Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 11 – 12- 2025 **Time:** 01:00pm – 04:00pm

School: SOCSE	**Program:** B.TECH, (CSE)	
Course Code: CSD3403	**Course Name:** Optimization Techniques for Data Science	
Semester: VII	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**C05**
Marks	**24**	**24**	**26**	**26**	**-**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	What is Convex Optimization.	**2 Marks**	**L**	**CO1**
2.	Define Lagrange Multiplier.	**2 Marks**	**L**	**CO1**
3.	What are KKT Conditions.	**2 Marks**	**L**	**CO2**
4.	Discuss about slack and surplus variables.	**2 Marks**	**L**	**CO2**
5.	What are constraints and discuss types of constraints.	**2 Marks**	**L**	**CO3**
6.	What is the weak duality theorem in optimization?	**2 Marks**	**L**	**CO3**
7.	Differentiate Linear and Quadratic programming problems.	**2 Marks**	**L**	**CO3**
8.	Define Saddle Point and local minima for a convex function.	**2 Marks**	**L**	**CO4**
9.	What is non- convex Optimization.	**2 Marks**	**L**	**CO4**
10.	Discuss any two metaheuristic methods.	**2 Marks**	**L**	**CO4**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Find the stationary points of the function f(x, y) = x^3 + y^3 - 3xy and classify them as minima, maxima, or saddle points.	**20 Marks**	**L**	**CO1**
	b.	Differentiate Convex and Concave Optimization.		**L**	**CO1**
		Or			
12.	**a.**	Differentiate Convex and Concave Optimization. Given the cost function $J(y)=(y-3)^2+12$, apply Gradient Descent starting from y=0 with learning rate $\eta=0.5$ Perform two iterations and compute J(y) at each step.	**20 Marks**	**L**	**CO1**
	b.	Discuss the taxonomy to find solutions to linear equations		**L**	**CO1**

13.	**a.**	Consider the function $f(x, y)=x^2+xy+y^2$. 1. Derive the gradient vector $f'(x, y)$ 2. Using a learning rate $\eta=0.1$ and initial point $(x_0,y_0)=(1,-1)$, perform two iterations of Gradient Descent. 3. Discuss whether the learning rate is appropriate for this function and explain how learning rate affects convergence.	**20 Marks**	**L**	**CO2**
	b.	List advantages of using adaptive learning rate.		**L**	**CO2**
		Or			
14.	**a.**	Consider the function $f(x, y) = x^2 - 3xy + y^2 + 4x$ (a) Find all critical points of the function. (b) Using the second-order derivative test, determine whether each critical point is a local maximum, local minimum, or saddle point. (c) Interpret the nature of the function based on the behaviour around each critical point.	**20 Marks**	**L**	**CO2**
	b.	List Importance of gradient and discuss gradient descent		**L**	**CO2**

15.	**a.**	Discuss Support Vector Machine algorithm and scope of Optimization.	**20 Marks**	**L**	**CO3**

	b.	Solve the function $f(x, y)= x^2 + 2y^2$, subjected to constraint $x + y = 3$.		**L**	**CO3**
		Or			
16.	**a.**	Discuss Fundamental theorem of Linear Programming and solve the linear Programming Problem Min $z = 2x_1 + 3x_2$ and subjected to $2x_1 + 3x_2 <= 4$, $x_1 + 2x_2 <=5$ and $x_1, x_2 >=0$.	**20 Marks**	**L**	**CO3**
	b.	Solve the following LPP max $Z= 5x_1 + 4x_2$, subjected to $6x_1 + 4x_2 <= 24$, $x_1 + 2x_2 <= 6$, $-x_1 + x_2 <= 1$, $x_2 <= 2$ and $x_1, x_2 >=0$.		**L**	**CO3**

17.	**a.**	Discuss optimization landscapes of neural networks.	**20 Marks**	**L**	**CO4**
	b.	Given a Convex function f(x) and a set of convex constraints $g_i(x)$, Prove that there always exists a global minima. i.e., $f(x')<=f(x)$		**L**	**CO4**
		Or			
18.	**a.**	Define clustering and optimization in k-means clustering algorithm.	**20 Marks**	**L**	**CO4**
	b.	State the difference between the primal problem and the dual problem in optimization.		**L**	**CO4**