ME 411 Mechatronics @ UIC

Breadboard, Multimeter, Resistor circuits

This lab is to be done in a group of two during lab hours

1 Prelab (To be done before you come to the lab)

1.1 Motivation

The goals of this lab are as follows: (1) Introduction to Breadboard (2) Taking measurements using a multimeter (3) Understanding series and parallel resistor circuits. (4) Voltage and Current Divider circuit.

1.2 Assigned Reading

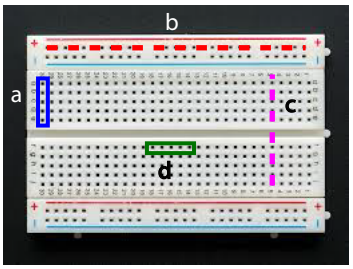
This part of the Lab needs to be done before you come to the lab.

1. Section 2.2.1 Resistor (see Lecture 1)
2. Section 2.3 Kirchoff's Laws (see Lecture 2).
3. Section 2.10 Practical Considerations. (see Lecture 3 notes).

1.3 Questions based on reading

The teaching assistant/instructor may ask you any question related to the pre-lab material. Be prepared to answer these. Example question. Here are some example questions

1. A resistor has the following bands in that order: Red, Red, Black, Gold. The resistance is
   (a) 22 $\Omega \pm 5\%$
   (b) 22 $\Omega \pm 10\%$
   (c) 220 $\Omega \pm 5\%$
   (d) 220 $\Omega \pm 10\%$
2. Consider two resistances, $R_1 = 5\Omega$ and $R_2 = 10\Omega$. The two resistors when connected in series, have an effective resistance R_{series} and when connected in parallel, have an effective resistance R_{parallel}. Indicate all true statements.
   (a) $R_1 > R_{\text{parallel}}$
   (b) $R_2 > R_{\text{parallel}}$
   (c) $R_{\text{series}} > R_{\text{parallel}}$
   (d) $R_{\text{series}} > R_1$
3. Consider the breadboard below. Tick all TRUE statements



(a) Holes shown by the blue vertical box denoted by a are all connected

(b) Holes shown by the red dashed line denoted by b are all connected

(c) Holes shown by the pink vertical line denoted by c are all connected

(d) Holes shown by the green horizontal box denoted by d are all connected

4. An ammeter measures current flowing through a resistor and a voltmeter measures voltage across the resistor. Tick all true statements about these meters

   (a) Ammeter should be connected in series with the resistance

   (b) Ammeter should be connected in parallel with the resistance

   (c) Voltmeter should be connected in series with the resistance

   (d) Voltmeter should be connected in parallel with the resistance

Answers 1 a; 2 a b c d; 3 a,b; 4 a,d;

2 Labwork (To be done during the lab)

Equipment list

1. 3 Resistors (any values will do).
2. Breadboard.
3. DC voltage supply.
4. Hantek2D72 Oscilloscope/Digital Multimeter/Function Generator

2.1 (20 points) Understanding resistor values

1. Pick 3 resistors. Compute resistance using the table.
2. Now measure the resistance using the multimeter. Use the probes shown below. Connect the black one to the COM port and the red one to the Ω port. Press the DMM button.
3. Fill the table below. Show any one calculation to your teaching assistant.

Resistance	Theoretical	Experimental
1		
2		
3		

Table 1: Understanding resistor value

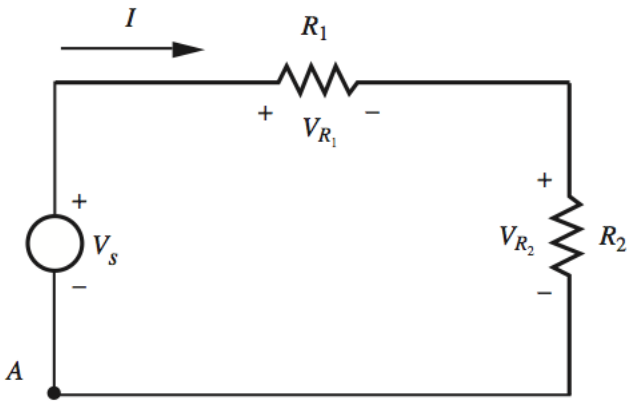
2.2 (20 points) Using breadboard to create circuits and measurements using a multimeter

1. Connect the voltage source to any one resistor above. Use breadboard to make the connection.
2. Draw the circuit diagram.
3. Compute the theoretical value of voltage and current across resistor.
4. Now use the multimeter to measure the the voltage and current across the resistor. Use the probes shown below. Connect the black one on the COM port and the red one on the V port. Press the DMM button. Ensure that the DMM is in parallel with the resistor. **WARNING:** Connect this circuit under the supervision of the teaching assistant. If you do not connect the multimeter properly than you can damage it. Show the circuit and measurement to the teaching assistant for credit.

	Theoretical	Experimental
Voltage		
Current		

Table 2: Basic resistor circuit measurement

2.3 (20 points) Series circuit as a voltage divider



For the circuit shown above use Kirchoff's laws to compute the voltage V_{R_2} across resistance R_2 as a function of R_1, R_2 and supply voltage and write it below

V_{R_2} = _____;

Now choose R_1 and R_2 such that the voltage across R_2 is $V_s/3$.

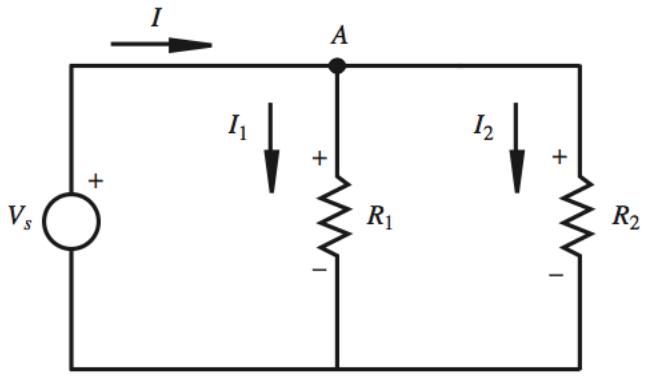
R_1 = _____; R_2 = _____.

Now build the circuit and compare the theoretical value with the measured value.

$V_{R_2}^{\text{theoretical}}$ = _____; $V_{R_2}^{\text{experimental}}$ = _____.

Show the measurement and your circuit to the teaching assistant for credit.

2.4 (20 points) Parallel circuit as a current divider



For the circuit shown above use Kirchoff's laws to compute the current I_1 across R_1 and I_2 across resistance R_2, each as function of only R_1, R_2 and total current I and write it below

$I_1 =$ _____; $I_2 =$ _____;

Now choose R_1 and R_2 such that the ratio of voltage I_1/I_2 is 2.

$R_1 =$ _____; $R_2 =$ _____.

Now build the circuit and compare the theoretical value with the measured value.

$(I_1/I_2)^{\text{theoretical}} = 2$; $(I_1/I_2)^{\text{experimental}} =$ _____.

Be careful about how you connect the multimeter to measure the current. Use the probes shown below. Connect the black one on the COM port and the red one on the A port. Press the DMM button. Ensure that the DMM is in series with the resistor.

Show the measured current ratio to the teaching assistant for credit.