UNIVERSITY OF MANITOBA

DATE: April 20, 2013 FINAL EXAMINATION

TITLE PAGE

COURSE: MATH 2130 TIME: 3 hours

EXAMINATION: Engineering Mathematical Analysis 1 EXAMINER: M. Davidson

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FAMILY NAME: (Print in ink) ______________________

GIVEN NAME(S): (Print in ink) ______________________

STUDENT NUMBER: ____________

SEAT NUMBER: ____________

SIGNATURE: (in ink) ______________________

(I understand that cheating is a serious offense)

INSTRUCTIONS TO STUDENTS:

This is a 3 hour exam. **Please show your work clearly.**

No texts, notes, or other aids are permitted. There are no calculators, cellphones or electronic translators permitted.

This exam has a title page and 12 pages of questions. Please check that you have all the pages.

The value of each question is indicated in the lefthand margin beside the statement of the question. The total value of all questions is 100 points.

Answer all questions on the exam paper in the space provided beneath the question. If you need more room, you may continue your work on the reverse side of the page, but CLEARLY INDICATE that your work is continued.

Question	Points	Score
1	6	
2	8	
3	8	
4	9	
5	6	
6	14	
7	6	
8	9	
9	6	
10	6	
11	12	
12	10	
Total:	100	

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

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[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 $(24, -3, 3)$.

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[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 $(1, 3, -2)$.

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

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

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

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

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

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

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

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[9] 8. Find the volume of the solid obtained by revolving an annulus (the area between concentric circles; a washer) having inner radius of 1m and outer radius of 3m, about a line that is 5m from the center of these circles.

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[6] 9. A thin quadrilateral plate has corners $(1,1),(4,1),(4,2)$ and $(2,2)$ and density given by $\rho(x,y) = x + y$. Find the moment of inertia of this plate about the x-axis (I_x). (A numerical answer need not be simplified.)

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[6] 10. Set up, but **do not evaluate**, a double iterated integral to find the surface area of the portion of $z = 2xy$ that lies below $z = 4 - x^2 - y^2$ in the first octant.

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[12] 11. Set up all six triple iterated integrals (in Cartesian coordinates, each having a different order of integration) for the volume of the solid in the first octant that is bounded by the surfaces:

$$y^2 + z^2 = 9 \quad ; \quad y = 3x \quad ; \quad x = 0 \quad ; \quad z = 0.$$

Do not evaluate.

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[10] 12. Set up, but **do not evaluate**, a triple iterated integral to evaluate

$$\iiint_V (x^2 + y^2)\, dV$$

where V is the region bounded by

$$\sqrt{3}z = \sqrt{x^2 + y^2} \quad \text{and} \quad x^2 + y^2 + z^2 = 4$$

using

(a) Cylindrical coordinates.

(b) Spherical coordinates.