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EE2CI5 Lab 3 Circuits

1 Please read carefully:

Please review the course material on voltmeters and ammeters. Recall that a voltmeter in placed in *parallel* across the points where the voltage measurement is to be made. The voltmeter looks like a very *large* resistance across its terminals. (For these ohmmeters, the actual resistance value is 10*M*Ω). On the other hand, the ammeter is placed in *series* in the branch where current is to be measured. The ammeter looks like a very *small* resistance across its terminals. You will need to know the resistor colour code so that you can determine the resistance value of the resistor. The colour code will be given in the lab.

2 Objective

The objective of this lab is for you to become familiar with hooking up series/parallel circuits with resistive elements, and calculating and measuring currents and voltages. It will also familiarize you with some of the difficulties associated with making current and voltage measurements.

3 Equipment

Function generator
variable power supply
Multi-meter
Oscilloscope
Hook-up wire
Assortment of resistors (see below)

4 Resistor Values

Quantity	Value (1/4 Watt)
1	56Ω
3	100Ω
4	390Ω
4	1K
2	2.2K
1	3.3K
1	4.7 K
1	5.6K
1	12K
1	18K
1	5.6M
1	10M

5 Procedure

1. Consider the circuit of Figure 1
before the lab, calculate the voltage values V_1 to V_3, and the current values I_1 to I_3, and I_T .

during the lab, connect the circuit, measure and record these values. Is there any discrepancy? If so, explain. For the writeup for this part of the lab, present your analysis of the above circuit, and then give your experimental results. Note that a naive analysis will give a wrong answer. This error is not due to resistor tolerance. Think about what is happening to the circuit when the voltmeter is placed across the output! Do your analysis to take this consideration in to account.

2. For this part, you can choose the problem you wish to work on. Propose a circuit with two or three node or meshes, using only resistor values from the above table. Include a DC voltage source (which is your DC power supply) and a sinusoidal source, which is your function generator, set to a sinusoidal waveform. First, analyze your circuit for various voltages and currents. Then go to the lab and build it. Compare your theoretical findings with your measurements. Note that the function generator connects to a co-axial cable. This means that one of the terminals of the function generator is a metal ring, and the other is a dot in the centre of the ring. The metal ring is connected to ground through

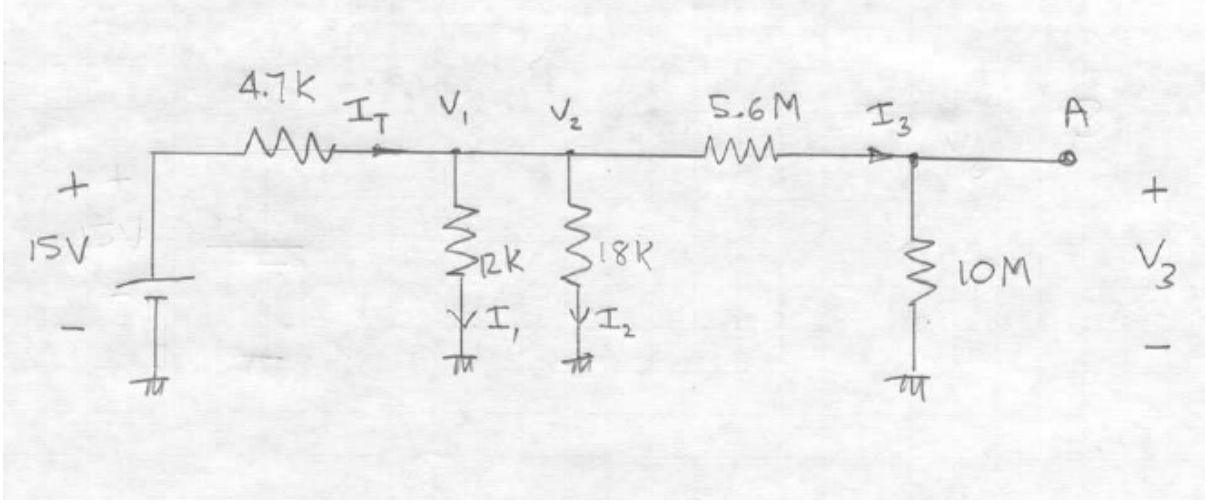

Figure 1: Circuit for Part 1.

the instrument. Therefore, in your circuit, you must connect the function generator from a node directly to ground. If it is connected across two non-grounded nodes, the one connected to the outer ring will necessarily become ground.

Hint: The sinusoidal waveform is time varying. Let the sinusoidal voltage waveform $v(t)$ from the function generator be defined as $v(t) = A\cos(2\pi ft)$, where f is the frequency in Hz, and A is the amplitude (1/2 the peak-to peak amplitude). Since Ohm's law holds for every instant of time, in your analysis you can treat the sinusoidal waveform as if it were DC, with value A. Then your analysis will produce a voltage or current of interest which will have a value of the form kA, where k is a constant. The resulting sinusoidal signal $x(t)$ that describes the desired voltage or current waveform is then given by $x(t) = kA\cos(2\pi ft)$. Do NOT use your ammeters or voltmeters for measurements in this part of the lab. Due to the fact that the waveforms are offset sinusoids, these instruments will give you the wrong answer. These instruments give an accurate value of a sinusoidal waveform only if there is no DC offset. For sinusoidal waveforms, these instruments are calibrated to give the *rms* (root mean square) value of the waveform (that is $A/\sqrt{2}$). Use the scope to make voltage and current measurements. You can measure the current waveform through a resistor by placing a scope probe on each side of the resistor. Then

set up the scope to show the *difference* between Ch1 and Ch2. The current value is then the difference voltage divided by the resistor value. For your write-up, show your proposed circuit, and all your analysis. Then present your experimental results, and compare them with your predicted values.