THE CITADEL
THE MILITARY COLLEGE OF SOUTH CAROLINA

Department of Electrical and Computer Engineering

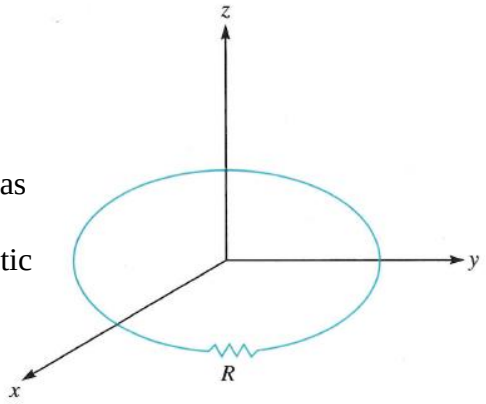
ELEC 318 Electromagnetic Fields **HW #8, due April 2nd, 2015**

Reading Assignment: Chapter 6 (all)
Chapter 7 (Section 7.1)

Written Assignment:

1. A circular conducting loop lies in the *x*-*y* plane as shown in the figure. The loop as a radius of 20 cm and a resistance of $R = 4\ \Omega$. The magnetic flux density is $40\sin\left(10^4 t\right)\hat{\mathbf{z}}\ \text{mWb/m}^2$.

   Determine the current induced in the loop.



2. A coil comprises 50 turns of wire wrapped around a square frame with each side measuring 20 cm. The coil is centered at the origin on plane $z = 0$ such that its sides are parallel to the *x* and *y* axes.

   The loop is subject to the magnetic flux density $2\cos(y)\cos\left(10^3 t\right)\hat{\mathbf{z}}\ \text{Wb/m}^2$.

   Determine the voltage induced in the coil.

3. At a frequency of 1 GHz, calculate the ratio of conduction current density (magnitude) to displacement current density (magnitude) for

   (a) distilled water ($\mu = \mu_0$, $\varepsilon = 81\varepsilon_0$, $\sigma = 2\cdot 10^{-3}\ \text{S/m}$),

   (b) seawater ($\mu = \mu_0$, $\varepsilon = 81\varepsilon_0$, $\sigma = 25\ \text{S/m}$), and

   (c) limestone ($\mu = \mu_0$, $\varepsilon = 5\varepsilon_0$, $\sigma = 2\cdot 10^{-4}\ \text{S/m}$).

4. In a region of free space, the electric flux density is $D_0\cos(\omega t + kz)\hat{\mathbf{y}}\ \text{C/m}^2$.

   Write an expression for the magnetic flux density.

5. The rectangular conducting loop shown in the figure rotates at 3000 revolutions per minute in a uniform magnetic flux density of $75\,\hat{\mathbf{y}}\ \text{mWb/m}^2$. The internal resistance of the loop is 2 Ω.

   Determine the maximum current induced in the loop.