University of Delaware
Department of Mathematical Sciences

MATH-243 – Analytical Geometry and Calculus C
Instructor: Dr. Marco A. MONTES DE OCA
Spring 2013

Homework 4

Due date: March 4, 2013

Problems

Based on Sections 13.3–14.1 of the book *Calculus: Early Transcendentals* 7th edition by J. Stewart.

1. Find the length of the curve $\vec{r}(t) = \langle \cos t, \sin t, \ln \cos t \rangle$, $0 \leq t \leq \pi/4$.
2. Using any method you like, find the curvature of the curve $\vec{r}(t) = \langle \sqrt{2}t, e^t, e^{-t} \rangle$.
3. Find the curvature of the graph of $y = \sin x$. At what point(s) does the graph of $y = \sin x$ have minimum curvature?
4. Consider a continuous function f with continuous first and second order derivatives. Show that the curvature of $y = f(x)$ is zero at the inflection points of f.
5. Find the velocity and position vectors of a particle that has the given acceleration and the given initial velocity and position. $\vec{a}(t) = \langle 2, 6t, 12t^2 \rangle$, $\vec{v}(0) = \hat{i}$, $\vec{r}(0) = \hat{j} - \hat{k}$.
6. The position vector of a particle is given by $\vec{r}(t) = \langle t^2 - t, \cos t, \sin t \rangle$. When is the particle's speed minimum?
7. Show that a projectile reaches three-quarters of its maximum height in half the time needed to reach its maximum height.
8. Find and sketch the domain of the function $f(x, y) = \sqrt{xy}$.
9. Draw a contour map of the function $f(x, y) = x^3 - y$ showing several level curves.
10. Describe the level surfaces of the function $f(x, y, z) = (x - 2)^2 + y^2 + z^2$