MATH 307 Second Midterm

November 13, 2013

Name: ______________________ **ID:** __________________

Question:	1	2	3	4	5	Total
Points:	20	20	20	20	20	100
Score:						

There are 5 problems on 5 pages in this exam (not counting the cover sheet). Make sure that you have them all.

You may use a calculator if you wish, provided your calculator does not do calculus. However, it is unlikely to be of much help.

Do all of your work in this exam booklet, and cross out any work that the grader should ignore. You may use the backs of pages, but indicate what is where if you expect someone to look at it. **Books, extra papers, and discussions with friends are not permitted.** If you ask me how to do any of the problems during the test, I'll be happy to tell you exactly how to do it. But I'm in India, so good luck with that.

You have some amount of time to complete this exam. It is like an hour and some more, more or less.

$\boxed{\text{20 pts.}}$ 1. For the function $f(x, y) = x^2 + 2xy + y^4$, find all critical points. Then classify each of them as a local minimum, local maximum, saddle point, or something else.

$\boxed{\text{20 pts.}}$ 2. Calculate the volume of the region that lies between the planes $z = x + y$ and $z = 0$, where $x^2 + y^2 \leq 1$, $x \geq 0$, and $y \geq 0$.

3. Let $F(x, y, z) = \langle xz, xy, xyz \rangle$.

$\boxed{\text{10 pts.}}$ (a) Write the matrix which represents the derivative of F at the point $(1, 1, 1)$.

$\boxed{\text{10 pts.}}$ (b) Write the matrix which represents the derivative of F^{-1} at the point $(1, 1, 1)$, if it exists. If it doesn't exist, say why not.

$\boxed{\text{20 pts.}}$ 4. Suppose a rectangular box has dimensions $h = 1$, $w = 2$, $\ell = 3$ (in meters). In order to increase the surface area of the box most quickly with the least change in each coordinate, how should the dimensions be adjusted?

(Said another way: the edges of the box are actually a frame made out of PVC pipe. You have an additional short section of pipe you can cut into pieces, and add them to the frame. How should you cut up the additional pipe to make the surface area of the new box the largest?)

$\boxed{\text{20 pts.}}$ 5. Find the dimensions of the largest rectangular box that fits completely inside the ellipsiod

$$\frac{x^2}{16} + \frac{y^2}{4} + z^2 = 27.$$