Engineering 5812 Tutorial 1 **Spring 2010**

1. In Cartesian coordinates, the three corners of a triangle are $P_1(0, 2, 2)$, $P_2(2, -2, 2)$, and $P_3(1, 1, -2)$. Determine the area of the triangle.

2. Given $\vec{B} = \hat{x}(2z - 3y) + \hat{y}(2x - 3z) - \hat{z}(x + y)$, find, in cylindrical coordinates, a unit vector parallel to $\vec{B}$ at the point $P(1, 0, -1)$.

3. Given the vector field, $\vec{G}(x,y,z) = \left[\frac{2x}{(1+y^2)}\right]\hat{x} + (y+z+1)\hat{y} + (5x-z^2)\hat{z}$, find the value of $\int_{y=0}^{2}\int_{x=1}^{3} \vec{G}\cdot dxdy\hat{y}$ at the plane $z=1$.

4. Given a vector field defined by $\vec{F} = 5\hat{\rho}+\hat{\phi}-2\hat{z}$ at position $Q(2,45°,5)$, at Q find a unit vector in Cartesian coordinates that is perpendicular to $\vec{F}$ and tangent to the cylinder $\rho = 2$.

5. Verify, using partial derivatives and the relationships between the unit vectors, that $d\vec{r} = d\vec{L} = dx\hat{x} + dy\hat{y} + dz\hat{z}$ transforms to

$$\boxed{d\vec{r} = d\vec{L} = d\rho\hat{\rho} + \rho d\phi\hat{\phi} + dz\hat{z}}$$