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# B.M.S. College of Engineering, Bengaluru-560019

**Autonomous Institute Affiliated to VTU**

## January 2024 Semester End Main Examinations

**Programme: B.E.** | **Semester: VII**
**Branch: Institutional Elective** | **Duration: 3 hrs.**
**Course Code: 21MD7OEOPR** | **Max Marks: 100**
**Course: Operations Research**

**Instructions:** 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

**Important Note:** Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

| | | **UNIT - I** | ***CO*** | ***PO*** | **Marks** |
|---|---|---|---|---|---|
| 1 | a) | Use the graphical method to solve the following Linear Programming problem.<br>Minimize $Z = 3x_1 + 2x_2$<br>subject to the constraints<br>$5x_1 + x_2 \geq 10$<br>$x_1 + x_2 \geq 6$<br>$x_1 + 4x_2 \geq 12$<br>and $x_1, x_2 \geq 0$. | *CO2* | *PO2* | **08** |
| | b) | Solve the following linear programming problem by simplex method:<br>Maximize Z = 16x1 + 17x2 + 10x3<br>subject to the constraints<br>x1 + x2 + 4x3 ≤ 2,000<br>2x1 + x2 + x3 ≤ 3,600<br>x1 + 2x2 + 2x3 ≤ 2,400<br>x1 ≤ 30<br>and x1, x2, x3 ≥ 0 | *CO3* | *PO3* | **12** |
| | | **OR** | | | |
| 2 | a) | What is the significance of cj – zj numbers in the simplex table? Interpret their economic significance in terms of marginal worth. | *CO2* | *PO2* | **06** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | b) | Solve the following linear programming problem by Big-M method:<br>Minimize $Z = 5x_1 + 3x_2$<br>subject to constraints<br>$2x_1 + 4x_2 \leq 12$<br>$2x_1 + 2x_2 = 10$<br>$5x_1 + 2x_2 \geq 10$<br>and $x_1, x_2 \geq 0$. | *CO3* | *PO3* | **14** |
| | | | **UNIT - II** | | | |
| | 3 | a) | Determine an initial basic feasible solution to the following transportation problem by using (i) NWCM, (ii) LCM: | *CO2* | *PO2* | **08** |

| | | Distribution Centre | | | | Supply |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | |
| Plant | 1 | 2 | 3 | 11 | 7 | 6 |
| | 2 | 1 | 0 | 6 | 1 | 1 |
| | 3 | 5 | 8 | 15 | 9 | 10 |
| Demand | | 7 | 5 | 3 | 2 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | b) | A potato chip manufacturer has three plants and four warehouses. Transportation cost for shipping from plants to warehouses, the plant availability and warehouses requirements are as follows: | *CO3* | *PO3* | **12** |

| Plants | Warehouses | | | | Plant Availability (quintals) |
|---|---|---|---|---|---|
| | $W_1$ | $W_2$ | $W_3$ | $W_4$ | |
| $F_1$ | 7 | 4 | 3 | 5 | 235 |
| $F_2$ | 6 | 8 | 7 | 4 | 280 |
| $F_3$ | 5 | 6 | 9 | 10 | 110 |
| Requirements (quintals) | 125 | 160 | 110 | 230 | |

Find optimum shipping schedule.

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **UNIT - III** | | | |
| | 4 | a) | Alpha Corporation has four plants, each of which can manufacture any one of four products *A*, *B*, *C* or *D*. Production costs differ from one plant to another and so do the sales revenue. The revenue and the cost data are given below. Determine which product should each plant produce in order to maximize profit. | *CO4* | *PO4* | **10** |

| Sales Revenue | | | | | | | Production Cost | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Plant | | | | | | | Plant | | | |
| | | 1 | 2 | 3 | 4 | | | | 1 | 2 | 3 | 4 |
| Product | A | 50 | 68 | 49 | 62 | | Product | A | 49 | 60 | 45 | 61 |
| | B | 60 | 70 | 51 | 74 | | | B | 55 | 63 | 45 | 49 |
| | C | 52 | 62 | 49 | 68 | | | C | 55 | 67 | 53 | 70 |
| | D | 55 | 64 | 48 | 66 | | | D | 58 | 65 | 54 | 68 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | b) | Products 1, 2, 3, 4 and 5 are to be processed on a machine. The set-up costs in rupees per change depend upon the product presently on the machine and the set-up to be made. These are given by the following data: | *CO3* | *PO3* | **10** |

$C12 = 16$, $C13 = 4$, $C14 = 12$, $C23 = 6$, $C24 = 5$, $C25 = 8$, $C35 = 6$, $C45 = 20$;

$Cij = Cji$, $Cij = \infty$ for $i = j$

for all values of $i$ and $j$ not given in the data. Find the optimum sequence of products in order to minimize the total set-up cost.

## UNIT - IV

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | a) | Compare CPM and PERT with respect to: i. Orientation ii. Model iii. Estimates iv. Crashing concept | *CO2* | *PO2* | **08** |
| | b) | Draw the network diagram and determine the early start, finish and late start, finish in respect of all node points and identify critical path for the following: | *CO3* | *PO3* | **12** |

| Activity | 1 – 2 | 1 – 3 | 1 – 4 | 2 – 5 | 3 – 7 | 4 – 6 | 5 – 7 |
|---|---|---|---|---|---|---|---|
| Duration | 10 | 8 | 9 | 8 | 16 | 7 | 7 |
| Activity | 5 – 8 | 6 – 7 | 6 – 9 | 7 – 10 | 8 – 10 | 9 – 10 | |
| Duration | 6 | 7 | 5 | 12 | 13 | 15 | |

**OR**

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | a) | What is float? What are the different types of floats? | *CO2* | *PO2* | **08** |
| | b) | A small project is composed of 7 activities whose time estimates are listed below. Activities are being identified by their beginning (i) and ending (j) node numbers. | *CO3* | *PO3* | **12** |

| Activity | 1 – 2 | 1 – 3 | 1 – 4 | 2 – 5 | 3 – 5 | 4 – 6 | 5 – 6 |
|---|---|---|---|---|---|---|---|
| $t_o$ | 1 | 1 | 2 | 1 | 2 | 2 | 3 |
| $t_l$ | 1 | 4 | 2 | 1 | 5 | 5 | 6 |
| $t_p$ | 7 | 7 | 8 | 1 | 14 | 8 | 15 |

i. Draw the network
ii. Calculate the expected time and variances for each activity
iii. Calculate the probability that the project will be completed at least 3 weeks than expected

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **UNIT - V** | | | |
| | 7 | a) | Use the principle of dominance to find the optimal strategy for both the players and also value of the game for the following pay – off matrix: | *CO3* | *PO3* | **08** |
| | | | b) | | | |

Player B

| | | I | II | III | IV |
|---|---|---|---|---|---|
| Player A | 1 | 4 | 2 | 3 | 6 |
| | 2 | 3 | 4 | 7 | 5 |
| | 3 | 6 | 3 | 5 | 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | b) | Two firms A and B make colour and black & white television sets. Firm A can make either 150 colour sets in a week or an equal number of black & white sets, and make a profit of Rs 400 per colour set, or 150 colour and 150 black & white sets, or 300 black & white sets per week. It also has the same profit margin on the two sets as A. Each week there is a market of 150 colour sets and 300 black & white sets and the manufacturers would share market in the proportion in which they manufacture a particular type of set. Write the pay-off matrix of A per week. Obtain graphically A's and B's optimum strategies and value of the game. | *CO4* | *PO4* | **12** |

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