ECE 3301L **Lab 5** **Felix Pinai**
Session 2

Digital Voltage Meter / Ohm Meter

Using the provided schematics, you will need to design the following meters:

A) Voltage Meter:

Connect AN5 (RE0 @pin 8) directly to a variable power supply. Write a program that will measure the voltage input Vin at AN5 (RE0) and display its value on the two 7-segment displays with the leftmost digit in Volt and the rightmost digit representing the 1/10V unit. Turn on the Decimal Point (connected to pin RE2) of the leftmost digit (Upper digit) to show the decimal point. In addition, your team will need to show the same result on the TeraTerm software by doing the output through the use of 'printf'.

Hint: Copy the function 'get_full_ADC(void)' used in the previous lab to measure the value of the input voltage. Make sure that on the register ADCON0 you select AN0 (pin RE0) as the voltage source. Also, you must make sure that the register ADCON1 has the proper value to use the external voltage VREF = 4.096V as the VREF+ reference voltage for the A/D while using GND as the source for VREF-.

Make 9 measurements from 0.5 to 4V in increments of 0.5V (do not go past 4.0V). For each measurement, take only the data shown on the **output of TeraTerm (not the display)** and then measure the same voltage using a DVM. Show the percentage error between the value from the DVM and the one shown on TeraTerm for each measurement.

	V(DVM)	V(TeraTerm)	% difference
0.5V			
1.0V			
…			
4.0V			

B) Ohm Meter:

You will need to acquire the following resistors:

* 1 100 ohm (0.1 Kohm) with 1% precision
* 1 1 Kohm with 1% precision
* 1 10 Kohm with 1% precision

Note: Use the unit of Kohm instead of ohm because for the purpose of this lab it would prevent overflow in the computations.

In addition to the above resistors, you also need to get the following resistors to be used as unknown resistors RL:

* 1 22 ohm
* 1 220 ohm
* 1 470 ohm
* 1 1Kohm
* 1 2.2Kohm
* 1 10Kohm
* 1 22Kohm
* 3 33Kohm
* 1 47Kohm
* 1 100Kohm

Before doing the lab, measure each resistor using the DVM and record its value and put them on a spreadsheet.

You don't have to get the exact value of the resistors listed above but something close to those resistors. However, there should be a couple of resistors that have high value up to 100K ohms.

Part B1)

Connect the 100 ohm 1% precision resistor at Rref1 and an unknown resistor at RL1. The junction of Rref1 and RL1 is called VL1 and it must be connected to AN0 (pin RA0). Modify the program for the Voltage meter above that measures the input voltage at RA0 and uses that value in conjunction of the KVL and KCL laws to derive the value of the unknown RL1 based on the fact that Rref1 is 4.096V.

The measured value of the unknown resistor has to be shown on the two 7-segment displays. If the unknown resistor is less than 10K, show the decimal point on the leftmost digit so that we will see the values to be from 0.0 to 9.9K. If the resistor is greater than 10K, then show only the integer portion of that value without turning on the decimal point so that we will see values from 10 to 99. In addition, you need to use the serial port to display the same result on the TeraTerm. Use the 'printf' function to display the floating point result.

Note: Make sure that the proper bits are set on the ADCON0 register to you select AN0 now as the voltage source.

Make 10 measurements using the different values that I have asked you to obtain and tabulate them along with the values measured of each unknown resistor using a DVM. Show the percentage error between the value shown on TeraTerm (not the value from the display) and the measured value for each measurement (the one that you have measured at the start of the experiment). Sort the results in ascending order of the resistors RL1.

Resistor (in Kohms)	RL1(DVM)	RL1(TeraTerm)	% difference
0.022			
0.220			
0.470			
…			
100			

When a value of resistance is measured, set the color of the RGB LED D1 to reflect the range of value of the resistance. Use the following color table:

Resistance Range	D1's color
Below 10K	Off
10K-19 K	Red
20K-29 K	Green
30K-39 K	Yellow
40K-49K	Blue
50K-59 K	Purple
60K-69K	Cyan
Above 70K	White

Part B2)

This part will use the alternate circuit built with the resistor Rref2 and RL2 to measure an unknown resistor. Rref2 is 1Kohm 1% instead of the 100 ohm 1% used as Rref1. The voltage VL2 is connected to AN1 (or RA1). Change the program in Part B1) to determine the value of RL2. Use the same set on unknown resistors used in Part B1) and repeat the same measurements. Make another table to show all the measurements. Don't forget to change ADCON0 accordingly.

Part B3)

This part will use the alternate circuit built with the resistor Rref3 and RL3 to measure an unknown resistor. Rref3 is 10Kohm 1% instead of the 1K ohm 1% used as Rref1. The voltage VL3 is connected to AN2 (or RA2). Change the program to determine the value of RL3. Use the same set on unknown resistors used in part 1 and repeat the same measurements. Make another table to show all the measurements. Don't forget to change ADCON0 accordingly.