

# ECE 3041

## Homework Assignment No 4

### Spring 2012 Homework for Experiment No. 5

Due Week of February 20

1. A **Tektronix 3012B** 100 MHz digital storage oscilloscope is being used to measure the voltage across nodes  $AA'$  in the circuit shown below. Use SPICE to determine and plot the rms value of the voltage that is measured as a function of the frequency of the sinusoidal source,  $e(t) = 50\sqrt{2}\cos(\omega t)$  V, as the frequency of the source varies from 10 Hz to 100 MHz. Plot the frequency on a log scale and voltage on a linear scale. The input impedance of this instrument may be characterized as a  $1\text{ M}\Omega$  resistor in parallel with a  $13\text{ pF}$  capacitor. Also plot the voltage that would be measured with an ideal oscilloscope (one with an infinite input impedance). Make both plots on the same sheet of graph paper. Verify the SPICE solution with a hand calculation at the frequency  $f = 11.2\text{ MHz}$ . Use SPICE to determine and plot the percentage error due to oscilloscope loading for the measurement described in the previous problem. Use the same frequency range for the plot as was used in the previous problem. Plot the frequency on log scales and the percentage error on a linear scale. Verify the SPICE solution with a hand calculation at the frequency  $f = 11.2\text{ MHz}$ . The component values are:  $R_1 = R_2 = 18\ \Omega$ ,  $R_3 = 15\text{ k}\Omega$ ,  $R_4 = 22\text{ k}\Omega$ ,  $L_1 = 2.8\text{ H}$ ,  $L_2 = 30\text{ mH}$ ,  $C_1 = 0.15\ \mu\text{F}$ , and  $C_2 = 470\text{ pF}$ .

