

Lab 4: *Multivariate Calculus*

This lab will be the most open-ended of the labs we do in class. The purpose of this lab is to encourage you to explore the Maple software.

First, go through the examples from the handout. You will be building something similar- A document that tells us how to use Maple to solve some particular problems we encounter in Calculus III- You may use the online Calculus textbook.

Minimum issues to look at:

- Plotting in polar and spherical coordinates.
- Arc length and curvature for space curves (parametric curves).
- Tangent planes and Directional Derivatives
- Explore Clairaut's Theorem:
 - (1) Can you tell graphically if the limit of $z = f(x, y)$ exists at a given point?
 - (2) Does Clairaut's Theorem always work? In particular, look at

$$f(x, y) = \begin{cases} \frac{xy(x^2 - y^2)}{x^2 + y^2} & \text{for } (x, y) \neq (0, 0) \\ 0 & \text{for } (x, y) = (0, 0) \end{cases}$$

To help you, you might graphically see that the following inequalities hold:

$$-|xy| \leq f(x, y) \leq |xy|$$

$$-2|y| \leq f_x(x, y) \leq 2|y| \quad -2|x| \leq f_y(x, y) \leq 2|x|$$

You will type something similar to the Maple guide (which is available in Latex form on the class website).