North Carolina State University
MA 242 Section 008 Exam 1

Read all directions carefully. **A graphing calculator may NOT be used on this exam.** You must Show All Work for credit and clearly indicate your final answer; no work equals no credit. When you are finished fold your exam, write your name on the outside, turn it in, and then you may leave quietly. Good Luck!

1) For the vectors $\vec{v} =< 2, \frac{-1}{3}, 1 >$ and $\vec{u} =< 6, 3, 0 >$ compute the following.
a) (6 pts) $\vec{u} \cdot \vec{v}$
b) (6 pts) $\vec{u} \times \vec{v}$.
c) (6 pts) Are the vectors perpendicular, parallel, or neither? Give reasons for your answer.

2) a) (10 pts) Find the equation of the line through the point (1,-5,7) that is parallel to the line given by the vector equation $< 7 + 2t, -1 + t, -t >$.

b) (14 pts) Find the equation of the plane that contains the line $< 7 + 2t, -1 + t, -t >$ and the point $(2, -1, -1)$.

3) (16 pts) Find the position vector of a particle that
has acceleration $\vec{a}(t) = ti + e^t j + e^{-t} k$, initial velocity $\vec{v}(0) = j - k$, and initial position $\vec{r}(0) = i + j + 2k$.

4) The vector equation of a circle of radius a in two dimensions is $\vec{r}(t) = a\cos(t)i + a\sin(t)j$.
a) (12 pts) Find the unit normal vector N to the curve.
b) (12 pts) Calculate the curvature κ.

5) Given $\vec{u_1}$ and $\vec{u_2}$ are orthogonal unit vectors, $\vec{a} = a_1 u_1 + a_2 u_2$, and $\vec{b} = b_1 u_1 + b_2 u_2$ compute the following.
a) (6 pts) $\vec{a} \cdot \vec{u_1}$
b) (6 pts) $\vec{a} \cdot \vec{b}$
c) (6 pts) $\vec{u_1} \cdot (\vec{u_1} \times \vec{a})$ give reasons for your answer.

BONUS
In real number multiplication when $a \neq 0$ and $ab = ac$ this implies b=c.
a) (3 pts) Show this is not true for the dot product. Find vectors $\vec{a}, \vec{b}, \vec{c}$ such that $\vec{a} \neq \vec{0}$ and $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$ but $\vec{b} = \vec{c}$.
b) (2 pts) There is also no such rule for cross products. Find vectors $\vec{a}, \vec{b}, \vec{c}$ such that $\vec{a} \neq \vec{0}$ and $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$ but $\vec{b} \neq \vec{c}$.