UNIVERSITY OF TECHNOLOGY, JAMAICA
School of Engineering -

Electrical Engineering Science

Laboratory Manual

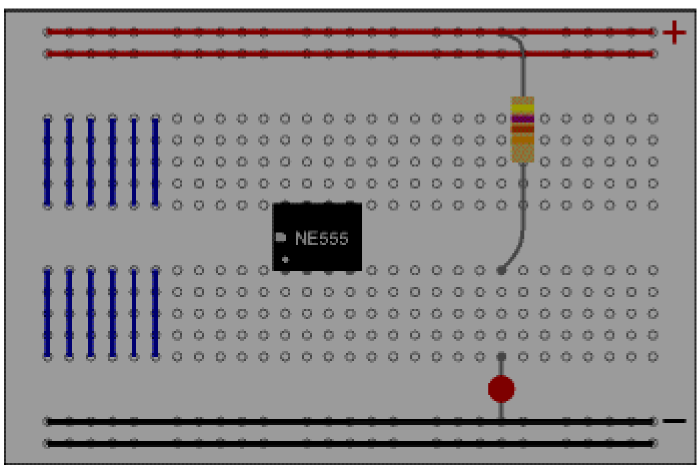

Table of Contents

Safety Rules and Operating Procedures

1. Students are allowed in the laboratory only when laboratory personnel are present.

2. Open drinks and food are not allowed near the lab benches.

3. Report any broken equipment or defective parts to the laboratory personnel. Do not open, remove the cover, or attempt to repair any equipment.

4. Ask for circuits to be checked before energizing / turning on.

5. When the lab exercise is over, all instruments / equipment must be turned off.

6. University property must not be taken from the laboratory.

7. ANYONE VIOLATING ANY OF THESE RULES OR REGULATIONS MAY BE DENIED ACCESS TO THESE FACILITIES.

I have read and understand these rules and procedures. I agree to abide by these rules and procedures at all times while using these facilities. I understand that failure to follow these rules and procedures will result in my immediate dismissal from the laboratory and additional disciplinary action may be taken.

………………………………. ………………
Signature Date

Troubleshooting Hints

1. Be sure that power is turned on.

2. Be sure the circuit you built is identical to that in the diagram. (Do a node-by-node check).

3. Be sure that the supply voltages are correct.

4. Be sure that the equipment is set up correctly and you are measuring the correct parameter.

5. If steps 1 through 4 are correct, then you probably have a component with the wrong value or one that doesn't work. It is also possible that the equipment does not work (although this is not probable) or the protoboard / breadboard you are using may have some unwanted paths between nodes. To find your problem you must trace through the voltages in your circuit node by node and compare the signal you have to the signal you expect to have. Then if they are different use your engineering judgment to decide what is causing the difference or ask any of the laboratory personnel.

UNIVERSITY OF TECHNOLOGY, JAMAICA
SCHOOL OF ENGINEERING - CEEC

Experiment #1 **OHM'S LAW**

STUDENT NAME……………………… COURSE NO……………………
TEAMMATE…………………………… MARKS…………………………
LECTURER'S SIGNATURE…………... **DATE……………………………**

Objectives: 1) To use measured values of voltage, resistance and current to verify Ohm's law.

2) To calculate the power dissipated in a resistor.

Introduction

A dc power supply, ammeter, and decade resistance box are connected in series. A voltmeter is connected to monitor the resistor voltage. The measured quantities should confirm Ohm's law.

To further demonstrate Ohm's law, the resistance and voltage are independently adjusted and the current level is measured.

Equipment

DC Power Supply – (0 to 25V, 100 mA)
DC Ammeter – (100 mA)
Electronic Voltmeter – (30V)
Decade resistance box – (0 to 10KΩ, 100 mA)

Diagram

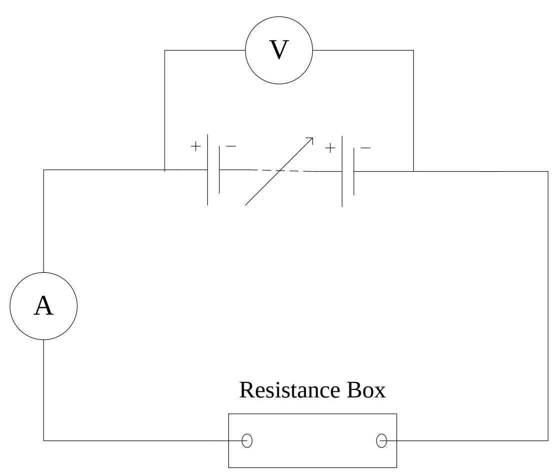

Fig. 1

Procedures

1. Check that the power supply is switched off and that its output is set for zero voltage.

2. Set the resistance box to 100 Ω and connect the equipment as shown in Fig.1.

3. Switch on the power supply and adjust it to give E = 5 V.

4. Record the current level in Table 1, then calculate the current using measured values of resistance and voltage. Compare the measured current to the calculated value.
5. Alter R to 180 Ω and adjust the voltage until the ammeter indicates I =40mA.

6. Record the new level of the measured voltage E, then calculate the voltage drop across the resistor R using the measured values of current I and voltage V obtained from step 5.

7. Adjust the power supply to give E = 10 V, and alter the decade box until I = 15 mA.

8. Record the calculated and measured values of R.
9. Adjust the decade box to double the value of R. Record the corresponding values of R, E and I. *How is the current affected when R is doubled*?

10. Adjust the decade box until R is half the resistance used in procedure 8. Record the corresponding values of R, E and I. *How is the current affected when R is halved?*

11. Reset R to 400 Ω and E to 5V. Record R, E and I.

12. Adjust the power supply to double the value E to 10 V. Record the new values of R, E and I. *How is the current affected when the voltage is halved?*

13. Adjust the power supply to E= 2.5V, (half the voltage level used in procedure 11). Record the level of I, and note how the current is affected when the voltage is halved?

14. Adjust the power supply to give E = 0 V, and reset R to 400 Ω.

15. Adjust the power supply output to increase E in 2V steps from 0 V to 10 V. At each step record the levels of E and I indicated on the instruments.

16. The End of the Experiment. Switch off the power supply, and dismantle the circuit.

Table 1

Procedure #		
4	R = 100 Ω E = 10 V	Calculated "I" Measured "I" =
6	R = 180 Ω I = 40 mA	Measured Voltage "E" = Calculated "V" =
8	E = 10 V I = 15 mA	Measure "R" = Calculated "R" =
9	"R" doubled	R = E = I = Effect on current?
10	"R" halved	R = E = I = Effect on current ?

Procedure #		
11		R = E = I = Effect on current ?
12	"E" doubled	R= E = I = Effect on current?
13	"E" halved	R = E = I = Effect on current ?
15	R = 400 Ω	E (Volts) I (mA) 0………………… 2………………… 4………………… 8…………………. 10………………….

Analysis 1 – (Ohm’s Law)

2-1 From the results of procedures 3 through 6, calculate the power dissipated in R, in each case.

2.2 For procedures 7 through 10, calculate the power dissipated in R, in each case. Discuss the effects upon power when R is doubled and halved.

2.3 For procedures 11 through 13 calculate the power dissipated in R in each case. Discuss the effects upon power when E is doubled and halved, and when I is doubled and halved.

UNIVERSITY OF TECHNOLOGY,JAMAICA
School of Engineering

Experiment # 2 SERIES AND PARALLEL CIRCUITS

STUDENT NAME……………………… COURSE NO………………
TEAMMATE…………………………… MARKS…………………
LECTURER'S SIGNATURE……….…………. DATE……………

OJECTIVE: To investigate the properties of series and parallel resistive circuits and to determine the internal resistance of a 1.5V cell.

APPARATUS: D.C. Power Supply
Bread Board
Digital Multimeter
R1, 20KΩ Carbon Resistor
R2, 33KΩ Carbon Resistor
R3, 100Ω Carbon Resistor

PROCEDURE:

Activity #1

1. Connect the circuit as shown in figure 1, have it checked and approved by the lecturer / technician.

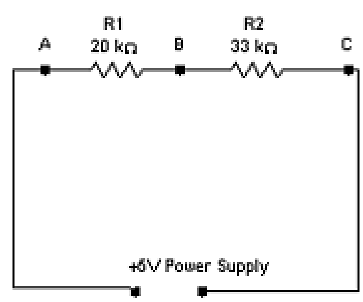

Figure 1

2. Open the circuit at point A and use the multimeter to measure the current. Record this value in table 1.

3. Repeat procedure in step 2 for points B and C.

4. Measure and record the voltage across each of the resistors R1 and R2 in Table. 1.

5. Measure and record the total voltage across R1 and R2 in Table 1.

6. Use the Ohmmeter to measure the total resistance of the circuit comprising R1 and R2 and record this value (**make sure the power is disconnected before performing this step.**)

7. What is the significance of disconnecting the power, as instructed in step 6?

____

____

<u>Results For Activity 1</u>

Table 1

	A	**B**	**C**
Current measured			
	R1	**R2**	**R1 & R2**
Voltage measured			
Resistance measured			

What can you say about the current at each point of the circuit?

____
____
____

Are the resistors connected in series or parallel? ____________________

Calculate the total resistance of R1 and R2 using the appropriate measured values of voltage and current.

____

____

____

____

Compare the measured value of the total resistance obtained with the calculated total resistance.

____

Activity #2

8. Connect the circuit as shown in figure 2, have it checked and approved by the lecturer / technician.

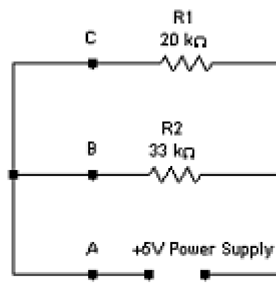

Figure 2

9. Open the circuit at point A and use the multimeter to measure the current. Record this value in table 2.

10. Repeat procedure in step 8 for points B and C.

11. Measure and record in Table 2 the voltage across each of the resistors R1 and R2.

12. Use the Ohmmeter to measure the total resistance of the circuit and record this value (**make sure the power is disconnected before performing this step.**).

RESULTS FOR ACTIVITY # 2

Table 2

	A	**B**	**C**
Current measured			
	R1	**R2**	**R1 & R2**
Voltage measured			
Resistance measured			

What can you conclude about the sum of the individual voltages with respect to the total voltage?

____
____
____
____

Using Ohm’s law and the appropriate measured values, calculate the total resistance of R1 and R2.

____
____
____
____
____
____

How does the measured value of total resistance compare with that you calculated?

____

____

UNIVERSITY OF TECHNOLOGY, JAMAICA
SCHOOL OF ENGINEERING

Experiment # 3 MEASURING POTENTIAL DIFFERENCE AND CURRENT IN SERIES-PARALLEL CIRCUITS

STUDENT NAME……………………… COURSE NO……………………
TEAMMATE…………………………… MARKS…………………………
LECTURER'S SIGNATURE…………... DATE……………………………

Objective: To analyse series-parallel connections of resistors in a circuit**.**

Apparatus:

Resistors, 1/4W, 1K, 3.3K, (2)-10K, (2)-5K (OHM)
Power supply 10V D.C.
Ammeter

Introduction:
In many electronic circuits, series-parallel connections are used so this experiment is designed to facilitate your understanding of these types of connection by analysis of the currents and voltages of the circuits.

<u>Circuit Diagram</u>

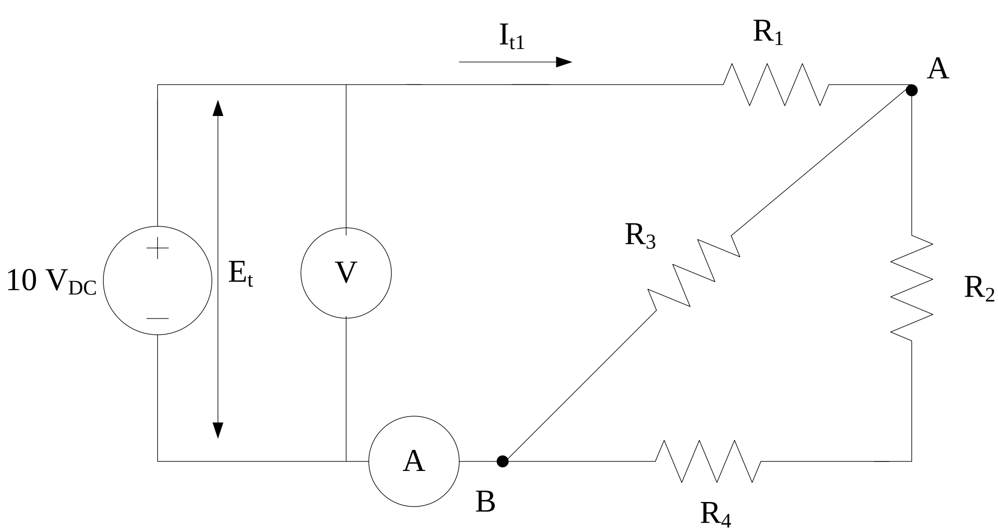

Fig. 1

Wire a circuit according to diagram of Fig. 1. Have the technologist or technician check and approve circuit connection before switching on the power supply.

3.1 Measure and record the voltage across the supply, E_t.

E_t = _______________

3.2 Calculate the total current I_{t1} in the circuit.

I_{t1} = ____________________

Measure the current I_{tl}

I_{t1} = _____________________

3.3 Change to the circuit in Fig. 2. (The AMMETER changes place)

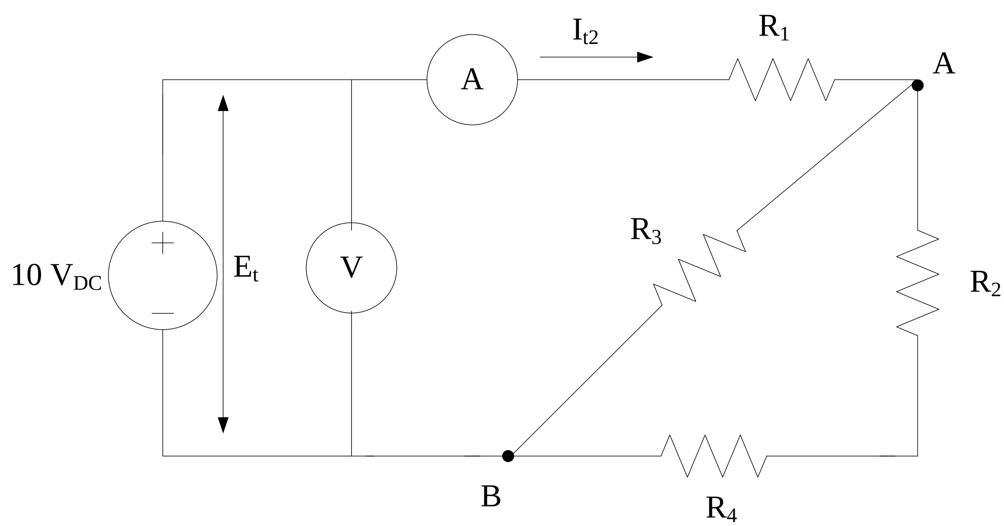

Figure 2

Measure I_{t2}

I_{t2} = _______________

If I_{t2} is equal to I_{t1} in section 3.2, explain why.

____

____

____

3.4 We shall now examine the effects of disconnecting a series resistor.

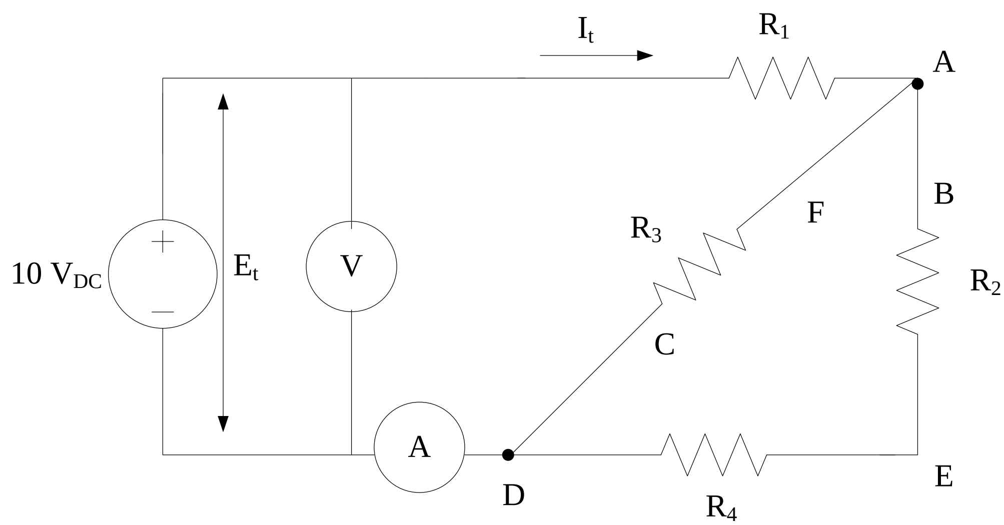

Figure 3

Disconnect R_1 at point A.
Draw below a single equivalent diagram of this circuit, leaving out any branch without current.

Calculate I_t I_{t3} = __________________________

Calculate E_t E_{t3} = ______________________________

Now measure I_t and E_t. I_{t3} = ____________ E_{t3} = ________________

3.5 Examination of the effects of disconnecting a parallel branch.

Refer to the circuit diagram of Fig. 3
Re-connect R1 at point A
Disconnect R2 at point B
Draw the equivalent circuit below:

Calculate I_t and E_t I_{t4} = ____________ E_{t4} = ____________

Measure I_t and E_t I_{t4} = ____________ E_{t4} = ____________

3.6 Change the circuit to the one in Fig.4 (AMMETER changes place)

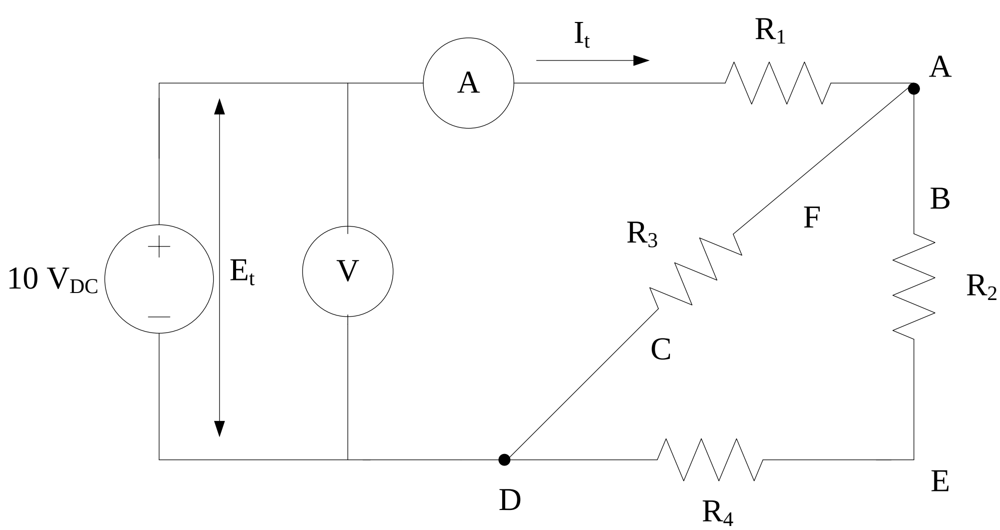

Figure 4

Now again disconnect R2 at point B and measure I_t and E_t

I_{t5} = ______________ E_{t5} = ______________

If I_{t5} equals I_{t4} (section 3.5), then explain why:

____

____

____

____

3.7 We shall examine the effects of disconnecting an alternative parallel branch.

Refer to fig. 3

Reconnect R2 at point B.

Disconnect R3 at point C

Draw below the equivalent circuit, leaving out all branches, without current flow.

Calculate I_t and E_t in this circuit:

I_{t6} = _________________ E_{t6} = _________________

Measure I_t and E_t

I_{t6} = _________________ E_{t6} = _________________

Explain possible discrepancies between your calculations and measurements.

____
____
____
____

3.8. We shall now examine the effects of short-circuiting one of the series resistors in the parallel branch.

Refer to fig. 3.

Reconnect R3 at point C.

Short circuit R4 by connecting a wire between points D and E.

Draw the equivalent circuit for this configuration below.

Calculate I_t and E_t

I_{t7} = _______________ E_{t7} = ___________________

Measure I_t and E_t

I_{t7} = _______________ E_{t7} = ______________

3.9 We shall now examine the effects of short-circuiting the single resistor parallel branch.

Refer to fig. 3

Remove the wire between points D and E.

Short-circuit R3 by connecting a wire between F and C.

Draw the equivalent circuit below leaving out any branch without current.

Calculate I_t and E_t

I_{t8} = ______________ E_{t8} = ______________

Measure I_t and E_t

I_{t8} = ______________ E_{t8} = ______________

UNIVERSITY OF TECHNOLOGY, JAMAICA
SCHOOL OF ENGINEERING

Experiment # 4 **CATHODE RAY OSCILLOSCOPE**

STUDENT NAME……………………… COURSE NO……………………
TEAMMATE…………………………… MARKS…………………………
LECTURER'S SIGNATURE…………... **DATE……………………………**

OBJECTIVES:

1) To use the oscilloscope to display a sinusoidal waveform.
2) To measure voltages, amplitudes and frequencies of a sinusoidal waveform using the oscilloscope.

APPARATUS

- Oscilloscope
- Signal Generator

PROCEDURES

Activity 1

a) Turn on the oscilloscope and adjust the necessary controls to establish a clear bright, horizontal line across the center of the screen.
b) Connect the signal generator to the vertical input (V or Y-input) of the oscilloscope and set the output of the generator to a 1000Hz waveform.
c) Set the volts/div setting of the oscilloscope to 1V/div and adjust the amplitude control of the signal generator to establish a 4V peak-to-peak sinusoidal waveform on the screen.
d) Set the time/div setting of the scope to 0.1ms/div (or 100µs/div). Observe the waveform and calculate the time period and frequency.
e) Change the time/div setting of the scope to 1ms/div. Observe the waveform and calculate the time period and the frequency.

Question 1: i) Did the frequency you calculated in parts (d) and (e) change significantly? ________________________

ii) What did you observe about the height and the width of one cycle of the sinusoidal waveform as the time/div setting changed from 0.1ms/div to 1ms/div? ____
____

____
____

Give reasons for your observations.? ______________________________________
____
____

Activity 2

a) Do not touch the controls of the signal generator but return the time /div setting of the scope 0.1ms/div.
b) Change the volts /div setting of the scope to 2V/div. Observe the waveform and calculate the peak-to-peak value of the sinusoidal waveform on the screen.

c) Change the volts/div setting of the scope to 0.5V/div. Observe the waveform and calculate the peak-to-peak value of the sinusoidal waveform on the screen.

Question 2: i) Did the voltage values you calculated in parts (b) and (c) change significantly? ______________________________________

ii) What did you observe about the height and the width of one cycle of the sinusoidal waveform as the volts/div setting changed from 2V/div to 0.5V/div? ______________________________________
____
____
____

Give reasons for your observations.? ______________________________________
____
____
____
____

Activity 3

a) Make all the necessary adjustments to clearly display a 5,000Hz 6V pp sinusoidal signal on the oscilloscope in the center of the screen.

b) Draw the waveform on figure 1, carefully noting the required number of horizontal and vertical divisions. Record your chosen volts/div and time/div settings.

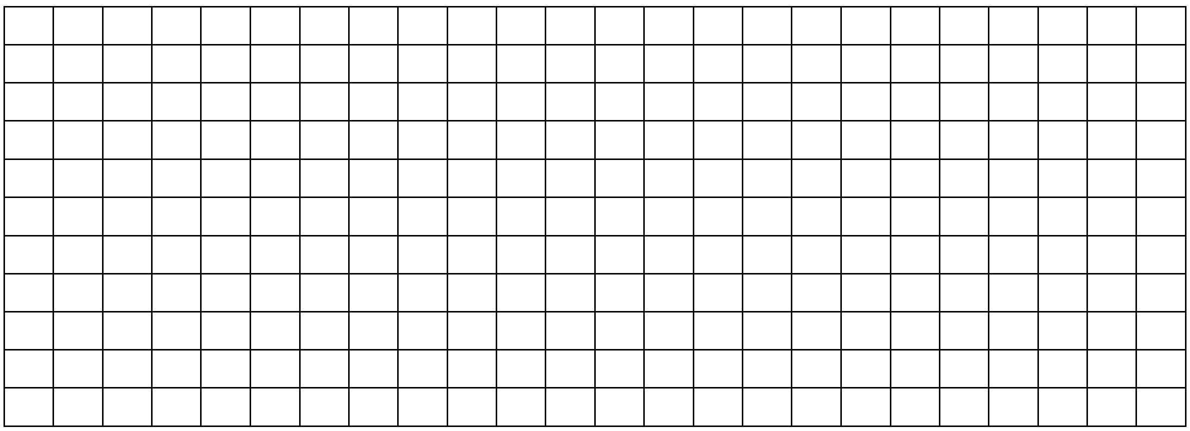

Fig. 1 - Graph for Waveform

Volts/div = _________

Time/div = _________

Calculations and Observations

UNIVERSITY OF TECHNOLOGY, JAMAICA

School of Engineering

LAB # 5: RC Time Constant

NAME:______________________

GROUP:____________________

OBJECTIVE To investigate the time constant of a RC circuit.

APPARATUS
Digital Multimeter (DMM)
Timer/Stop watch
R1 - 560KΩ Resistors
C1 - 33µF Capacitor
C2 - unknown Capacitor

Activity #1 : Charging a capacitor through a resistor

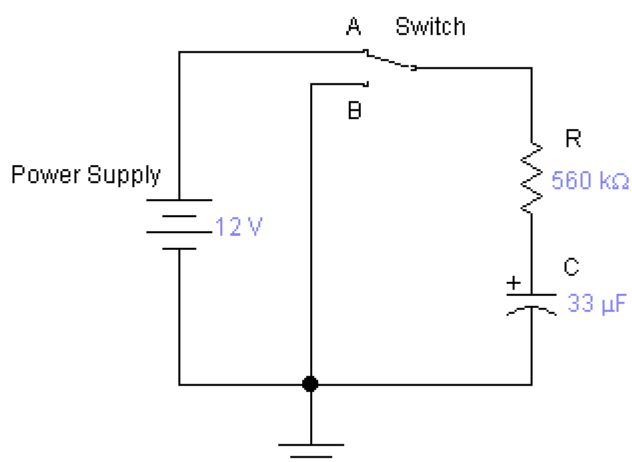

Figure 1.

1. Set up the circuit as shown in figure 1 with the switch in position A. (**NOTE THE POLARITY OF CAPACITOR SHOWN IN THE CIRCUIT. Energizing a circuit with the capacitor polarity wrongly connected in the circuit can result in explosion and personal injury.**)

Have your circuit checked and approved by the lecturer / technician before turning on the power supply!

2. Place a piece of wire across the capacitor and turn on the power supply. The wire across the capacitor keeps the capacitor voltage at zero.

   This step requires two persons, one to operate the stopwatch and one to take readings. The person with the stopwatch will tell the other when to take readings from the voltmeter, the other person should be watching the voltmeter to record the voltage at the instances when told by the person *with the timer*.

3. Set the stopwatch to 00:00. Simultaneously remove one end of the wire and start the stopwatch. Record the voltage at the time intervals shown in table 1. **Do not stop the timer until this process is completed.**

Time (s)	5	10	15	20	25	30	35	40	45	50
Voltage (V)										

Time (s)	55	60	65	70	75	80	85	90	95	100
Voltage (V)										

Table 1.

4. Use the values in table 1 to plot a neat graph of voltage versus time.

<u>Activity #2</u>: Discharging a capacitor through a resistor

1. With the switch still in position A, briefly place the piece of wire across the terminals of the resistor (**the wire will be removed in step 2**). This is done to make sure the capacitor is fully charged. At this point the voltage across the capacitor should be about 12V.

2. Reset the stopwatch. With the same two person partnership, remove the wire and then quickly place the switch in position B, start the stopwatch just about the same time the switch is being placed in position B (be sure the wire is removed before the switch makes contact in position B, otherwise this will distort the voltage readings you are about to take causing significant error in your results). Record the voltage across the capacitor at the time intervals in table 2.

Time (s)	5	10	15	20	25	30	35	40	45	50
Voltage (V)										

Time (s)	55	60	65	70	75	80	85	90	95	100
Voltage (V)										

Table 2

3. Use the values in table 2 to plot on the **same graph sheet**, the graph of voltage versus time.

Activity #3: Using the time constant to determine the value of an unknown capacitor.

1. Place the unknown capacitor in parallel with the one already in the circuit and repeat procedures of activity 2 and record your values in table 3. Use the values in table 3 to plot on the **same graph sheet**, the graph of voltage versus time.

Time (s)	5	10	15	20	25	30	35	40	45	50
Voltage (V)										

Time (s)	55	60	65	70	75	80	85	90	95	100
Voltage (V)										

Table 3

Questions

(Show all working)

1. Calculate the theoretical value of the time constant,τ for the circuit of figure 1. Given that $\tau = RC$.

___

___

___

2. The time constant τ is the time the RC circuit takes to **charge** to 63% of the supply voltage or to **discharge** to 37% of the supply voltage. Determine from both the charge and discharge graph the time constant of the circuit of figure 1.

63% of the supply voltage =___________ 37% of the supply voltage =___________

Time constant (charging), τ_c = ____________________________________

Time constant (discharging), τ_d = ____________________________________

Compare the theoretical and actual values of the time constant.

3. Examine the two discharging curves, which of the two has the larger time constant? Give reason/s for your answer.

4. Determine from the discharge curve of the paralleled capacitors RC circuit, the value of the unknown capacitor. **Show all working.**

5a. If a resistor was placed in series with the one in figure 1, how would this affect the time constant?

5b. Give reason/s.

UNIVERSITY OF TECHNOLOGY, JAMAICA
SCHOOL OF ENGINEERING - CEEC

Experiment #6: CHARACTERISTICS OF A SERIES RLC CIRCUIT

NAME: _________________________________

GROUP: _________________________________

ID: _______________

<u>Objective(s)</u>

1) To verify that the impedance Z of a series RLC circuit is $z = \sqrt{R^2 + (X_L - X_C)^2}$.

2) To determine how the impedance of a series RLC circuit varies with frequency.

<u>Apparatus</u>:

6.3 V 50Hz power supply
Digital Multi-meter
Audio frequency signal generator
Resistor: ½ W, 5000Ω
Capacitor: 0.1F, 0.05F
Switch: SPST
Inductor/choke: 8mH at 50mA

<u>Introduction</u>

In this experiment you will examine how the impedance of a series RLC circuit varies with frequency. At one particular frequency, referred to as **RESONANT FREQUENCY (F_R)**, it is known that the impedance of the circuit is a minimum value equal to the resistance of the circuit. Since the impedance is minimum then the current, I must be a maximum.

We know from the general impedance formula of $z = \sqrt{R^2 + (X_L - X_C)^2}$.

At resonance $X_L = X_C$; Z = R, hence $I = \frac{E}{Z} = \frac{E}{R}$.

Note that the current at resonance is limited only by the circuit's resistance, even though it still possesses inductance and capacitance. In the absence of a resistor, the limiting resistance will be equal to the inherent resistance of the inductor, capacitor and associated wiring. It is the latter resistance which limits the current in practical series resonant.

Voltage Amplification

The quality, Q, of a series resonant CL circuit is given by the formula: $Q = \frac{X_L}{R}$.

It should not be forgotten that at resonance, although the p.d. across the series capacitance – inductance combination is zero, the p.d. across each is in fact, a maximum. (It is because the two voltages are in opposite phase that their joint new voltage is zero.)

Now the voltage across L, $V_L = IX_L$, but at resonance $I = \frac{E}{X_L}$ and if we substitute, this is the formula we get:

$$V_L = \frac{E}{R} X_L$$

Recall $Q = \frac{X_L}{R}$, hence $V_L = QE$.

Frequency Response Characteristics

The graph of I versus F will look something like that shown in Fig.0.

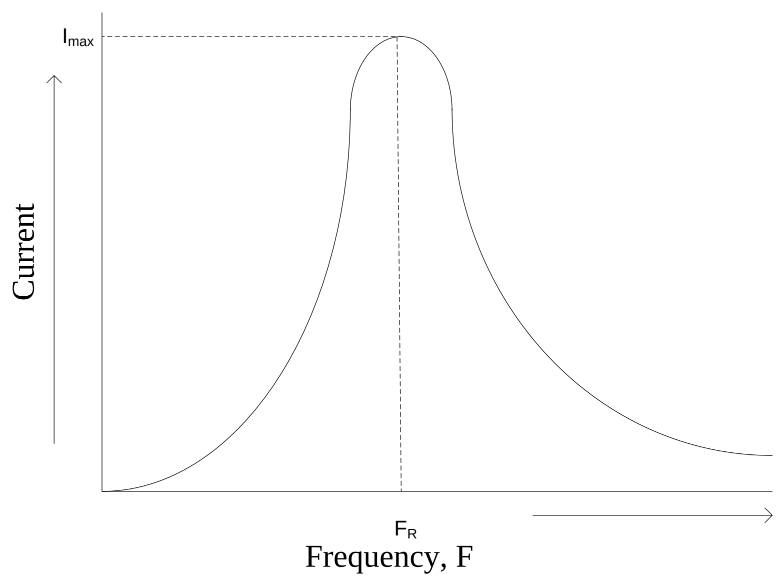

Fig. 0

Activity #1: Verification of $z = \sqrt{R^2 + (X_L - X_C)^2}$

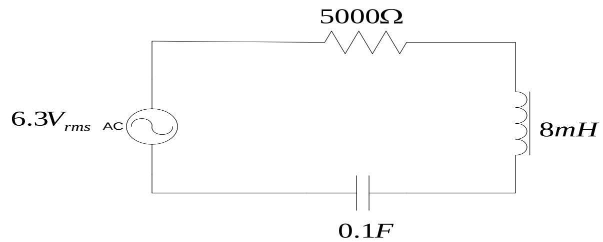

Fig. 1

1) Wire the circuit as shown in fig.1
2) Measure and record in **Table.1** the applied voltage, E, and the potential differences V_R, V_L and V_C across R, L and C respectively, using the voltmeter.

E/	V_R/	V_L/	V_C/

Table.1

3) From the measured values of V_R and from the rated value of R, compute the current I.

____

____

____

____

____

4) Compute the values the values X_L and X_C from the computed value I and from the measured values V_L and V_C.

____

____

____

____

____

____

____

____

5) Compute the impedance z of the RLC circuit in fig. 1 using the formula: $Z = \frac{E}{I}$

6) Compute and record Z using the formula: $z = \sqrt{R^2 + (X_L - X_C)^2}$; use the values of X_L and X_C from table. 2.

7) Compare the values obtained using the formula in parts 5 and 6.

Activity 2: Effect of Frequency on Impedance

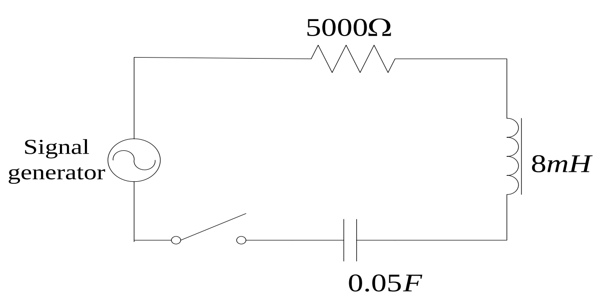

Fig. 2

1) Disconnect the power supply from the circuit in fig. 1 and connect the circuit as shown in fig. 2. GET YOUR CIRCUIT APPROVED.
2) Set the signal generator to about three quarters of the maximum voltage and a frequency of 150Hz.

3) Connect a voltmeter across R and an ***oscilloscope across the inductor, L and capacitor to measure V_{LC} (Voltage across L and C).***
4) Increase or decrease the frequency of the signal generator as required, until the voltage across, L and C is a minimum. At this point, the voltage across R should be at a maximum.
5) Note the frequency F_R at which there is a minimum V_{LN} and record this in **Table. 2.**
6) Measure and record in table 2 also, the applied voltage E, the voltage V_R, V_L, and V_C and V_{LC}. (use the oscilloscope to measure all voltages except $V_{R,}$ but remember that they are peak-to-peak values which you must convert to RMS values, before recording them in table 3;

   recall that $V_{rms} = \frac{V_P}{\sqrt{2}}$)
7) Compute and record the difference between V_L and V_C. Also compute and record the current I using $I = \frac{V_R}{R}$ and the impedance $Z = \frac{E}{I}$.
8) Decrease the frequency of the generator by 20Hz and record the new frequency, F_R. Set the output E of the generator at the same level as for F_R in the step #6 repeat the measurements and computations of steps 6 and 7 at the frequency FR – 20 and record in Table 2.

9) Repeat step #8 for each of the frequencies shown in table 2. Be certain that for each frequency, the output of the generator is kept at the same voltage level as in step #6.

Frequency/ Hz	Applied Voltage E/V_{P-P}	VR /V_{P-P}	V_L /V_{P-P}	V_C / V_{P-P}	V_{LC} / V_{P-P}	V_L - V_C / V_{P-P}	I/A	Z/Ω
F_R +100 =								
F_R + 80 =								
F_R + 60 =								
F_R +20 =								
F_R =								
F_R – 20 =								
F_R – 40 =								
F_R – 60 =								
F_R – 80 =								
F_R – 100 =								

Table 2

8) From the data in table 2 draw a graph of: **Z versus F**; **I versus F**.

Questions:

RESONANCE

1. State the condition for which the current I will be a maximum, and impedance z a minimum in circuit in fig. 2.

   ____

   ____

   ____

2. Compute the value of minimum current.

3. What is the value of minimum impedance?

4. How does the experimental value of Z in activity #1, part 5 compare with the formula value in part 6 of same activity? Explain any differences.

5. Refer to your data in table 2 and to the graph of Z versus F. Explain, in your own words the effect on Z of a change in F.

6. Refer to your data in table 2 and to the graph of I versus F. Explain, in your own words the effect on I of a change in F.

7. In fig. 2 what should be the effect on Z, if any, of interchanging L and c? Why?

8. In table 2, comment on the relationship, if any between the measured voltage V_{LC} and the voltage $V_L - V_C$, (or $V_C - V_L$), at any specific frequency. Explain any unexpected results.

9. Assume that the external resistor R, in circuit 2 is short-circuited. What will limit the value of current I when $X_L = X_C$.

UNIVERSITY OF TECHNOLOGY
<u>JAMAICA</u>

School of Engineering - CEEC

LAB # 7: RECTIFICATION AND SMOOTHING

NAME:______________________

GROUP:____________________

OBJECTIVE To investigate diode testing, rectification and smoothing circuits.

APPARATUS

Oscilloscope
Digital Multimeter (DMM)
Signal Generator
4 -Silicon Diodes, 1N4001
1- Germanium Diode
3.3KΩ Resistors
10μF Capacitor
100μF Capacitor

THEORY Most modern digital multimeter (DMM) can be used to determine the condition of the diode, that is, whether it is good or bad. They have a scale denoted by a diode symbol that will indicate the condition of the diode in the forward and reverse bias regions. If connected to establish a forward and reverse bias connection, the meter will display the forward bias threshold voltage while in the reverse bias condition, an “OL” or “1” may appear on the display to indicate the open circuit approximation. The threshold voltage for silicon is 0.7V while that for germanium is 0.3V.

Activity #1 Diode Test

1. Choose a silicon and germanium diode.

2. Using the connection shown in figure 4.1 check each diode using the diode testing scale on the DMM. Record your results in table 4.1.

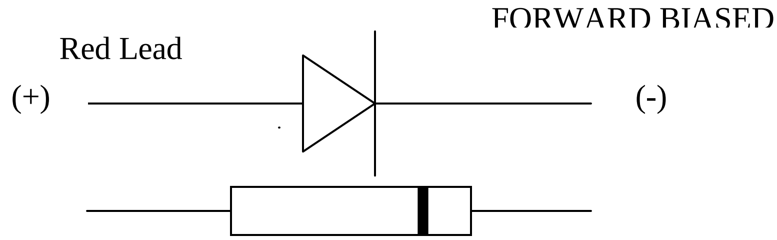

Figure 4.1

TEST	SILICON	GERMANIUM
FORWARD		
REVERSE		

Table 4.1

From the results you have obtained in 1. and 2., what can you say about the work condition of each diode?

____

<u>Activity #2</u> **Half-Wave Rectifier**

1. Construct the circuit of figure 4.1.
2. Obtain your input signal V_{in} from the output of the transformer provided.

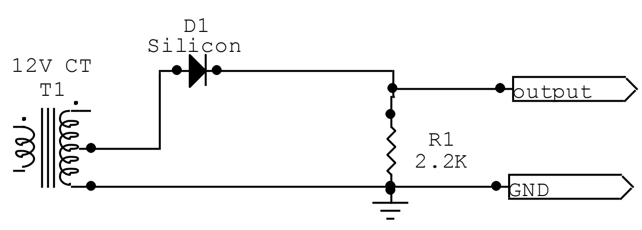

Figure 4.1

3. On the graphs of figure 4.2a and 4.2b sketch the input voltage, V_{in} and the output voltage V_{out} respectively. Use the dual trace feature on the oscilloscope if possible so that both waveforms can be viewed and accurately sketched in the same time interval. Also note the vertical and horizontal sensitivity.

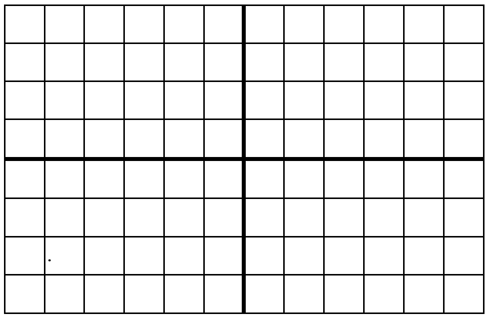

Figure 4.2a

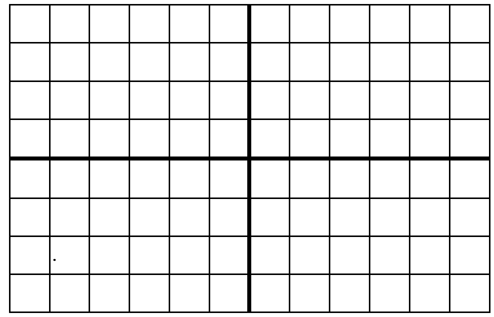

Figure 4.2b

Vertical sensitivity = __________

Horizontal sensitivity = ________

Vertical sensitivity = _________

Horizontal sensitivity = ________

Activity #3 Full - Wave Bridge Rectification And Smoothing.

4. Construct the circuit of figure 4.3. Obtain your input signal V_{in} from the output of the transformer provided.

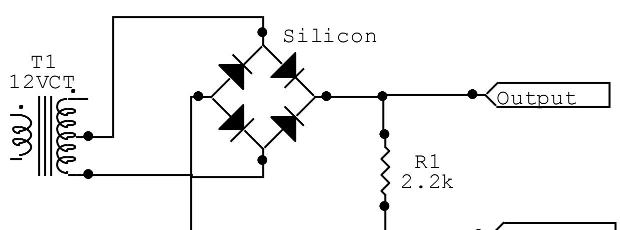

Figure 4.3

5. On the graphs of figure 4.4a and 4.4b sketch the input voltage, V_{in} and the output voltage V_{out} respectively. Also note the vertical and horizontal sensitivity.

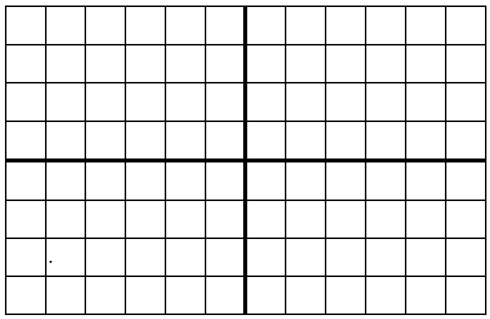

Figure 4.4a

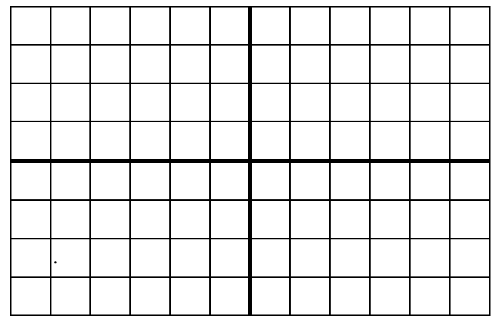

Figure 4.4b

Vertical sensitivity = __________

Horizontal sensitivity = ________

Vertical sensitivity = __________

Horizontal sensitivity = ________

3. Connect the given capacitor across the output, one at a time. Use the oscilloscope to observe the voltage at the output and make sketches on figure 4.4 to show the effect of each capacitor when it is placed in the circuit.

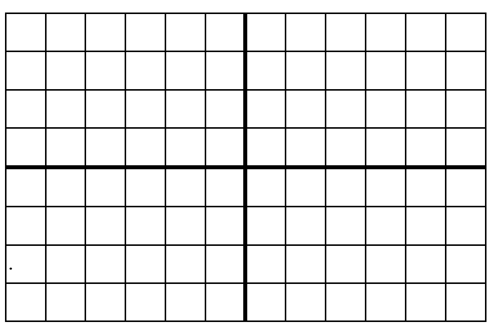

Figure 4.5a

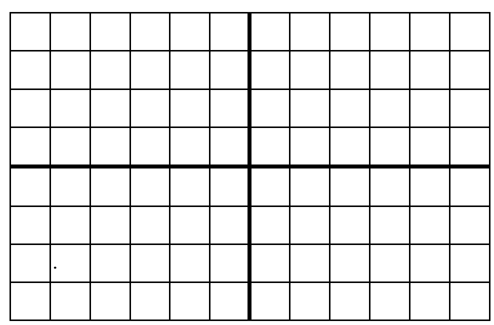

Figure 4.5b

Capacitor value = ____________

Vertical sensitivity = __________

Horizontal sensitivity = ________

Capacitor value = ___________

Vertical sensitivity = __________

Horizontal sensitivity = ________

Comment on the effect of the capacitors on the output.