# MAC 2313 Calculus—Analytic Geometry III
# Homework #1

**Please hand in your solutions by January 30, 2008, 7 p.m.**
**Solutions that are handed in later will be graded with 0 points.**

### Problem 1 (Dot product) (6P)

**(a)** Determine all values $\alpha \in \mathbb{R}$ such that the vectors

$$\langle -8, \alpha, 6\rangle, \langle 42 \cdot \alpha, 42 \cdot \alpha^2, 42 \cdot \alpha\rangle \in \mathbb{R}^3$$

are orthogonal.

**(b)** Determine a unit vector $\mathbf{v} \in \mathbb{R}^3$, i. e., a vector of length one, that is orthogonal to both $\langle 2, 2, 0\rangle$ and $-2 \cdot \mathbf{i} - 2 \cdot \mathbf{k}$.

### Problem 2 (Cross product) (4P)

Let $\mathbf{v} \in \mathbb{R}^3 \setminus \{\mathbf{0}\}$, and let $\mathbf{x}, \mathbf{y} \in \mathbb{R}^3$ such that

$$\mathbf{v} \times \mathbf{x} = \mathbf{v} \times \mathbf{y}.$$

Does this imply $\mathbf{x} = \mathbf{y}$? Justify your answer.

### Problem 3: (Points, lines and planes) (6P)

**(a)** Determine a vector equation for the line that passes through the origin $O(0, 0, 0)$ and is perpendicular to the plane $x + 2y + z = 4$.

**(b)** Consider the planes

$$\begin{aligned} x - \frac{4}{3}y + \frac{5}{3}z &= 3 \quad \text{and} \\ \langle 3, -4, 5\rangle \cdot (\langle x, y, z\rangle - \langle 4, 2, 0\rangle) &= 0 \end{aligned}$$

in $\mathbb{R}^3$. If these planes are parallel, determine their distance. Otherwise determine their angle of intersection.

**Problem 4: (Derivatives of vector functions) (4P)**

Let $\mathbf{a}, \mathbf{b}, \mathbf{c} \in \mathbb{R}^3$. Find the derivative of the following functions:

**(a)** $\mathbf{r}(t) = \mathbf{a} + 5^t\mathbf{b} + t^2\mathbf{c}$

**(b)** $\mathbf{y}(t) = t\mathbf{a} \times (\mathbf{b} + \sin(t)\mathbf{c})$

**Good luck, have fun & do not hesitate to ask questions!!!**