**U.S.N** | | | | | | | | | |

## P.E.S. College of Engineering, Mandya - 571 401
*(An Autonomous Institution affiliated to VTU, Belagavi)*
**Eighth Semester, B.E. - Mechanical Engineering**
**Semester End Examination; July - 2023**
**Operations Research**

*Time: 3 hrs*                                                                         *Max. Marks: 100*

### Course Outcomes

*The Students will be able to:*
*CO1: Identify and develop operation research models from the verbal description of real life.*
*CO2: Analyse the problem using mathematical tools and simple queue system.*
*CO3: Describe the model and the solving technique to analyse the results and propose recommendation.*
*CO4: Solve Transportation and Assignment problem using different methods.*
*CO5: Explain the game theory with their characteristics and Solve problems.*

**Note:** *I) PART - A is compulsory. **Two** marks for each question.*
   *II) PART - B: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

| Q. No. | Questions | Marks | BLs | COs | POs |
|---|---|---|---|---|---|
| | **I : PART - A** | **10** | | | |
| I a. | Write general formulation of Linear Programming Problem (LPP). | 2 | L1 | CO1 | PO1 |
| b. | Define degeneracy in LPP. | 2 | L1 | CO2 | PO1 |
| c. | Mention the different methods to find basic feasible solution in transportation problems. | 2 | L1 | CO3 | PO1 |
| d. | What is project controlling? | 2 | L1 | CO4 | PO1 |
| e. | What are the classifications of game theory problems? | 2 | L1 | CO5 | PO1 |
| | **II : PART - B** | **90** | | | |
| | **UNIT - I** | **18** | | | |
| 1 a. | A manufacture of packing material produced two types of packing tins round and flat. Major production facilities involved are cutting and joining. The cutting department can process 300tins of round or 500tins of flat per hour. If the profit contribution of round tins is Rs 100 per tin and that of flat is Rs 80 per tin, formulate the problem as LPP. | 9 | L2 | CO1 | PO2 |
| b. | Solve the following LPP by Graphical method. find the minimum value of , $Z = -X_1 - 2X_2$ Subjected to $-X_1 - 3X_2 \leq 10$ $X_1 + X_2 \leq 6$ $X_1 - X_2 \leq 2$ $X_1, X_2 \geq 0$ | 9 | L3 | CO1 | PO2 |
| c. | Explain the scope of OR. | 9 | L2 | CO1 | PO2 |

**UNIT - II**                                    **18**

2 a.   Solve by simplex method, minimize

$Z = X_1 - 3X_2 - 3X_3$

Subjected to,

$3X_1 - X_2 + 2X_3 \leq 7$                                   14     L3   CO2  PO2

$2X_1 + 4X_2 \geq -12$

$-4X_1 + 3X_2 + 8X_3 \leq 10$

$X_1, X_2, X_3 \geq 0$

b.   Solve the following LPP by using two phase simplex method

Minimize $Z = X_1 + X_2$

Subjected to                                            14     L3   CO2  PO2

$2X_1 + X_2 \geq 4$

$X_1 + 7X_2 \geq 7$

$X_1, X_2 \geq 0$

c.   State the comparison between Big-M method and two phase method.     4     L4   CO2  PO2

**UNIT - III**                                   **18**

3 a.   A find the optimum solution to the following transportation problem in
which the cell contains the transportation, transportation cost in rupees.

                                            Supply
                                                                 12     L1   CO3  PO2

| 21 | 16 | 25 | 13 | 11 |
|----|----|----|----|----|
| 17 | 18 | 14 | 23 | 13 |
| 32 | 17 | 18 | 41 | 19 |

Demand   6    10   12   15

b.   A sales man wants to visit cities 1, 2, 3 and 4. He does not want to visit
any city twice before completing the tour of all cities and wishes to
return starting station. Cost of going from one city to another in rupees is
gives in the table. Find the least cost route.

                          To city                          12     L1   CO3  PO2

|          |   | 1  | 2  | 3   | 4  |
|----------|---|----|----|-----|----|
|          | 1 | 0  | 30 | 80  | 50 |
| From City| 2 | 40 | 0  | 140 | 30 |
|          | 3 | 40 | 50 | 0   | 20 |
|          | 4 | 70 | 80 | 130 | 0  |

c.   Discuss the concepts of degeneracy in transportation problem.     6     L2   CO3  PO2

## UNIT - IV                                                              18

4 a.  A project schedule has the following characteristics

| Activity | Time (weeks) | Activity | Time (weeks) |
|----------|--------------|----------|--------------|
| 1-2 | 4 | 5-6 | 4 |
| 1-3 | 1 | 5-7 | 8 |
| 2-4 | 1 | 6-8 | 1 |
| 3-4 | 1 | 7-8 | 2 |
| 3-5 | 6 | 8-10 | 5 |
| 4-9 | 5 | 9-10 | 7 |

12    L1   CO4   PO2

   i) Construct Network diagram

   ii) Compute E and L for each event

   iii) Find the critical path and project duration.

  b.  Consider the network shown in below figure for each activity the three
      time estimates $t_o$, $t_m$, $t_p$ are given along the arrows in the $t_o$,- $t_m$, -$t_p$ order.
      Find various and expected time for each activity.
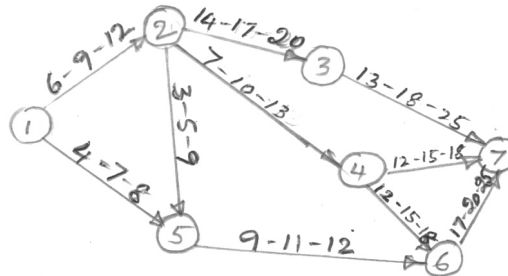


12    L1   CO4   PO2

  c.  Explain Falkerson rule.                                                6    L2   CO4   PO2

## UNIT - V                                                               18

5 a.  What are the characteristics of games?                                6    L1   CO5   PO2

  b.  Solve the following 2×4 game be graphical method.

Player B

|          |   | 1 | 2 | 3 | 4 |
|----------|---|---|---|---|---|
| Player A | 1 | 3 | 3 | 4 | 0 |
|          | 2 | 5 | 4 | 3 | 7 |

12    L3   CO5   PO2

  c.  A self service store employee is cashier at its counter nine customers
      arrive on an average every 5 minutes while the cashier can serve 10
      customers in 5 minutes. Assuming Poisson distribution for arrival rate
      and exponential for service time. Find;

   i) Average number of customers in the system.

   ii)Average queue length

   iii) Average time a customer spend in the system

   iv) Average time a customer's waits before being served

6    L1   CO5   PO2

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