University of Arizona
Department of Electrical and Computer Engineering

ECE 381a Homework Set 6

Spring 2013 February 18, 2013 Ziolkowski

Mandatory Problems on Electrostatics and Magnetostatics

1. Consider the a device constructed from two, concentric, infinitesimally thin, perfectly conducting infinite cylindrical shells or radii $b\,(m)$ and $a\,(m)$ where $b < a$. The region between the cylinders, $b \le r \le a$, is filled with a dielectric of homogeneous permittivity ε. The interior cylinder has the potential $V_0\,(V)$ with respect to the outer cylinder, i.e., $\Phi(\mathrm{b},\phi,z) - \Phi(\mathrm{a},\phi,z) = \mathrm{V}_0 > 0$. The outer cylinder is grounded.

a. Determine the potential $\Phi(r,\phi,z)$ for $b \le r \le a$

b. Determine the electric field $\vec{E}(r,\phi,z)$ for $b \le r \le a$

c. Determine the total charge on the inner cylinder $r = b$

d. Determine the total charge on the outer cylinder $r = a$

e. Determine the capacitance of this device.

2. Consider in a homogeneous medium of relative permittivity μ_r a straight wire of length L that carries a constant current I. The wire is oriented along the z-axis and its ends are located at the points $(x,y,z) = (0,0,-a)$ and $(x,y,z) = (0,0,-a-L)$.

a. Determine the magnetic induction field at a point along the y-axis, i.e., find $\vec{B}(0,y,0)$.

b. Determine the magnetic field $\vec{H}(0,y,0)$ everywhere

c. If a charge q (Coulombs) is moving with the constant velocity $\vec{v} = v_0\,\hat{y}$, determine the force exerted on the charge by the magnetic field when it passes through the point $P = (0,y,0)$.

3. Ulaby Problem 4.48

4. Ulaby Problem 4.56

5. Ulaby Problem 5.12

6. Ulaby Problem 5.14

Optional problems on Electrostatics and Magnetostatics

Ulaby: Problems 4.49, 4.50, 4.58, 5.9, 5.10, 5.11, 5.13

Homework Solutions provided: ONLINE