國立彰化師範大學 100 學年度碩士班招生考試試題

1. There is a spherical cloud of electrons with a volume charge density $\rho = -\rho_0$ for $0 \leq R \leq a$ and $\rho = 0$ for $R > a$ where both ρ_0 and a are positive.
   (1) Determine the electric field **E** caused by the spherical cloud of electrons for $0 \leq R \leq a$. (10%)
   (2) Determine the electric field **E** caused by the spherical cloud of electrons for $R > a$. (10%)

2. A lucite sheet with a relative dielectric constant ε_r of 3 is introduced perpendicularly in a uniform electric field $\mathbf{E_O} = \mathbf{a_x} E_O$ in free space, as shown in Figure 1. Determine the electric field intensity $\mathbf{E_i}$, the electric flux density $\mathbf{D_i}$, and the polarization vector $\mathbf{P_i}$ inside the lucite. (15%)
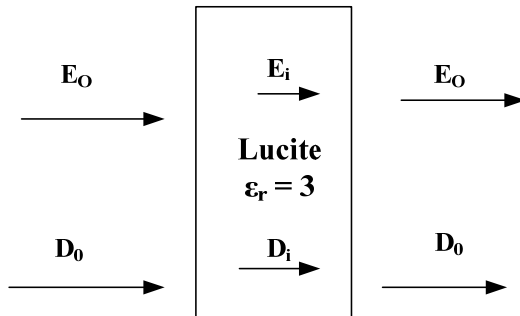

Figure 1

3. At an interface between two media,
   (1) derive the boundary condition for the normal components of magnetostatic fields, (10%)
   (2) derive the boundary condition for the tangential components of magnetostatic fields. (10%)

4. A long wire carrying a current I folds back with a semicircular bend of radius R as in Figure 2. Determine the magnetic flux density at the center point **P** of the bend. (15%)
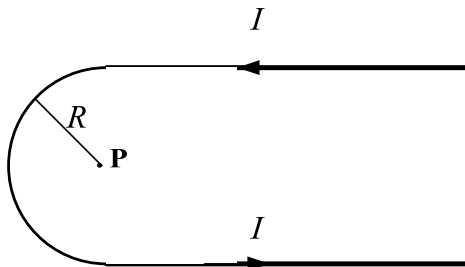

Figure 2

5. Find the resistance between two concentric spherical surfaces of radii a and b ($a < b$) if the space between the surfaces is filled with a homogeneous and isotropic material having conductivity σ. (15%)

6. Show that the instantaneous Poynting vector of a circularly polarized plane wave propagation in a lossless medium is a constant that is independent of time and distance. (15%)