

Electrical Circuits LAB #4 – Mesh-Current Method and Node-Voltage Method

Objectives

Understand and apply Mesh-Current Method and Node-Voltage Method to circuit analysis and fault detection.

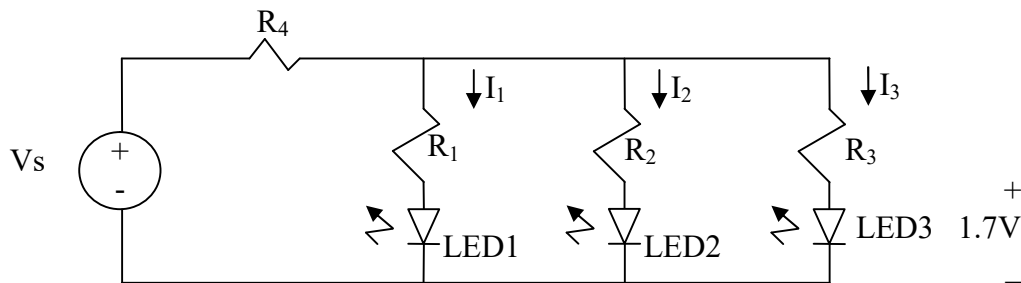
Preparation

Complete the following steps before starting to work on the experiments in this lab:

- 1) Complete Lab 3 and associated report
- 2) Read textbook, watch lecture videos, and complete homework in Chapter 4 “Mesh-Current Method and Node-Voltage”.

Experiment 1

- a) Select values of the components in the following circuit such that $I_1 = 2.5 \text{ mA}$, $I_2 = 5 \text{ mA}$ and $I_3 = 7.5 \text{ mA}$. You can model LEDs as independent voltage sources of 1.7 Volts in the forward direction.

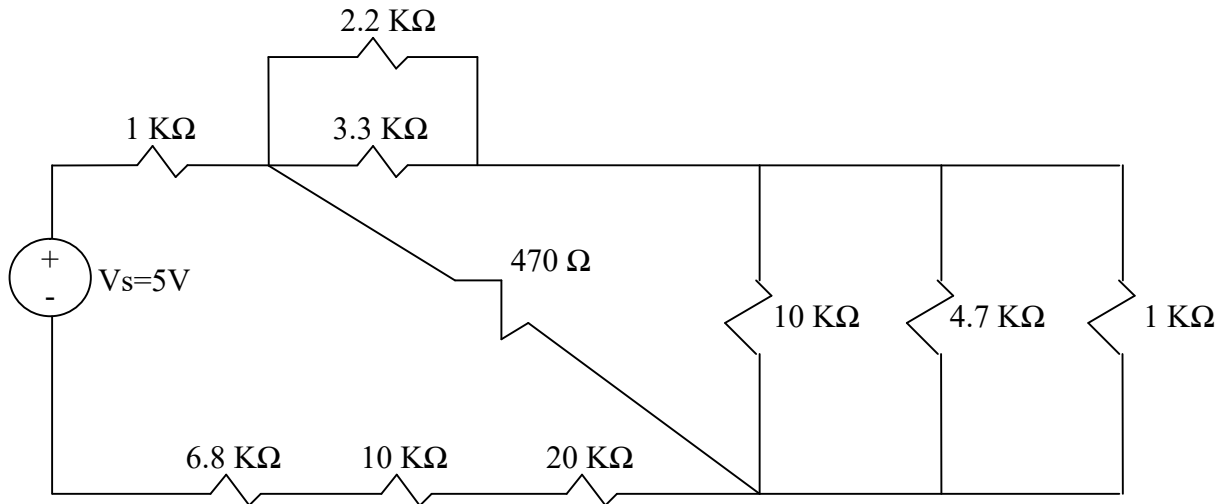


- b) Implement the circuit in LTspice with values calculated in section (a) and measure the actual value of I_1 , I_2 , I_3 .

Experiment 2

Electrical Circuits may fail due to design flaws, manufacturing issues, component failures or operational stresses. For example, a failure due to a single fault may occur when a single resistor is either shorted ($R=0$) or opened ($R=\infty$). Multiple faults can occur, when multiple failures occur at the same time. Typically, a single failure will cause stress on other components, resulting in multiple fault condition. For this experiment, only resistors can fail.

Answer the listed questions for the following circuit:



- Identify a single fault that would result in maximum supply current. Use LTspice to measure the value of maximum source current. Explain your reason for selecting the fault.
- Identify a single fault in this experiment's original circuit such that maximum current flows through the 4.7 kΩ resistor. Use LTspice to measure the resulting current. Explain your reason for selecting the fault.
- Identify a double-fault in this experiment's original circuit such that maximum current flows through the 4.7 kΩ resistor. Use LTspice to measure the resulting current. Explain your reason for selecting the fault.

Report Requirements

This lab and associated report must be completed individually. All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum:

For each experiment include:

- Clear problem statement in your words.
- Answer to any specific experiment questions (if any)
- Identify the theory or process and associated calculations
- Documents resulting circuit schematics from LTspice, simulation output and additional tables, timing diagram or chart required by the experiment.

For the whole report include:

- A Cover page with your name, class, lab and completion date.
- A Lessons Learned section which summarizes your learning from this lab in 5 sentences or more.
- A New Experiment section that has description of a new experiment and the experiment's results. Experiment should be related to material covered in class but not simply variation of the existing lab experiments.