**EET 1140**

**1. LAB NUMBER: 6**

**2. TITLE: Thevenin Equivalent Circuit Analysis**

**and Maximum Power Transfer Theorem**

**3. OBJECTIVES:**

After completing this lab, the student will be able to:

a. measure the Thevenin equivalent resistance Rth, b. measure the Thevenin equivalent voltage Eth,

c. verify the Thevenin’s theorem,

d. verify the Maximum Power Transfer theorem.

**4. EQUIPMENT:**

DC Power Supply: Uni PS-2303

Digital Multimeter: RIGOL DM 3058E

Experimenter board (C.A.D.E.T.) or a Breadboard

Multisim Software

**5. COMPONENTS:**

2 - 100 Ω ½ watt 5% Resistor

2 - 470 Ω ½ watt 5% Resistor

2 - 1k Ω ½ watt 5% Resistor

3 - 2k Ω ½ watt 5% Resistor

1 - 2.7k Ω ½ watt 5% Resistor

**6. TEXT REFERENCE:**

Circuit Analysis: Theory and Practice (5th Edition): A.H. Robbins and W.C. Miller

Section 2.6: Measuring Voltage and Current

Section 3.7: Measuring Resistance – the Ohmmeter

Section 9.2: Thevenin’s Theorem

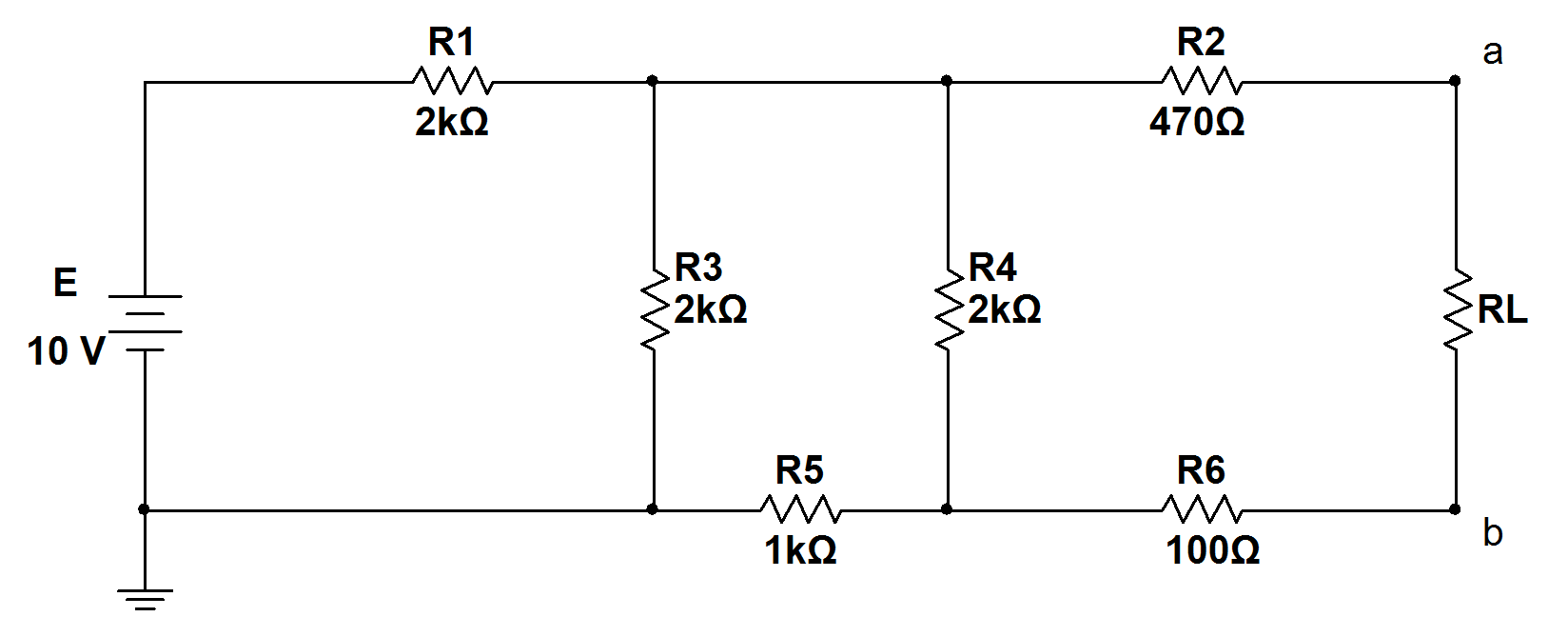
Section 9.4: Maximum Power Transfer Theorem

**7. PRE-LAB ASSIGNMENT:**

Study Fig. 1 and do the following calculations:

(Attach all your calculations at the end of your report as an Appendix)

Figure 1:



1. Redraw the circuit of Fig. 1 with the load RL removed. Replace the source E with a short circuit. Calculate the Thevenin equivalent resistance Rth as seen into the circuit from terminal (a-b). Record your result in Table 1.
2. Insert the source E in the circuit and calculate the Thevenin equivalent voltage Eth at the terminal (a-b) without the load RL. Record your result in Table 1.

Table 1:

Rth = kΩ

Eth = V

1. Draw the Thevenin equivalent circuit just derived with the load RL attached. Use it to calculate the load current IL for various load resistances as in Table 2. Calculate the corresponding Power dissipated in each load. Record your result in Table 2.

Table 2:

|  |  |
| --- | --- |
| IL (470) = mA | P (470) = mW |
| IL (1k) = mA | P (1k) = mW |
| IL (Rth) = mA | P (Rth) = mW |
| IL (2.7k) = mA | P (2.7k) = mW |

**8. MEASUREMENTS:**

**A – Measure Load Current with the Original Circuit:**

1. Locate the variable voltage source on the DC power supply and set its meter to measure voltage. Set its output voltage to 10V.
2. Build the circuit of Fig.1 and set the DMM to measure the load currents for various values of RL as in Table 3. Record your results in Table 3.

(Use available resistors in series to create Rth as calculated)

Table 3:

|  |
| --- |
| IL (470) = mA |
| IL (1k) = mA |
| IL (Rth) = mA |
| IL (2.7k) = mA |

**B – Measure Rth:**

1. Remove the source E. Connect the end of R1 to the junction of R3 and R5. Remove the load RL.
2. Set the DMM to read resistance (Ω). Measure the resistance between points “a” and “b”, it is Rth. Record your result in Table 4.

Table 4:

Rth = Ω

Eth = V

**C – Measure Eth:**

1. Remove the short between R1 and R3-R5. Reconnect the source E (10V).
2. Set the DMM to read voltage then measure the voltage between points “a” and “b”, it is Eth. Record your result in Table 4.
3. Compare Table 4 to Table 1.

**D – Measure Load currents with the Thevenin Equivalent Circuit:**

1. Remove the original circuit. Use available resistors and combine them in series to create a total resistance equal to Rth.
2. Set the variable source voltage to the value of Eth.
3. Connect the source to Rth and RL (start with 470Ω). Insert DMM to measure load currents for various load resistances. Record your results in Table 5.

Table 5:

|  |
| --- |
| IL (470) = mA |
| IL (1k) = mA |
| IL (Rth) = mA |
| IL (2.7k) = mA |

k) Compare the currents of Table 2, 3, and 5.

**E – Power calculations:**

l) From the current of Table 5, calculate the Power dissipated by the loads. Record your results in Table 6.

Table 6:

|  |
| --- |
| P (470) = mW |
| P (1k) = mW |
| P (Rth) = mW |
| P (2.7k) = mW |

m) Compare the results in Table 6 to those of Table 2.

**F – Multisim simulations:**

n) Create a Multisim circuit similar to Fig. 1 (original circuit) with:

1. One Voltmeter to measure Load voltage.

2. One Ammeter to measure load current with RL = 1kΩ.

**9. LAB REPORT REQUIREMENT:**

Your team’s Lab Report should contain the followings:

**A Cover Page** with Lab Number, Lab Title, Team members’ Names and Date.

**Result Pages** with:

**A – Measure Load Current with the Original Circuit:**

Results:

Show a copy of Table 3.

Discussions:

1. Compare the result in Table 3 for 1kΩ with that from Multisim.
2. Explain any differences.

**B – Measure Rth and Eth:**

Results:

Show a copy of Table 4.

Discussions:

1. Answer 8(g).
2. Explain any differences.

**C – Measure Load currents with the Thevenin Equivalent Circuit:**

Results:

Show a copy of Table 5.

Discussions:

1. Answer 8(k).
2. Explain any differences.

**D – Power calculations:**

Results:

Show a copy of Table 6.

Discussions:

1. Answer 8(m)
2. Explain any differences.
3. Which load resistance dissipates the largest power?

**E - Conclusion:** (*it helps to compare your prelab with measured results*)

1. What conclusion can you make about the accuracy of Thevenin’s equivalent circuit?
2. What conclusion can you make about the validity of the Maximum Power Transfer Theorem?
3. Are all the Lab objectives met? Explain if some are not.

**Appendix**: Attach a printout of **Multisim** simulation and all **Pre-Lab calculations**.

**Circuit Layout**

