Notes on Experiment #4

Use only Ohm's Law, Voltage Division, Current Division and the Power equation to do your circuit analysis.

Do part I as is.

In part II you will be measuring and recording the voltages with both the DMM and the scope. So set up your data tables accordingly.

For the circuit analysis in part I you MUST USE VOLTAGE DIVISION to find every voltage value. For the voltage $V_i$ across a single resistor $R_i$ we have:

$$V_i = \frac{R_i}{R_1 + R_2 + R_3 + R_4} \times V_s$$

If you need the voltage across two adjacent resistors, say $R_1$ and $R_2$, then let

$$R_i = R_1 + R_2$$

in the above formula and you have it!

For the circuit analysis in part III you MUST USE CURRENT DIVISION to find every current value. In this case you MUST find $I_s$ first.

$$I_s = V_s \times \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right) = \frac{V_s}{R_{eq}}, \text{ Where } R_{eq} = R_1 \parallel R_2 \parallel R_3 \parallel R_4$$

then For the current $I_i$ in a single resistor $R_i$ we have:

$$I_i = \frac{G_i}{G_1 + G_2 + G_3 + G_4} \times I_s, \text{ Where } G = \frac{1}{R} \text{ (conductance)}$$

For the current in two resistors, say $R_1$ and $R_2$, then $G_i = G_1 + G_2$
ECE 225 Experiment #4

Power, Voltage, Current, and Resistance Measurement

Purpose: To measure V, I, and R with a Digital Multimeter (DMM) and the V with the oscilloscope; verify voltage and current division rules; investigate the effect of power dissipated by a resistor

Equipment: Agilent 54622A Oscilloscope, Agilent 34401A Digital Multimeter (DMM), Agilent 33120A 15MHz Function/Arbitrary Waveform Generator, Agilent E3631A Triple Output DC Power Supply, Universal Breadbox

I. Power

Accurately measure the resistance of a 27-ohm, 1/4 watt resistor. If the value is more than 5% in error ask your lab instructor for a replacement resistor. Calculate the DC voltage which results in 1/2 watt of power dissipation in the resistor, and set the DC supply to that value. Use the + and - terminals of the 6 volt output. Set the current limit to 200 mA. Attach cables from breadbox directly to the + and - terminals of the DC voltage supply. Use hookup wire to connect the resistor to the cables. Wait a few minutes and feel the resistor. Comment. Disconnect the resistor from the DC supply and measure the resistor's value and see if the value has changed as a result of the abuse. Now repeat the experiment with the DC supply set for a power dissipation of 1 watt (four times the rated amount). Don't burn yourself! Be sure to measure the resistor again before you start the 1 watt trial.

II. Voltage Division

For the next two parts you will need accurate values of the resistors in order to verify the voltage division and current division shortcuts. Measure these values accurately if you have not already done so. Set up the circuit in Figure 1. using the DC supply as $V_S$. Set $V_S$ to 10 volts. Then by measuring $V_1$, $V_2$, $V_3$, $V_4$, $V_{12}$, $V_{123}$, and $V_S$ with the DMM, verify the voltage division rule for each of these voltages. Present your results (measured values vs. values calculated on the basis of the voltage division rule, using the accurately measured R values) in the form of a table. Next, replace the DC supply with the function generator, set it for a waveform $4\sin(4000\pi t)$ volts (be sure the DC offset is zero), and repeat.

Next, repeat all of the above measuring the voltages with the oscilloscope.
III. **Current Division**

Verify the current division rule, in a manner similar to your verification of the voltage division rule above, for the circuit in Figure 2. Let $V_S$ be 10 volts DC. Measure the currents using the DMM. No need to use the scope. The scope is a voltmeter.

**NOTE: WE WILL NOT DO AC CURRENT MEASUREMENT. THE AC CURRENTS ARE TOO SMALL TO BE MEASURED BY THE DMM IN THIS LAB.**

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**Figure 1.**

**Figure 2.**

$R_1 = 1.0\, \text{K}$

$R_2 = 3.3\, \text{K}$

$R_3 = 2.0\, \text{K}$

$R_4 = 4.7\, \text{K}$

$V_S$