UNIVERSITY OF MANITOBA

DATE: March 13 , 2017 — MIDTERM TITLE PAGE

EXAMINATION: Multivariable Calculus — TIME: 75 minutess

COURSE: MATH 2150 — EXAMINER: G.I. Moghaddam

NAME: (Print in ink) _____

STUDENT NUMBER: _____

SEAT NUMBER: _____

SIGNATURE: (in ink) _____

(I understand that cheating is a serious offense)

INSTRUCTIONS TO STUDENTS:

This is a 75 minutes 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, 6 pages of questions and also 1 blank page for rough work. Please check that you have all the pages. You may remove the blank pages if you want, but be careful not to loosen the staple.

The value of each question is indicated in the left hand margin beside the statement of the question. The total value of all questions is 50 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	12	
2	10	
3	9	
4	9	
5	10	
Total:	50	

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1. Let C be the curve with vector function $\mathbf{r}(t) = \langle\, 3+\sqrt{2}\cos t\,,\; 2-\sin t\,,\; 4+\sin t\,\rangle\,.$

[3] (a) Find the arc length of the curve C between the points $(3+\sqrt{2},\, 2\,,\, 4)$ and $(3,\, 1\,,\, 5)\,.$

[6] (b) Find the curvature and the torsion of the curve $C\,.$

[3] (c) Identify the curve C as intersection of two surfaces. What kind of curve is $C\,?$

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2. Evaluate each of the following limits or explain why it does not exist.

[5] (a) $\lim_{(x,y)\to(0,1)} \dfrac{(y-1)\sqrt[5]{x^{16}}}{x^4+(y-1)^5}$

[5] (b) $\lim_{(x,y)\to(1,0)} \dfrac{y^3}{(x-1)^2+y^2}$.

[9] 3. If $f(u)$ and $g(v)$ are differentiable functions, find the value of

$$\nabla f(3x^2 - 2y^2) \bullet \nabla\, g(5x^2\, y^3)\,.$$

4. Let $f(x,y) = e^{x^2-y^2}$.

[5] (a) Find the directions in which the directional derivative of the function f at the point $(\frac{1}{2}, -\frac{1}{2})$ has the value 1 .

[4] (b) Find the second directional derivative of f at the point $(-1,-1)$ in the direction of $\mathbf{v} =< 3,4 >$.

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[10] 5. Let C be the curve of intersection of the cylinder $y^2 + z^2 = 1$ and the plane $x + 2y + 3z = 0$. Use Lagrange multipliers to find the closest and the farthest points on C from the origin.

BLANK PAGE FOR ROUGH WORK