

GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course ECE 2040
Circuit Analysis

Assigned: September 15, 2000

Due: September 22, 2000

Problem Set #4

Reading: Read the following sections from the class notes:

Chapter 2, Section 2.3

Chapter 3, Section 3.1

Reading: Read the following sections from Dorf and Svoboda:

Chapter 4, Section 4.6, 4.7, 4.8; (mesh method)

Problem 4.1:

Solve for the voltage $v(t)$ using the mesh method.

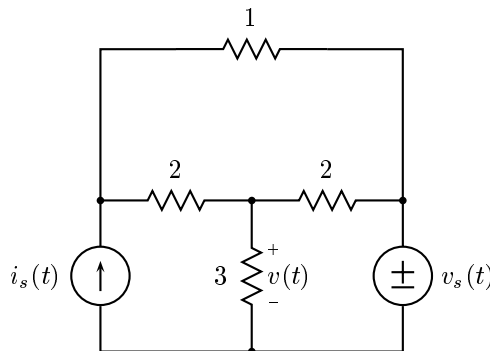


Figure 1: Circuit for Problem 5.1.

Problem 4.2: (a) Which method, the mesh method or the node method, will result in fewer equations to solve in order to determine $v(t)$ in the circuit in Figure 2?

(b) Determine $v(t)$ using the method that you selected in (a).

Problem 4.3: In our derivation of the mesh method, we stressed its duality with the node method, i.e., the similarity of the two methods if the roles of voltages and currents, and nodes and meshes are reversed. This problem lets you explore this issue further. Consider the network in Figure 3.

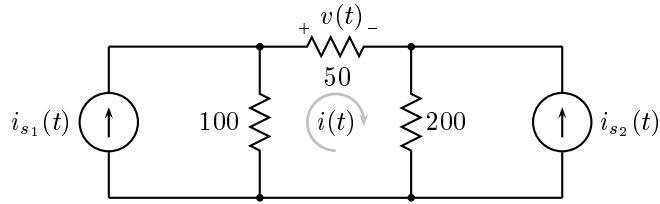


Figure 2: Circuit for Problem 4.2.

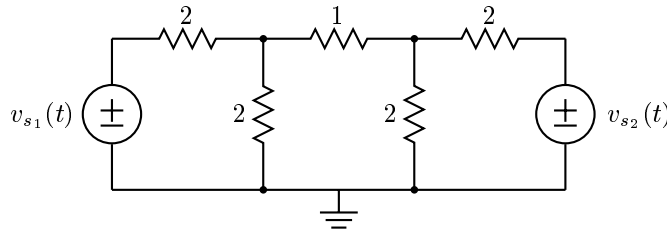


Figure 3: Circuit for Problem 4.3.

- (a) Use the node method to determine the set of equations that must be solved to find the equilibrium solution. Omit the ground node when writing your equations. Express these equations in the form

$$\mathbf{C}\mathbf{v}(t) = \mathbf{s}_1 v_{s_1}(t) + \mathbf{s}_2 v_{s_2}(t).$$

Here $\mathbf{v}(t)$ is a vector of node potentials, \mathbf{s}_1 and \mathbf{s}_2 are column vectors of constants, and \mathbf{C} is a constant matrix.

- (b) Now design a *different* network containing two *current* sources with currents $i_{s_1}(t)$ and $i_{s_2}(t)$, such that the set of *mesh* equations that need to be solved to find the equilibrium solution is

$$\mathbf{C}\mathbf{i}(t) = \mathbf{s}_1 i_{s_1}(t) + \mathbf{s}_2 i_{s_2}(t).$$

and $\mathbf{i}(t)$ is the vector of mesh currents.

- (c) Solve your equations from part (b).

Problem 4.4: Find the $v - i$ relation of the two-terminal network shown in Figure 4.

Problem 4.5: Show that the network in Figure 5 is equivalent to a single resistor and determine the value of the equivalent resistance, R_{eq} .

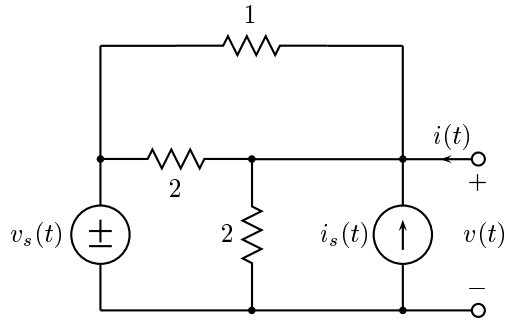


Figure 4: Two-port network for Problem 4.4.

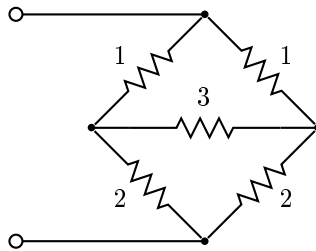


Figure 5: Network for Problem 4.5.