Math 164: Multidimensional Calculus

Midterm I

Oct 16, 2014 8:00-9:15 am

NAME (please print legibly): _____

Your University ID Number: _____

Indicate your instructor with a check in the box:

Rebecca Glover	TR	9:40-10:55 am	
Doug Haessig	MW	12:30-1:45 pm	
Sema Salur	MWF	9:00-9:50 am	

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QUESTION	VALUE	SCORE
1	15	
2	15	
3	20	
4	20	
5	20	
6	10	
TOTAL	100	

1. (15 points) Let $\mathbf{a} = 5\mathbf{j} - 3\mathbf{k}$ and $\mathbf{b} = \mathbf{i} + \mathbf{j} + \mathbf{k}$ be two vectors.

(a) (3 pts) Find the dot product of $\mathbf{a}$ and $\mathbf{b}$.

(b) (6 pts) Find the scalar component of $\mathbf{b}$ in the direction of $\mathbf{a}$.

(c) (6 pts) What is the vector projection of $\mathbf{b}$ onto $\mathbf{a}$?

2. (15 points) Determine whether the lines are parallel, intersect or are skew. Find the minimum distance between these lines.

Line 1 : $x = 1 + 2t, \quad y = -1 - t, \quad z = 3t, \quad -\infty < t < \infty,$

Line 2 : $x = 5 + 2s, \quad y = 1 - s, \quad z = 8 + 3s, \quad -\infty < s < \infty.$

3. (20 points) The planes $3x + 6z = 1$ and $2x + 2y - z = 3$ intersect in a line.

(a) (10 pts) Find the angle between these two planes.

(b) (10 pts) Find the equations for the line of intersection.

4. (20 points) A particle traveling in a straight line is located at the point $(1, -1, 2)$ and has speed 2 at time $t = 0$. The particle moves toward the point $(3, 0, 3)$ with constant acceleration $\mathbf{a}(\mathbf{t}) = \mathbf{2i} + \mathbf{j} + \mathbf{k}$. Find the position function $\mathbf{r}(\mathbf{t})$ of the particle at time t.

5. (20 points) Find the curvature function $\kappa(t) = \dfrac{|\mathbf{T}'(t)|}{|\mathbf{r}'(t)|}$ for the plane curve given by $\mathbf{r}(t) = (\cos t + t \sin t)\mathbf{i} + (\sin t - t \cos t)\,\mathbf{j}$ for $t > 0$.

6. (10 points) Find the equations for the level surfaces of the functions through the given points P and sketch the graph of these level surfaces.

(a) (5 pts) $f(x, y, z) = \ln(x^2 + y^2 + z^2)$, $P = (-1, \sqrt{2}, 1)$;

(b) (5 pts) $f(x, y, z) = \dfrac{x - y + z}{2x + y - z}$, $P = (1, 0, -2)$.