ECEn 560
Electromagnetic Wave Theory

Homework #1
Due January 12, 2016 at the beginning of class (may be turned in late for half credit)

1. Compute the curl and divergence of the following vector fields:
   (a) $x^2\hat{y} + y^2\hat{x}$
   (b) $\rho\hat{\phi}$
2. Check the following identities for $\phi = x^2 + y^2$ and $\overline{A} = x^2y^2\hat{x}$:
   (a) $\nabla \times (\nabla\phi) = 0$
   (b) $\nabla \cdot (\nabla \times \overline{A}) = 0$
   (c) $\nabla^2\overline{A} = -\nabla \times (\nabla \times \overline{A}) + \nabla(\nabla \cdot \overline{A})$
3. For the vector $\overline{A} = \hat{\rho}\rho^2 + \hat{z}2z$, verify the divergence theorem for the cylindrical region enclosed by $\rho = 5$, $z = 0$, $z = 3$.
4. Write down (a) the electric field intensity vector and (b) the magnetic field intensity vector in phasor form for a plane wave with frequency 2.4 GHz, propagating in the $\hat{x} + \hat{y}$ direction, linearly polarized in the z direction, and carrying a time-average power density of 2 W/m^2. (c) Give the time-varying electric and magnetic fields. (d) Is the solution unique, or is there more than one possible solution?
5. Find the (a) complex Poynting vector and (b) time average Poynting vector for the plane wave with electric field $\overline{E} = 3\hat{y}e^{ikz}$. (c) What is the electric field strength corresponding to 10 W/m^2 time average power density?
6. A plane wave with electric field intensity 1 V/m strikes an infinite perfect electric conductor (PEC) plane at a normal incidence angle. Find the surface current density induced on the PEC plane.