Engineering 5812 Tutorial 1 Winter 2012

1. In Cartesian coordinates, a vector $\vec{A}$ is directed from the origin to point $P_1(2, 3, 3)$, and vector $\vec{B}$ is directed from P_1 to point $P_2(1, -2, 2)$. Determine (a) vector $\vec{A}$, its magnitude A, and unit vector $\hat{a}$, (b) the angle that $\vec{A}$ makes with the y-axis, (c) vector $\vec{B}$, (d) the angle between $\vec{A}$ and $\vec{B}$, and (e) the perpendicular distance from the origin to vector $\vec{B}$.

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

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