Math 2263	**Name (Print):** _____
Spring 2016	**Student ID:** _____
Midterm 1	**Section Number:** _____
February 18, 2016	**Teaching Assistant:** _____
Time Limit: 50 minutes	**Signature:** _____

This exam contains 6 pages (including this cover page) and 6 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated. Calculators may be used. Please turn off cell phones! You are allowed to bring a bf crib sheet: one single - sided 8.5 inch $\times$ 11 inch sheet of notes into the exam.

Do not give numerical approximations to quantities such as $\sin 5$, π, or $\sqrt{2}$. However, you should simplify $\cos \frac{\pi}{2} = 0$, $e^0 = 1$, and so on.

The following rules apply:

- **Show your work**, in a reasonably neat and coherent way, in the space provided. **All answers must be justified by valid mathematical reasoning.** To receive full credit on a problem, you must show enough work so that your solution can be followed by someone without a calculator.
- **Mysterious or unsupported answers will not receive full credit**. Your work should be mathematically correct and carefully and legibly written.
- **A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit**; an incorrect answer supported by substantially correct calculations and explanations might still receive partial credit.

1	20 pts	
2	15 pts	
3	20 pts	
4	20 pts	
5	25 pts	
6	50 pts	
TOTAL	150 pts	

1. (20 points) Find an equation for the **plane** passing through the two points $(x, y, z) = (-2, 0, 1)$ and $(3, 3, 2)$ so that the vector $\vec{i} + \vec{j}$ is tangent to the plane.

2. (15 points) Suppose $z = f(x, y)$ is a function with first partial derivatives $f_x(3, -1) = 5$ and $f_y(3, -1) = 3$. If x and y are both functions of t: $x = g(t) = 1 + 2t$ and $y = h(t) = 3 - 4t$, find the **derivative of z with respect to t at $t = 1$** :

$$\frac{dz}{dt}(1) = \frac{d}{dt} f\Big(g(t), h(t)\Big).$$

3. (20 points) The lines given parametrically by

$$(x, y, z) = (2t, 2 - 3t, 2 + 3t), \quad -\infty < t < \infty$$

and

$$(x, y, z) = (s, 3 - 2s, 9 - 2s), \quad -\infty < s < \infty$$

intersect at the point $(x, y, z) = (2, -1, 5)$. Find an equation for the **plane** which contains both lines.

4. (20 points) For the function $f(x, y) = e^{2x-y^2} \sin y$, find the **second partial derivatives**

$$f_{xx} = \frac{\partial^2 f}{\partial x^2}, \quad f_{xy} = \frac{\partial^2 f}{\partial x \partial y}, \quad f_{yy} = \frac{\partial^2 f}{\partial y^2}.$$

Write each answer as a polynomial times $f(x, y)$ plus another polynomial times $g(x, y) := e^{2x-y^2} \cos y$.

5. (25 points) The point $(x, y, z) = (3, 1, -3)$ lies on the surface S:

$$2x^2 + z^2 - 3xz - 5y^2 = 49.$$

Find the equation of the **tangent plane** to the surface S at $(3, 1, -3)$. Write it in the form $ax + by + cz = d$.

6. **(50 points) (a)** (10 points) Compute the first and second partial derivatives of $f(x, y) = x^3 + xy^2 - 3x^2 - y^2 - 6x$.

(50 points) (b) (15 points) Find all the **critical points** of $f(x, y)$.

(50 points) (c) (25 points) For each critical point, determine whether it is a **local maximum point,** a **local minimum point,** or a **saddle point.**