Mahindra University Hyderabad

École Centrale School of Engineering

Minor I

Program: B.Tech. Branch: Computation & Mathematics Year: Second Semester: Spring

Subject: Optimization Techniques (MA 2210)

Date: 08/03/2023 **Start Time: 10:00 AM**

Time Duration: 1.5 Hours **Max. Marks: 20**

Instructions:

1) All questions are compulsory.
2) Please start each answer on a separate page, and ensure you clearly number the responses. Also, make sure to address all parts of each question together and in the correct order.
3) It is essential to provide an explanation of each step. Correct outcomes without any description will not be evaluated.

Q 01: Please select the correct option for the following questions and explain your choice correctly. Any correct choice without a valid reason will not be accepted. [01 × 05]

A) Which of the following parameters is not required to use the golden section search method for optimization?

i) The lower bound for the search region ii) The golden ratio

iii) The upper bound for the search region iv) The function to be optimized

B) Which of the following is correct about the maximum or minimum value of $f(x, y) = y^2 + 4xy + 3x^2 + x^3$?

i) Minimum at (0,0) ii) Maximum at (0,0)

iii) Minimum at $\left(\frac{2}{3}, -\frac{4}{3}\right)$ iv) Maximum at $\left(\frac{2}{3}, -\frac{4}{3}\right)$

C) Let x, y be two variables and $x > 0, xy = 1$, then the minimum value of $x + y$ is:

i) 1 ii) 2 iii) $2\frac{1}{2}$ iv) $3\frac{1}{3}$

D) In a simple one-constraint Lagrange multiplier setup, the constraint must be always one dimension lesser than the objective function. Which of the following holds true about the statement.

i) The statement is true ii) The statement is false iii) Cannot say

E) Divide 120 into three parts such that the sum of the products taken two at a time is maximum. Alternatively, if x, y, and z are three numbers whose sum is 120, what are the values of x, y, and z that will result in the maximum value of $xy + yz + zx$?

i) $x = 40, y = 40, z = 40$ ii) $x = 38, y = 50, z = 32$

iii) $x = 50, y = 40, z = 30$ iv) $x = 45, y = 45, z = 30$

Q 02: Please answer the following question with a detailed description and include an appropriate diagram where necessary. It is highly recommended that you provide an explanation of each step. [03 × 03]

A) For the function $f(x) = e^{-x^2}$, find the intervals of concavity and convexity.

B) Find the extreme points of the multivariable function $f(x_1, x_2) = x_1^3 + x_2^3 + 2x_1^2 + 4x_2^2 + 6$ along with their values $f(x_1, x_2)$ corresponding to extreme points. Categorize these extreme points as positive definite or semi definite, negative definite or semi definite, or indefinite.

C) Using the Lagrange multiplier method, find the maximum of the multivariable function

$$f(X) = 2x_1 + x_2 + 10, \text{ subject to the constraint}$$

$$g(X) = x_1 + 2x_2^2 = 3.$$

Also verify the result by using sufficient condition.

Q 03: Use the golden section search method to find the value of x that minimizes the function $f(x) = x^4 - 14x^3 + 60x^2 - 70x$ in the range $[0, 2]$. Perform the procedure for four iterations so that $|L_w| < 0.3$. [06]