

B.E. COMPUTER SCIENCE AND ENGINEERING FOURTH YEAR SECOND SEMESTER – 2025**Subject:** Optimization Techniques**Time:** Three hours**Full marks:**100**Answer the questions Group wise****Group1 (CO1): Answer any one question (20)**

1.
 - a. When do you select reverse simplex method over normal simplex method and why? 5
 - b. What is degeneracy in LPP? When does it occur? Explain with appropriate example. 5
 - c. What is the Kuhn-Tucker condition(s) for maximization and minimization problem? What is the significance of it? 5
 - d. Briefly note down the main differences between Simplex method and Dual simplex method 5
2.
 - a. Find the optimal solution using either Two-phase simplex method or Big M method (any one method). 10

$$\begin{aligned}
 &\text{Minimize } Z = 2x_1 + x_2 + x_3 \\
 &\text{s.t. } 4x_1 + 6x_2 + 3x_3 \leq 8 \\
 &\quad 3x_1 - 6x_2 - 4x_3 \leq 1 \\
 &\quad 2x_1 + 3x_2 - 5x_3 \geq 4 \\
 &\quad x_1, x_2, x_3 \geq 0
 \end{aligned}$$

- b. Solve the following LPP using simplex method 10

$$\begin{aligned}
 &\text{Maximize } Z = 270x_1 + 144x_2 + 225x_3 \\
 &\text{s.t. } 8x_1 + 4x_2 + 5x_3 \leq 1000 \\
 &\quad 5x_1 + 3x_2 + 3x_3 \leq 650 \\
 &\quad 9x_1 + 6x_2 + 9x_3 \leq 1260 \\
 &\quad x_1, x_2, x_3 \geq 0
 \end{aligned}$$

OR

ii. A firm manufactures two types of products X and Y and sells them at a profit of Rs. 2 on type X and Rs. 3 on type Y. Each product is processed on two machines G and H. Type X requires one minute of processing time on G and two minutes processing time on H. Type Y requires one minute on G and one minutes on H. The machine G is available for not more than 6 hours 40 minutes while machine H is available for 10 hours during any working day. Solve the problem using graphical method.

[Turn over

Group2(CO2): Answer any two questions (15 X 2=30)

3. a. What is the significance of duality in Linear Programming? 5
- b. Define Strong and weak duality in the perspective of optimization problem.? 5
- c. Convert the following primal problem to dual problem mentioning all the relations between them. 5

$$\text{Min } z = 10x_1 - 5x_2 + x_3$$

$$\text{s.t. } x_1 - 2x_3 \leq 8$$

$$-x_1 + x_2 = 2$$

$$x_1 \leq 0, x_2 \text{ free}, x_3 \geq 0$$

4. a. Why iterative method is preferred over derivative based method to solve Nonlinear programming? Explain with an example. 5
- b. Solve the following non-linear programming problem using the Langrange multiplier method. 10

$$\text{Minimize } f(x) = 4x_1^2 + 5x_2^2$$

$$\text{s.t. } 2x_1 + 3x_2 = 6$$

5. a. A company has factories at F1, F2, and F3 that supply products to warehouses at W1, W2 and W3. The weekly capacities of the factories are 200, 160 and 90 units, respectively. The weekly warehouse requirements are 180, 120 and 150 units, respectively. The unit shipping costs (in rupees) are as follows: 15

	Warehouse			
Factory	W1	W2	W3	Supply
F1	16	20	12	200
F2	14	8	18	160
F3	26	24	16	90
Demand	180	120	150	450

Determine the optimal distribution for this company in order to minimize its total shipping cost.

6. a. What do you mean by positive Semi-definite and negative semi-definite matrix? How are they related to optimization problems? 5
- b. Maximize $z = -\sin X_1 X_2 + \cos(X_1 - X_2)$ using steepest ascent search within tolerance of 0.05. 10

OR

Use Newton method to *maximize*: $z = -(x_1 - \sqrt{5})^2 - (x_2 - \pi)^2 - 10$ within tolerance of 0.05.

Group 3 (CO3): Answer all question (15)

7. a. What is the role of Hessian matrix to determine the convexity of a function? 5
- b. Classify whether the function $f(x_1, x_2) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$ is convex, concave or neither? 10

Group 4 (CO4): Answer any one question. (20)

8. a. What are the different types of strategy used in Game theory? Briefly describe 5
- b. Draw the Flow Chart of Game theory Approach. 5
- c. In a game of matching coins with two players, suppose A wins one unit of value when there are two heads, wins nothing when there are two tails and losses 1/2 unit of value when there is one head and one tail. Determine the payoff matrix, the best strategies for each player and the value of the game to A 10
9. a. Why Dynamic programming concept cannot be applied to solve most of the real life problem? Explain with appropriate justification 6
- b. Subimal lives in Kolkata and plans to drive by car to Chennai to visit his friends. During his journey he plans to sleep overnight at his friend's house during the journey. He has friends at Cuttack(dist. 420 km.), Bhubaneswar(dist. 442 km.), Puri (dist. 497 km.) , Visakhapatnam (dist. 468 km. from Cuttack, 441 km. from Bhubaneswar, 443 km. from Puri), and Vijayawada (dist. 796 km. from Cuttack, 769 km. from Bhubaneswar, 770 km. from Puri), Chennai (dist. 790 km. from Visakhapatnam, 453 km. from Vijayawada). He cannot drive more than 800 km in a day. He takes rest accordingly to his friend house. During resting at Puri, Visakhapatnam and Vijayawada he will visit nearby shops and other places which need to be added with the distance. It is around 2* (last two digits your roll no) km. on an average. Ranjit wants to select a route which minimizes the distance driven. Which town should he visit on his journey? (solve using dynamic programming). 14

Group 5 (CO5): Answer any one question (15)

10. a. What is Nadir objective vector? Demonstrate the usefulness of it in multiobjective problem solving. 2+3
- b. A transportation authority has two bridges spanning the same crossing. Bridge 1 accommodates 100,000 vehicles per open lane, per week, while bridge 2 accommodates 50,000 vehicles per open lane, per week. The transportation authority must accommodate 800,000 vehicles per week. Bridge 1 has 6 lanes, where one must always be kept open, while bridge 2 has 14 lanes, where two must always be kept open. Keeping one lane open on bridge 1 costs \$100,000 while keeping one lane open on bridge 2 costs \$10,000. Bridge 1 on average experiences 15 accidents per 1 million 10

crossings while bridge 2 on average experiences 45 accidents per 1 million crossings. The bridge authority is keen on minimizing cost per crossing and minimizing the number of accidents.

Solve the following multi-objective optimization problem using the weighted the sum method.

11. a. What is multi-objective optimization problem? Mention the name of different methods which are used to solve multi-objective optimization problem. 5
- b. Briefly explain the different steps of *Ideal Multi-objective Optimization Problem* using appropriate flow chart, 10