MAT 301  
Assignment 11  
Friday November 30, 2012

For full credit on these problems, each must be submitted with a complete and clear solution, showing all of your work. You may work with other classmates on these problems, but please indicate on your assignment if you received help. Partial answers and incomplete solutions may be eligible for some partial credit, depending on the level of completeness and demonstrated understanding.

1. For the vector-valued functions \( \vec{r}(t) = \langle t, 2t^3 - 3t, t^2 \rangle \) and \( \vec{s}(t) = \langle 3t, 4 - t, \sqrt{t} \rangle \), and the scalar function \( c(t) = 2t \), find each of the following.
   
   (a) \( \vec{r}(t) + \vec{s}(t) \)
   
   (b) \( c(t)\vec{r}(t) \).
   
   (c) \( \vec{r}(t) \cdot \vec{s}(t) \)
   
   (d) \( \frac{d}{dt} (\vec{r}(t) \cdot \vec{s}(t)) \).
   
   (e) \( \vec{r}(t) \times \vec{s}(t) \)
   
   (f) \( \frac{d}{dt} (\vec{r}(t) \times \vec{s}(t)) \).
   
   (g) \( \int_0^5 \vec{r}(t) \, dt \)

2. Show that if \( \vec{r}(t) \) is a vector valued function such that \( \|\vec{r}(t)\| \) is a constant, then \( \vec{r}(t) \cdot \vec{r}'(t) = 0 \).

3. A particle moves in the plane along the curve represented by the vector-valued function \( \vec{r}(t) = \langle 2 \cos t, 3 \sin t \rangle \).
   
   (a) Describe the curve.
   
   (b) Find the minimum and maximum values of \( \|\vec{r}'(t)\| \) and \( \|\vec{r}''(t)\| \).

4. A projectile is fired from a height of 50 meters at an angle of elevation of 40\(^\circ\) at a speed of 45 meters per second.
   
   (a) Find the maximum height of the projectile.
   
   (b) Find the distance the projectile travels.
   
   (c) Find the speed of the projectile when it impacts the ground.