

## 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.

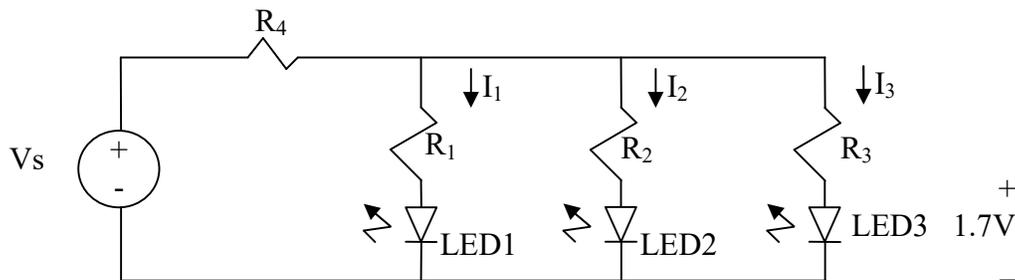
### Preparation

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.

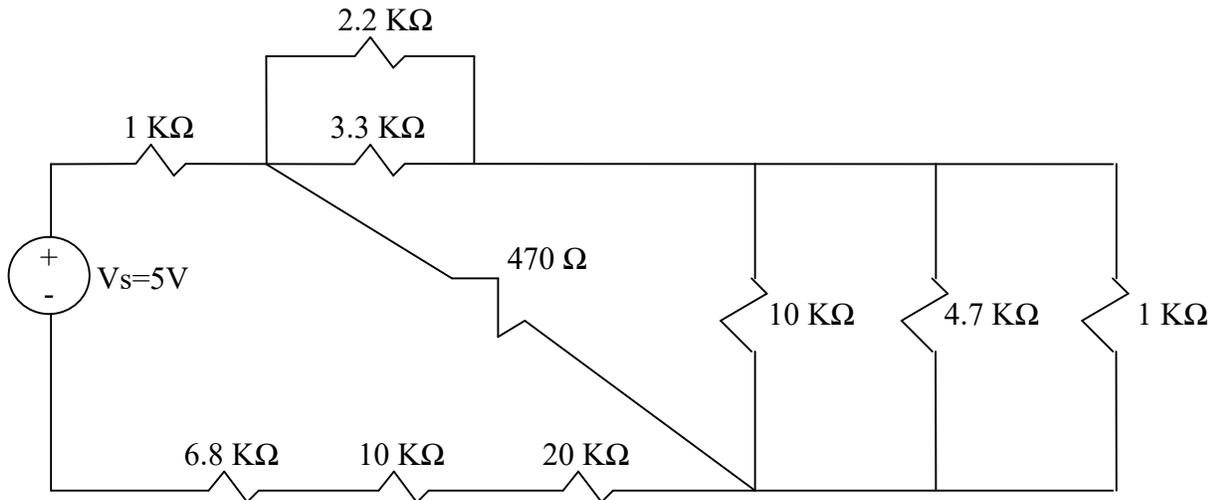


- b) Implement the circuit in LTspice with values calculated in section (a) and measure the actual value of  $I_1$ ,  $I_2$ ,  $I_3$ .

## 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  $4.7\text{ k}\Omega$  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  $4.7\text{ k}\Omega$  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.