

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

CLASS: M.Tech  
BRANCH: Production and Industrial Engineering

SEMESTER : I  
SESSION : MO/2025

SUBJECT: PE522 OPTIMIZATION TECHNIQUES

TIME: 3 Hours

FULL MARKS: 50

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) A plastic products manufacturer has 1,200 boxes of transparent wrap in stock at one factory and another 1,200 boxes at its second factory. The manufacturer has orders for this product from three different retailers, in quantities of 1,000, 700 and 500 boxes, respectively. The unit shipping costs (in INR per box) from the factories to the retailers are as follows: [5] CO 1  
BL 4

| Factory   | Retailer 1 (INR) | Retailer 2 (INR) | Retailer 3 (INR) |
|-----------|------------------|------------------|------------------|
| Factory A | 4                | 1                | 3                |
| Factory B | 3                | 3                | 2                |

- Q.1(b) Formulate a linear programming problem that minimizes the total transportation cost. Solve the following linear programming problem using graphical method. [5] 1 3
- Minimize:  $Z = 20x + 10y$*   
Subjected to:  
 $3x + y \geq 30$   
 $4x + 3y \geq 60$   
 $x, y \geq 0$

- Q.2(a) Consider the following linear programming problem. Develop the initial simplex tableau for the problem. What are the basic, and non-basic variables at this level? Also calculate the  $C_j - Z_j$  row. [5] 2 3
- Maximize:  $Z = 2x_1 + 3x_2 + 4x_3$*   
Subjected to:  
 $3x_1 + x_2 + 4x_3 \leq 600$   
 $x_1 + 2x_2 + x_3 \geq 240$   
 $2x_1 + 3x_2 + 3x_3 = 540$   
 $x_1, x_2, x_3 \geq 0$

- Q.2(b) Formulate the Dual of the following linear programming problem [5] 2 3
- Maximize:  $Z = 8x_1 + 6x_2 + 7x_3 + 10x_4$*   
Subjected to:  
 $3x_1 + 2x_2 + 2.5x_3 + 4x_4 \leq 80$   
 $25x_1 + 10x_2 + 7x_3 + 15x_4 \leq 250$   
 $4x_1 - x_2 = 10$   
 $x_3 \geq 5$   
 $x_1, x_2, x_3, x_4 \geq 0$

PTO

- Q.3(a) Find the maxima or minima (if any) to the following function: [5] 3 2  
 $f(x) = 4x^3 - 18x^2 + 27x - 7$
- Q.3(b) Find minima to the following problem [5]  
*Minimize* :  $f = 9 - 8x_1 - 6x_2 - 4x_3 + 2x_1^2 + 2x_2^2 + x_3^2 + 2x_1x_2 + 2x_1x_3$   
*S.T*  
 $x_1 + x_2 + 2x_3 = 3.$
- Q.4 Use method of steepest ascent to approximate the optimal solution to the following [10] 4 3  
 problem starting from the point (0.5, 0.5). (Do up to 4 iterations maximum)  
*Maximize* :  $Z = 2x_1x_2 + 2x_2 - x_1^2 - 2x_2^2$
- Q.5(a) Describe the differences between classical and metaheuristic based optimization [5] 5 2  
 approaches with any two examples from each type.
- Q.5(b) How can a genetic algorithm be applied to a TSP of 5 cities? Discuss with proper [5] 5 3  
 illustration of various steps.

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