Reading
Chapter 6, pp. 218–274

Problems 1
A hollow tube with a rectangular cross-section has external dimensions of 0.5 in by 1 in and a wall thickness of 0.05 in. Assume that the material is brass, for which the conductivity is $\sigma_1 = 1.5 \times 10^7$ S/m. A DC current of 200 A is flowing through the outer part of the tube.

Part a
Calculate the potential difference across an $L = 1$ m length of the tube in the $z$ direction.

Part b
Calculate the potential difference across the same tube that is filled with a second conducting material with conductivity $\sigma_2 = 1.5 \times 10^5$ S/m.
Problem #2

Two perfectly-conducting spherical surfaces located the origin have radii $r_1 = 3.0$ cm and $r_2 = 5.0$ cm. A resistive medium with conductivity $\sigma = 0.05$ S/m exists between these conductive surfaces. Given that the total current passing radially outward from surface 1 to surface 2 is 3.0 A, calculate the following quantities:

a. Potential difference $V_{12}$ between the two conductors,
b. Total resistance $R$ between the two conductors.
c. The electric field intensity $\vec{E}(r, \theta, \phi)$ inside the resistive medium.

Cross-sectional view of device for Problem 2.
Problem #3
A parallel plate capacitor is filled with a non-uniform dielectric characterized by 
\[ \varepsilon_r(z) = 2 + (2 \times 10^6)z^2, \]
where \( z \) is the height above the bottom plate. If the cross-sectional area is \( S = 0.02 \text{ m}^2 \) and \( d = 1 \text{ mm} \), calculate the total capacitance \( C \).

Device for Problem 3 (not drawn to scale).