UNIVERSITY OF MANITOBA

DATE: April 20, 2013 FINAL EXAMINATION

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COURSE: MATH 2130 TIME: 3 hours

EXAMINATION: Engineering Mathematical Analysis 1 EXAMINER: M. Davidson

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[6] 1. Find the distance between the line $\frac{x-4}{3} = \frac{y-3}{2} = \frac{z-4}{-2}$ and the line $x = 1+t$, $y = -4+t$, $z = 2$.

→ 1. 2

[8] 2. Let C be the curve of intersection of the surfaces $z+x = 3y^2$ and $x+3y-2z = 9$.

(a) Find a parametric representation for C in the direction of decreasing y.

(b) Set up but **do not evaluate** a definite integral to find the length of the curve C from the point $(4, 1, -1)$ to the point $(24, -3, 3)$.

→ 2. a) $x = 2t^2+t+3$
$y = -t$
$z = t^2-t-3$

b) $\int_{-1}^{3} \sqrt{20t^2+4t+3}\, dt$

[8] 3. Find equations, in parametric form, of the line tangent to the curve $x^2yz + 2x + y = z^3 + 7$, $3x^2y + 2xyz = -y$ at the point $(1, 3, -2)$.

→ 3. $x = 1-t$
$y = 3+t$
$z = -2+t$

[9] 4. For each of the following, either evaluate the limit, or show that the limit does not exist.

(a) $\lim_{(x,y)\to(0,0)} \frac{2x^2+y^2}{x^2+y^2}$,

(b) $\lim_{(x,y)\to(0,0)} \frac{2x^3}{x^2+y^2}$. (Hint: $\left|\frac{x^2}{x^2+y^2}\right| \le 1$.)

→ 4. a) DNE (path dependent limit)

b) 0 (Hint: apply Squeeze theorem or use polar coordinates)

[6] 5. Show that for any differentiable function f, the function $u(x,y) = f(x^2-y^3)+x^2y$ satisfies the equation $3y^2\frac{\partial u}{\partial x} + 2x\frac{\partial u}{\partial y} = 6xy^3 + 2x^3$.

→ 5. Hint: let $v = x^2-y^2$ →
$u(x, y, v(x,y)) = f(v)+x^2y$

[14] 6. Find the absolute maximum and absolute minimum of the function

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

over the triangular region with corners $(0,0), (0,2), (6,2)$.

u
x y v
x y

→ 6. 2, -16

[6] 7. Evaluate the following double iterated integral:

$$\int_0^4 \int_{\frac{x}{2}}^2 e^{y^2}\, dy dx.$$

→ 7. e^4-1