B.E. COMPUTER SCIENCE AND ENGINEERING FOURTH YEAR SECOND SEMESTER – 2024

Subject: Optimization Techniques **Time:** Three hours **Full marks:100**

Answer the questions Group wise

:Group1 (CO1): *Answer any one question*

1. a. What is the meant by feasible solution of a Linear Programming Problem (LPP)? What are the major assumptions and limitations of LPP? 5

   b. What is an infeasible solution, and how does it occur? How is this condition recognized in graphical method? 5

   c. Illustrate the general rules for formulating a dual LP problem from its primal. 5

   d What is the transshipment problem? Explain how it can be formulated and solved as a transportation problem. 5

2. a. What are the significance of necessary and sufficient conditions for Non-linear programming? Explain the first and second order necessary and sufficient conditions of Lagrangian function for solving equality & inequality constraint NLP problems with appropriate example. 10

   OR

   Develop the algorithm of Revise simplex method with proper algebraic notation.

   b. Analyze the sensitivity of the following problem after solving by Dual simplex method 10

$$minimize\ Z = 2x_1 + x_2$$
$$s.t.\ 3x_1 + x_2 \geq 3$$
$$4x_1 + 3x_2 \geq 6$$
$$x_1 + 2x_2 \geq 3$$
$$x_1, x_2 \geq 0$$

Group2(CO2): *Answer any two questions*

3. a. What is the significance of sensitivity analysis? How is it related with duality? 5

   b. Solve the following LPP by computing all the basic solutions 10

$$Maximize\ Z = 2x_1 + 3x_2 + 4x_3 + 7x_4$$
$$s.t.\ 2x_1 + 3x_2 - x_3 + 4x_4 = 8$$
$$x_1 - 2x_2 + 6x_3 - 7x_4 = -3$$
$$x_1, x_2, x_3, x_4, \geq 0$$

4. a. Compare the similarities and dissimilarities between gradient and conjugate gradient methods. 5

   When will you use conjugate gradient method over gradient method and why?

b. Solve the following non-linear programming problem using the Langrage multiplier method. 10

$$Minimize \quad Z = 2x_1^2 - 24x_1 + 2x_2^2 - 8x_2 + 2x_3^2 - 12x_3 + 20$$
$$s.t.\ x_1 + x_2 + x_3 = 1$$
$$x_1, x_2, x_3 \geq 0$$

5. a. Identify the initial basic feasible solution using Vogel approximation method of the following transportation problem: 15

	Warehouse				
Factory	W1	W2	W3	W4	Factory Capacity
F1	19	30	50	10	7
F2	70	30	40	60	9
F3	40	8	70	20	18
Warehouse Requirement	5	8	7	14	34

Then solve it using the MODI method.

6. a. What do you mean by positive definite and negative definite matrix? How are they related to optimization problems? 5

b. Solve the following problem using Steepest Descent method. 10
Minimize, $f(x_1, x_2, x_3) = x_1^2 + x_1(1 - x_2) + x_2^2 - x_2 \times x_3 + x_3^2 + x_3$

Group 3 (CO3): *Answer all question*

7. a. Proof the following proposition: 5

A linear function $f : R^n \rightarrow R$ *is both convex and concave.*

b. Classify whether the function $f(x1, x2, x3) = x1^2 + x2^2 + x3^2 - 2x1x2$ is convex or not? 10

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

8. a. What is Saddle point in game theory? Is it necessary that a game always poses a saddle point ?-justify. 5

b. Explain the "Best strategy" on the minimax criterion of optimality in game theory with appropriate example. 5

c. Solve the game whose payoff matrix is given below. 10

		Player B		
		B1	B2	B3
Player A	A1	1	-1	3
	A2	3	5	-3
	A3	6	2	-2

a. What is the necessity of Dynamic programming problem? 4

b. Summarize the different steps of Dynamic programming problem in your own words. 4

c. A student has to take examination in three courses x, y, z. He has three days available for study. He feels it would be best to devote a whole day to study same, so that he may study a course for one day, two day or three days or not at all. He estimates of grades he may get by studying are as follows. 12

Study days/course	x	y	z
0	1	2	1
1	2	2	2
2	2	4	4
3	4	5	4

How should he plan to study so that he maximizes the sum of his grades?

Group 5 (CO5): *Answer all question*

a. What is Ideal objective vector? Demonstrate the physical Interpretation of it. How is it different from Utopian objective vector? 2+3 +2

b. Describe the principle of weighted Sum method to solve multi-objective optimization problem along with the difficulties associated with it. 4+4
Summarize the different steps of *Ideal Multi-objective Optimization Problem* using appropriate flow chart.