Fields and Waves
Tutorial-7 (8th Match, 2016)

Q1. A sphere of radius R carries a polarization

$$\mathbf{P}(\mathbf{r}) = k\mathbf{r}$$

where k is a constant and **r** is the vector from the center.

a) Calculate the bound charges ρ_{sp} and ρ_{vp}.

b) Find the field inside and outside the sphere.

Q2. Figure 1 shows three dielectric slabs stacked one upon another. They have equal thickness but different dielectric constants. If $\mathbf{E_0}$ in air makes an angle of 45° with respect to the z-axis, find the angle of **E** in each of the other layers.

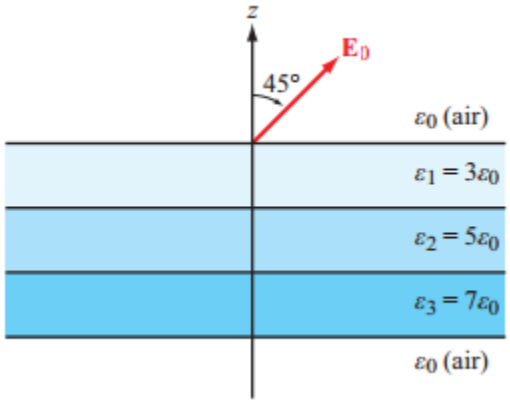

Figure 1

Q3. A 2 cm dielectric sphere with $\varepsilon_{1r} = 3$ is embedded in a medium with $\varepsilon_{2r} = 9$. If $\mathbf{E_2} = 3\cos\theta\,\mathbf{r} - 3\sin\theta\,\boldsymbol{\theta}$ (V/m) in the surrounding region, Find $\mathbf{E_1}$ and $\mathbf{D_1}$ in the sphere.

Home Assignment to be submitted and discussed during tutorial session.

Q1. The space between the plates of a parallel-plate capacitor (see Figure 2) is filled with two slabs of linear dielectric material. Each slab has thickness *s*, so that the total distance between the plates is 2*s*. Slab 1 has a relative dielectric constant of 2, and slab 2 has a relative dielectric constant of 1.5. The free charge density on the top plate is σ and on the bottom plate is - σ.

a) Find the electric displacement D in each slab.

b) Find the electric field E in each slab.

c) Find the polarization P in each slab.

d) Find the potential difference between the plates

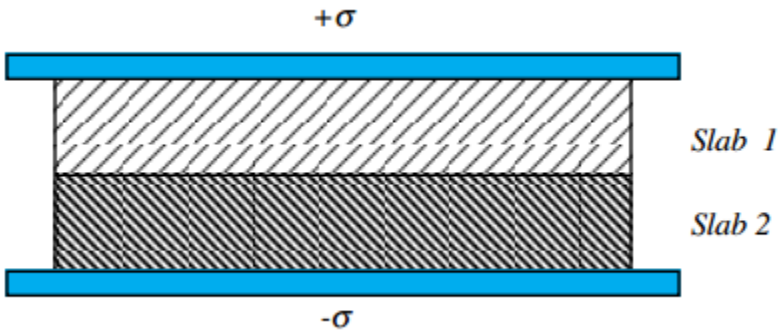

Figure 2

Q2. An infinitely long dielectric cylinder (no free charge on the surface) with $\varepsilon_{1r} = 10$ is described by $r \leq 20$ cm and is surrounded by a material with $\varepsilon_{1r} = 4$. If $\mathbf{E_1} = r^2 \sin\phi\, \mathbf{r} + 3r^2 \cos\phi\, \boldsymbol{\phi} + 3\, \mathbf{z}$ (V/m) in the cylinder, find $\mathbf{E_2}$ and $\mathbf{D_2}$ in the surrounding region.