Homework set 5 (David K. Cheng, Fundamentals of Engineering Electromagnetics)

P. 4-3 Lightning strikes a lossy dielectric sphere - $\varepsilon = 12\varepsilon_0$, $\sigma = 10(S/m)$ -of radius 0.1 (m) at time t=0, depositing uniformly in the sphere a total charge 1 (mC). Determine, for all t,

   a) the electric field intensity both inside and outside the sphere,

   b) the current density in the sphere.

P.4-6 Two lossy homogeneous dielectric media with dielectric constants $\varepsilon_{r1} = 2$, $\varepsilon_{r2} = 3$ and conductivities $\sigma_1 = 15(mS)$, $\sigma_2 = 10(mS)$ are in contact at the z=0 plane. In the z>0 region (medium 1) a uniform electric field $\mathbf{E}_1 = \mathbf{a}_x 20 - \mathbf{a}_z 50$ (V/m) exists. Find (a) $\mathbf{E}_2$ in the medium 2, (b) $\mathbf{J}_1$ and $\mathbf{J}_2$, (c) the angles that $\mathbf{J}_1$ and $\mathbf{J}_2$ make with the z=0 plane, and (d) the surface charge density at the interface.

P. 4-7 The space between two parallel conducting plates each having an area S is filled with an inhomogeneous Ohmic medium whose conductivity varies linearly from σ_1 at one plate (y=0) to σ_2 at the other plate (y=d). A d-c voltage V_0 is applied across the plates. Determine

   a) the total resistance between the plates, and

   b) the surface charge densities on the plates.

P. 4-11 Refer to the flat conducting quarter-circular washer in Example 4-4 and Fig. 4-4. Find the resistance between the curved sides.

P. 4-12 Find the resistance between two concentric spherical surfaces of radii R_1 and $R_2 (R_1 < R_2)$ if the space between the surfaces is filled with a homogeneous and isotropic material having a conductivity σ.