EEC 130A: Homework 6

Due: 3:30 pm, Tuesday, Feb. 17th, 2015

1. (FAE P4.22) Given the electric flux density

$$\mathbf{D} = \hat{\mathbf{x}}2(x+y) + \hat{\mathbf{y}}(3x-2y) \qquad (C/m^2)$$

determine

(a) ρ_v by applying the differential form of Gauss's law.

(b) The total charge Q enclosed in a cube 2 m on a side, located in the first octant with three of its sides coincident with the x-, y-, and z-axes and one of its corners at the origin.

(c) The total charge Q in the cube, obtained by applying the integral form of Gauss's law.

2. (FAE P4.27) An infinitely long cylindrical shell extending between $r = 1$ m and $r = 3$ m contains a uniform charge density ρ_{v0}. Apply Gauss's law to find D in all regions (i.e. for $0 < r \leq 1\ m$, $1\ m < r \leq 3\ m$, and $r > 3\ m$)

3. (FAE P4.32) A circular ring of charge of radius a lies in the x-y plane and is centered at the origin. Assume also that the ring is in air and carries a uniform density ρ_l

(a) Show that the electrical potential at $(0, 0, z)$ is given by

$$V = \frac{\rho_l a}{2\epsilon_0 \sqrt{a^2 + z^2}}.$$

(b) Find the corresponding electric field $\boldsymbol{E}$.

4. Given a load impedance of $Z_L = 20 - j20\ \Omega$, use the single (shorted) stub method to match it to a 50-Ω system. Find the position d and the length l (in terms of wavelegth λ) of the shorted stub. Assume all transmission lines used have characteristic impedance of 50-Ω.