Instructions

- Answer each of the questions on your own paper, and be sure to show your work so that partial credit can be adequately assessed. Put your name on each page of your paper.
- You may use a scientific calculator, but it should not be needed. If you use a calculator you must still write out the operations done on the calculator to show that you know how to solve the problem.
- There are 6 problems, with a total of 100 points possible.
- 1. **[15 Points]** Let $f(x, y) = ye^{xy^2}$. Compute f_{xy} .
- 2. **[15 Points]** Find the equation of the tangent plane to the surface $x^3y + z^2 = 3$ at the point (-1, 1, 2).
- 3. [15 Points] Let $f(x, y) = \sqrt{x^2 + y^2}$.
 - (a) Find the linear approximation of f(x, y) at the point (3, 4).
 - (b) Using your answer in part (a), approximate the number $\sqrt{(3.2)^2 + (3.9)^2}$.
- 4. [20 Points] Let $T(x, y, z) = 3x^2 + 2y^2 4z$.
 - (a) Find ∇T at (-1, -3, 2).
 - (b) Find the directional derivative of T at (-1, -3, 2) in the direction of the vector $\mathbf{v} = -\mathbf{i} 2\mathbf{j} + 2\mathbf{k}$.
 - (c) In which direction is T increasing most rapidly at (-1, -3, 2), and what is the maximum rate of increase of T at this point?
- 5. **[15 Points]** Let $f(x, y) = \frac{y}{x^2} + e^{xy}$, $x = r \cos t$, $y = r \sin t$. Compute $\frac{\partial f}{\partial t}$ when r = 1, t = 0.
- 6. [20 Points] Let $f(x, y) = x^3 + 3xy + y^3$.
 - (a) Find all the critical points of f(x, y)
 - (b) Determine whether each critical point is a local minimum, local maximum, or saddle point.