EE 483/583 Antennas for Wireless Communications (Spring 2024)
Homework 11
Thursday, April 18, 2024

1) 5.3 at 20 MHz. Assume loop is 'small'.
2) 5.14 at 80 MHz. Note: "resonant" means you assume $X_A = 0$. Assume antenna is 'small'.
3) 5.17
4) For single, 18 cm diameter, circular loop of wire (14 AWG, $\sigma_{wire} = 3 \times 10^7$ S/m) in free space, centered on the x-y plane and fed where it crosses the positive x-axis, use NEC-2 to:
   a) Determine the input impedance over normalized frequency range $0.1 \leq ka \leq 2$. On a single graph, plot R_{ant} and X_{ant} versus ka.
   b) **EE 483 only**: In a table, list ka = 0.1, the anti-resonant & resonant frequencies (ka & MHz), R_{ant}, X_{ant}, and antenna efficiency η. Format: col. 1 ka, col. 2 f (MHz), col. 3 R_{ant}, col. 4 X_{ant}, col. 5 η, and col. 6 description (e.g., small loop, resonance #1 …) **EE 583 only**: In a table, list ka = 0.1, the anti-resonant & resonant frequencies (ka & MHz), R_{ant}, X_{ant}, R_{rad}, R_{loss}, and η. Format: Col. 1 ka, col. 2 f (MHz), col. 3 R_{ant}, col. 4 X_{ant}, col. 5 $R_{rad,}$, col. 6 R_{loss}, col. 7 η, and col. 8 description (e.g., small loop, resonance #1 …)
   c) Determine the current distribution at ka = 0.1 and the first resonant frequency. On a single graph, plot the normalized current magnitudes (normalize each trace independently so that its maximum is 1) versus the fractional circumference (e.g., 0 ≤ distance/circumference < 1).
   d) **Extra credit:** At ka = 0.1 and the first resonant frequency, determine the far-zone E-plane (x-y plane) and H-plane (x-z plane) power gain radiation patterns (in dBi). On two polar graphs, plot the relative power radiation patterns for the E-plane and H-plane scaled so that the center of each plot is at –30 dB and the outer ring is at 0 dB. Tabulate the maximum and minimum gain in each plane at each frequency.

Hint: Use GA command to 'make' loop (start first segment at a negative angle so its center will be on axis) and GM command to rotate loop onto x-y plane.

Due Thursday, April 25, 2024