tr>
<tr><td>3</td><td>C</td><td>A</td><td>10</td></tr>
<tr><td>4</td><td>D</td><td>A</td><td>17</td></tr>
<tr><td>5</td><td>E</td><td>B</td><td>3</td></tr>
<tr><td>6</td><td>F</td><td>D, E</td><td>26</td></tr>
</table></td><td>10</td><td>L4</td><td>CO4</td></tr>
<tr><td><b>Q.6</b></td><td><b>a.</b></td><td>Why is job sequencing important?</td><td>3</td><td>L1</td><td>CO3</td></tr>
<tr><td></td><td><b>b.</b></td><td>Briefly explain the steps involved in decision-making process.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td><b>c.</b></td><td>Solve the following game graphically,<br>Player B<br>Player A
<table>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>1</td><td>$-5$</td><td>5</td><td>0</td><td>$-1$</td><td>8</td></tr>
<tr><td>2</td><td>8</td><td>$-4$</td><td>$-1$</td><td>6</td><td>$-5$</td></tr>
</table></td><td>10</td><td>L4</td><td>CO3</td></tr>
</table>

**Q.7** **a.** What is Degeneracy in transportation problem? — 3 | L2 | CO2

**b.** Solve the assignment problem. — 7 | L3 | CO3

|   | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| A | 85.3 | 90 | 87.5 | 82.4 | 89.1 | 91.3 |
| B | 78.9 | 84.5 | 99.4 | 80.4 | 89.3 | 88.4 |
| C | 82.0 | 31.3 | 28.5 | 66.5 | 80.4 | 109.7 |
| D | 84.3 | 34.6 | 86.2 | 83.3 | 85.0 | 85.5 |

**c.** The time estimates for various activities in a construction project are given below : — 10 | L4 | CO4

| Activity | Time estimates (months) | | |
|---|---|---|---|
| | Optimistic time ($t_e$) | Most likely time ($t_m$) | Pessimistic time ($t_P$) |
| 1 – 2 | 10 | 12 | 16 |
| 2 – 3 | 2 | 8 | 36 |
| 2 – 4 | 1 | 4 | 5 |
| 2 – 6 | 2 | 3 | 4 |
| 3 – 5 | 8 | 12 | 20 |
| 4 – 5 | 15 | 18 | 30 |
| 4 – 6 | 3 | 5 | 8 |
| 5 – 7 | 2 | 4 | 8 |
| 6 – 7 | 6 | 9 | 12 |
| 7 – 8 | 4 | 6 | 14 |

(i) Draw Network diagram.
(ii) Calculate the expected time for each activity.
(iii) Determine critical path.
(iv) What is the probability that the project will be finished in 4 years?
(v) What is the probability that the project will be finished in 55 months?

**Q.8** **Case Study:**

Given below is a table taken from the solution process of transportation problem.

| | To / From | Warehouse W$_1$ | W$_2$ | W$_3$ | W$_4$ | Capacity |
|---|---|---|---|---|---|---|
| Factories | F$_1$ | 10 | 8 | 7 | 12 | 5000 |
| | F$_2$ | 12 | 13 | 6 | 10 | 6000 |
| | F$_3$ | 8 | 10 | 12 | 14 | 9000 |
| | Demand | 7000 | 5500 | 4500 | 3000 | 20,000 |

Answer the following questions :
(i) Solve the transportation problem by VAM and check the optimality by MODI method.
(ii) Is this solution optimal? If not, find the optimal solution?
(iii) Does the problem have alternate optimal solution? If yes, give another optimal solution.

10 / 7 / 3 | L4 | CO2

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