國立台灣大學九十三學年度碩士班招生考試試題

科目：電磁學(A)　　　　　　　　　　　　　　　　　　　　　　　題號：292

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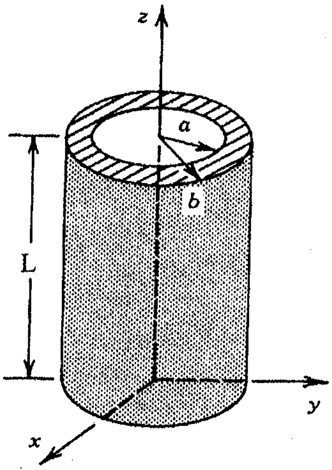
1. (25%) A cylindrical dielectric shell with inner and outer radii, respectively, of $a = 2$ cm and $b = 6$ cm, and of length L = 10 cm exhibits an electric polarization vector of

$$\mathbf{P} = \hat{\mathbf{e}}_\rho \frac{2}{\rho} \times 10^{-10} \text{ C/m}^2, \qquad a \le \rho \le b$$

when it is subjected to an electric field of

$$\mathbf{E} = \hat{\mathbf{e}}_\rho \frac{7.53}{\rho} \text{ V/m}, \qquad a \le \rho \le b$$



Neglecting fringing, find

(a) The bound surface charge density q_{sp} in each of the surfaces.

(b) The net bound charge Q_p at the inner, outer, upper, and lower surfaces.

(c) The volume bound charge density q_{vp} within the dielectric.

(d) The dielectric constant of the material.

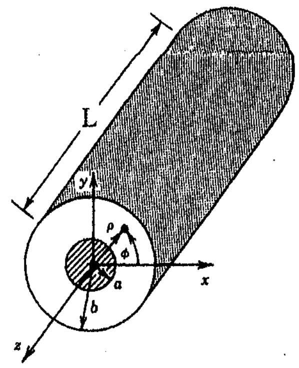
($\varepsilon_0 = 8.854 \times 10^{-12} \approx \frac{10^{-9}}{36\pi}$ farads/meter)

2. (25%) A coaxial line of length L with inner and outer conductor radii of 1 and 3 cm, respectively, is filled with a ferromagnetic material. When the material is subjected to a magnetic field intensity of

$$\mathbf{H} = \hat{\mathbf{e}}_\phi \frac{0.3183}{\rho} \text{ A/m}$$

it induces a magnetization vector potential of

$$\mathbf{M} = \hat{\mathbf{e}}_\phi \frac{190.67}{\rho} \text{ A/m}$$



Determine

(a) The bound magnetization surface current density in all surfaces.

(b) The bound magnetization volume current density within the material.

(c) The net bound magnetization current associated with the coaxial line.

(d) The relative permeability of the material. ($\mu_0 = 4\pi \times 10^{-7}$ henries/meter)

3. (25%) Determine the capacitance per unit length between two long, parallel, circular conducting wires of radius a. The axes of the wires are separated by a distance D.

4. (25%) Calculate the internal and external inductances per unit length of a transmission line consisting of two long parallel conducting wires of radius a that carry currents in opposite directions. The axes of the wires are separated by a distance d, which is much larger than a.