UNIVERSITY OF MANITOBA

DATE: November 15, 2011

MIDTERM 2

TIME: 1 hour

DEPARTMENT & COURSE NO: MATH 2130

COURSE: Engineering Mathematical Analysis 1

EXAMINERS: Lui, Williams

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[5] 1. Find the equation of the tangent plane to the surface $x^2 + 2yz - 1 = 0$ at the point $(1, 0, 3)$.

[7] 2. Given a smooth surface $f(x, y, z) = 0$. (a) Find a formula for $\left(\frac{\partial z}{\partial x}\right)_y$. (b) Evaluate $\left(\frac{\partial z}{\partial x}\right)_y \left(\frac{\partial x}{\partial y}\right)_z \left(\frac{\partial y}{\partial z}\right)_x$.

[7] 3. Find all unit vector(s) $\mathbf{v}$ so that the rate of change of the function $f(x, y) = xy^2 + x^3$ at the point $(1, -1)$ in direction $\mathbf{v}$ is zero.

[7] 4. Find and classify the critical point(s) of $f(x, y) = x^3 + xy - x + 2y$. Justify your answer.

[11] 5. Find the maximum and minimum values of $f(x, y) = (x - y - 10)^2$ in the region $\{(x, y),\ x^2 + y^2 \le 4\}$. Give also the coordinates of all the points where the values are attained.

[7] 6. Evaluate the integral $\int_0^1 \int_{x^{1/3}}^1 e^{y^4}\, dy\, dx$.

[6] 7. Set up, but DO NOT EVALUATE, a double iterated integral for the volume of the solid of revolution obtained by rotating the region bounded by $x + y = 4$, $y = 2\sqrt{x - 1}$ and $y = 0$ about the line $y = -1$.