

Multivariable Calculus

(MT1008) (CS)

Date: February 27th 2024

Course Instructor(s)

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Sessional-I Exam

Total Time: 1 Hour

Total Marks: 45

Total Questions: 04

Semester: SP-2024

Campus: Islamabad

Dept: Computer Science

Instructions:

1. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.
2. Show full steps for scoring full credit.
3. Solve the questions using techniques learnt in this course. Using a method other than the required method will result in deduction or zero marks.
4. Start each question on new page.

Musabe Ahsan Khan 23i-0569 CS-B Student Name Roll No Section Student Signature

Q1: You are in charge of installing a radio telescope on a newly discovered planet. To minimize interference, you want to place it where the magnetic field of the planet is weakest. The planet is spherical, with a radius of 6 units. Based on a coordinate system whose origin is at the center of the planet, the strength of the magnetic field is given by $M(x, y, z) = 6x - y^2 + xz + 60$. Where should you locate the radio telescope? Solve using the method of Lagrange multipliers. [15 marks]

Q2: The temperature T in a metal ball is inversely proportional to the distance from the center of the ball, which we take to be the origin. The temperature at the point $(1, 2, 2)$ is 120° . [10 marks]

- a) Find the function for temperature T .
- b) Find the rate of change of T at $(1, 2, 2)$ in the direction toward the point $(2, 1, 3)$. Hint: First calculate the vector between the two points before calculating the rate of change.

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Q3A: Check if the limit exists $\lim_{(x,y) \rightarrow (0,2)} (\sin(xy^2))/(xy)$. [04 marks]

Q3B: Find the absolute maximum and minimum values of f on the set D . $f(x, y) = xy^2 + 5$. $D = \{(x, y) | x \geq 0, y \geq 0, x^2 + y^2 \leq 3\}$ [08 marks]

Q4: Find and sketch/shade the given functions' domain. Determine if the domain is open or closed or neither. Also decide if it is bounded or unbounded. [08 marks]

i) $f(x, y) = \sqrt{y+1} + \ln(x^2 - y)$

ii) $f(x, y) = \frac{(\ln(y+1) + \sin(\frac{y}{x}))}{\sqrt{x^2 + y^2 - 4}}$
