Physics 323, Spring Quarter 2015
Electrodynamics: Homework Assignment 2

Turn in all problems and clearly note all constants and assumptions you use. (1-point penalty each otherwise)

Due 9:00 am Thursday April 16

1. Your microwave oven is a rectangular microwave cavity.
a. Look at your oven and estimate the cavity dimensions a, b, and d (with $b < a < d$).
b. Suppose you have mode indices M (associated with a), N (associated with b) and L (associated with d). Which is the "dominant" (lowest frequency) TE_{MNL} mode? Find that frequency.
c. Which is the dominant TM_{MNL} mode and frequency?

2. Last quarter we considered a "leaky" spherical capacitor of inner conducting-shell radius r_1 and outer conducting-shell radius r_2. The dielectric between the two shells is only slightly conducting with conductivity σ. Last quarter we found the magnetic field between the shells when the capacitor discharges through its own dielectric by several complicated approaches. We can use gauge freedom to make this calculation easier.
a. Suppose the initial current between the shells is I_0. Find the voltage at radius r within the dielectric. (You can choose the outer shell as grounded.)
b. Find all the components of the vector potential **A** (in Lorentz gauge) between the shells. Hint: In the Lorentz gauge you have the "Lorentz condition" Griffiths equation 10.12.
c. Find the resulting **B** field.

3. In the last homework you found the free-space ratio of magnitude of the transverse components of **E** and **H**. Repeat this for the rectangular waveguide TE_{10} example Griffiths 9.5.2.

4. Consider a cylindrical coaxial waveguide of inner radius r_1 and outer radius r_2. The space between conductors is vacuum.
a. Suppose you apply a sinusoidal voltage of amplitude V_0 and angular frequency ω across the inner and outer conductor at one end of the waveguide; a disturbance travels down the waveguide in the lowest TEM mode (assume the waveguide is infinitely long). Find the resulting current flowing along one or the other of the conductors.
b. Find the time-average power transmitted down the waveguide.
c. What is the ratio of magnitude of the transverse components of **E** and **H**? (In this context called the “wave impedance”.)
d. What is the ratio of the voltage across the conductor and the current down one of the conductors? (In this context called the “characteristic impedance”.)

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