

UNIVERSITY OF MANITOBA

DATE: April 20, 2013

FINAL EXAMINATION

PAGE: 1 of 12

COURSE: MATH 2130

TIME: 3 hours

EXAMINATION: Engineering Mathematical Analysis 1 EXAMINER: M. Davidson

Answers by Dawit  
ydawit@yahoo.com

- [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)  $\lim_{(x,y) \rightarrow (0,0)} \frac{2x^2 + y^2}{x^2 + y^2}$

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

→ 4. DNE (path dependent limit)

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

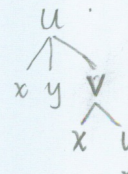
- [6] 5. Show that for any differentiable function  $f$ , the function  $u(x, y) = f(x^2 - y^2) + x^2y$  satisfies the equation  $3y^2 \frac{\partial u}{\partial x} + 2x \frac{\partial u}{\partial y} = 6xy^3 + 2x^3$ .

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

- [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  $(0, 0), (0, 2), (6, 2)$ .



→ 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.  $e^4 - 1$