Physics 370 **Homework 8** **Due Wednesday, April 4, 2018**

Reading: Griffiths pages 185-204 and 210-212.

<u>Problem 1</u> A solid dielectric spherical shell has inner radius a and outer radius b and electric susceptibility χ_e. There is a point charge $+Q$ located at $r = 0$, the center of the sphere. The regions $r < a$ and $r > b$ are vacuum. Find the electric field, the electric displacement, and the electric potential everywhere. Use the point at infinity as your reference point. Find the bound charge volume and surface densities.

<u>Problem 2</u> A long coaxial cable consists of a copper wire of radius a, surrounded by a concentric copper tube of inner radius b. The space between is filled with linear dielectric material with susceptibility χ_e. What is the capacitance per unit length of the cable? Is the capacitance per unit length greater or less if the dielectric is replaced by a vacuum?

[Hint: Let the length of the cable be L. Put a charge $-Q$ on the outer cylinder and a charge $+Q$ on the inner cylinder. Find $\vec{\mathbf{D}}$, then $\vec{\mathbf{E}}$, then the potential difference between the two cylinders.]

<u>Problem 3</u> The space inside a parallel-plate capacitor is filled with two slabs of linear dielectric materials. The top slab has thickness a, and the bottom slab has thickness b, so that the total distance between the capacitor plates is $a + b$. The top slab has permittivity ϵ_1 and the bottom slab has permittivity ϵ_2. Both plates are large squares of side s, and the top plate carries charge $-Q$ and the bottom plate carries charge $+Q$.

(a) Find the electric displacement in each slab.

(b) Find the electric field in each slab.

(c) Find the polarization in each slab.

(d) Find the locations and amounts of all bound charges.

(e) What is the potential difference between the plates?

(f) What is the capacitance?