Homework No. 1 – Vector Analysis
Engineering Electromagnetics

1. If $\vec{A} = 4\hat{a}_x + 4\hat{a}_y - 2\hat{a}_z$ and $\vec{B} = 3\hat{a}_x - 1.5\hat{a}_y + \hat{a}_z$, find the angle ($< 90°$) between $\vec{A}$ and $\vec{B}$.

2. (a) Find an equation for the plane that is perpendicular to the vector $\vec{A} = 2\hat{a}_x + 3\hat{a}_y + 6\hat{a}_z$ and passes through the end point (from the origin) of the vector $\vec{B} = \hat{a}_x + 5\hat{a}_y + 3\hat{a}_z$.
   (b) What is the shortest distance from the origin to the plane?

3. If $\vec{A} = 10\hat{a}_\rho/\rho + 5\hat{a}_\phi + 2\hat{a}_z$ and $\vec{B} = 5\hat{a}_\rho + \cos\phi\,\hat{a}_\phi + \rho\hat{a}_z$,
   (a) Find $\vec{A} \cdot \vec{B}$ at the point $x = 1$, $y = 1$, $z = 1$.
   (b) Find $\vec{A} \times \vec{B}$ at the point $x = 1$, $y = 1$, $z = 1$.

4. Given the following vector in Cartesian coordinates, convert it to cylindrical coordinates. $\vec{A} = 4\hat{a}_x + 4\hat{a}_y - 2\hat{a}_z$

5. Consider the following field: $\vec{A} = (x^2 + y^2)^{-1}(x\hat{a}_x + y\hat{a}_y)$
   (a) Express the field in cylindrical coordinates. Note, all components must be from the cylindrical coordinate system.
   (b) Evaluate $\vec{A}$ at $\rho = 2$, $\phi = 0.2\pi$, and $z = 5$. Express this vector in both cylindrical and rectangular coordinate systems.