

UNIVERSITY OF MANITOBA

DATE: March 14, 2013

MIDTERM II

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COURSE: MATH 2130

TIME: 70 minutes

EXAMINATION: Engineering Mathematical Analysis 1 EXAMINER: M. Davidson

- [5] 1. Find an equation in simplified form, of the plane <sup>tangent</sup> ~~normal~~ to the surface  $z^2 - x^2z + xy^2 = 3y + 10$  at the point  $(3, 1, -1)$ .
- [5] 2. If  $z = f(x, y)$ ,  $y = g(v, w, x)$  and  $x = h(v, w)$ , find the chain rule for  $\frac{\partial z}{\partial v}$ .
- [7] 3. Find the rate of change of  $f(x, y, z) = 3yz^2 - x^2y^3$  at the point  $(-1, 1, 2)$  in the direction  $\vec{r}(t) = \langle 3t + 2, t^2, t^2 + t + 2 \rangle$ .
- [4] 4. Find all directions where the rate of change of  $f(x, y) = x^2 + x^3y^2 + 7y$  is equal to 0 at the point  $(2, -1)$ . (Any answer should be in the form of a vector.)
- [8] 5. The following equations

$$u^3y^2 + 2xz^2 + v = u + y,$$

$$ux^2 + v^3y^2 + zy = z^2 - v$$

define  $x$  and  $z$  as functions of the other variables. Find  $\frac{\partial z}{\partial v}$ .

- [11] 6. Find and classify all critical points of

$$f(x, y) = 2x^2y + xy^2 - 6xy.$$

Answers by Dawit: plankion@yahoo.com

1.  $7x + 3y - 11z - 35 = 0$

2.  $\frac{\partial z}{\partial x} \frac{\partial x}{\partial v} + \frac{\partial z}{\partial y} \frac{\partial y}{\partial v} + \frac{\partial z}{\partial z} \frac{\partial z}{\partial v} \frac{\partial x}{\partial v}$

3.  $-\frac{12\sqrt{14}}{7}$

4.  $\pm a(9\hat{i} + 16\hat{j})$  ( $a$  is arbitrary Constant)

5.  $-\begin{vmatrix} 2z^2 & 1 \\ 2xu & 3v^2y^2+1 \end{vmatrix}$   
 $\begin{vmatrix} 2z^2 & 4xz \\ 2xu & y-2z \end{vmatrix}$

6.  $(0, 0)$  yields Saddle point.

$(0, 6) \quad > \quad > \quad >$

$(3, 0) \quad > \quad > \quad >$

$(1, 2) \quad > \quad > \quad \text{relative min.}$