MATH 224 Spring 2026

Assignment 11

**Due: Monday, March 9**

## Reading

Read carefully Sections 4.3 "Directional Derivatives" in our text *Multivariable Calculus: A Linear Algebra Based Approach.*

## Writing

Write out careful and complete solutions of Exercises 17 and 18 in Chapter 4 as well as Problems A, B, and C below.

*Problem A:* For each of these functions *f* find gradient $\nabla f(\mathbf{x})$ of *f* at a general point in the domain of *f:*

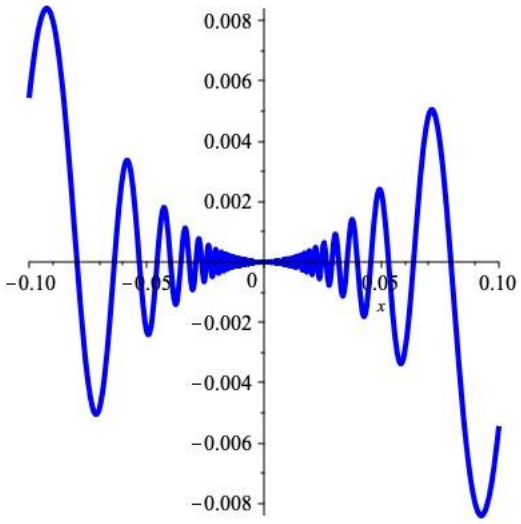
(1) $f(x,y) = 2x^3 - 3y^2$

(2) $f(x,y,z) = (5x - 7y)z$

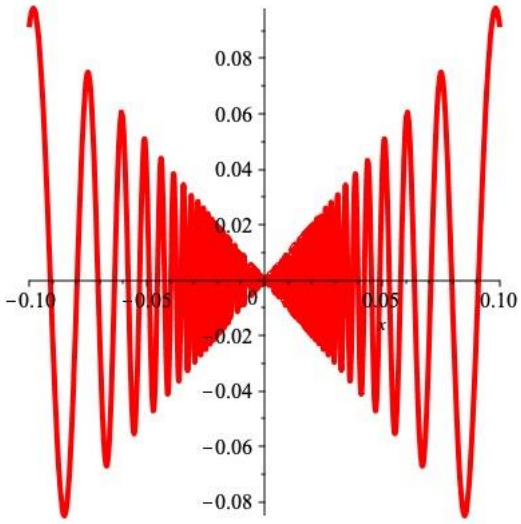
(3) $f(x_1,x_2,x_3) = \frac{x_1 x_3}{x_2}$

*Problem B:* Write an equation in terms of the coordinate variables (*x,y,z*) for the tangent hyperplane for $f(x,y,z) = 2x^2 - y^2 + 3z^2$ when $x = y = z = 1$.

Problem C: Let *f* be the real-valued function *f:* $\mathbb{R}^p \to \mathbb{R}$ defined by $f(\mathbf{x}) = |\mathbf{x}|^2 = \mathbf{x} \bullet \mathbf{x}$. If p = 2, prove that $\nabla f(\mathbf{x}) = 2\mathbf{x}$ for all $\mathbf{x}$ in $\mathbb{R}^p$. Is this result true for other values of *p*?




*Graph of* $f(x) = x^2 \sin\left(\frac{1}{x}\right)$




*Graph of* $f(x) = 2x \sin\left(\frac{1}{x}\right)$