GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course EE 2250

Electric Circuit Analysis

Assigned: January 14, 1999

Due: January 21, 1999

Problem Set #2

Announcement: The first test will be held on Monday, January 25, 1999. The coverage will be that material and reading on Problem Sets 1 and 2. The test will be *closed book.*

Reading: Read the following sections from Dorf and Svoboda:
Chapter 4, Sections 4.3–4.8; (mesh and node methods)

Problem 2.1: This problem is concerned with the three networks shown in Figure 1.

(a) For the network in (a)

- (i.) Draw the basic network.
- (ii.) Identify the closed paths in the original network that correspond to meshes in the basic network.
- (iii.) Identify the closed surfaces in the original network that correspond to nodes in the basic network.

(b) Repeat for the network in (b).

(c) Repeat for the network in (c).

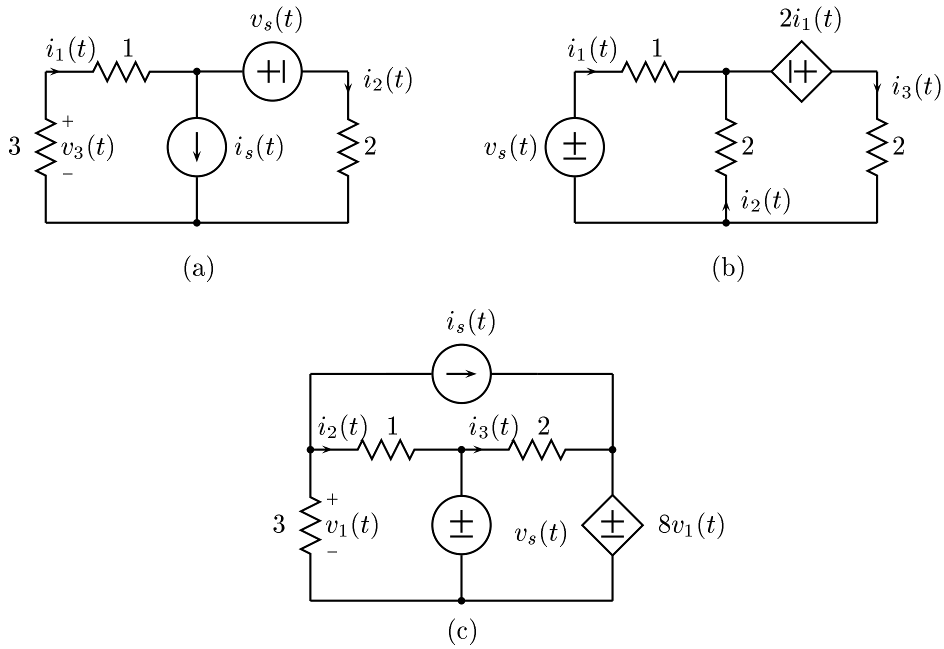

Figure 1:

Problem 2.2: Use the node method to write a set of equilibrium equations for the network of Figure 2. Use as variables the voltages $e_a(t)$, $e_b(t)$, and $e_c(t)$. Do not solve the set of equations.

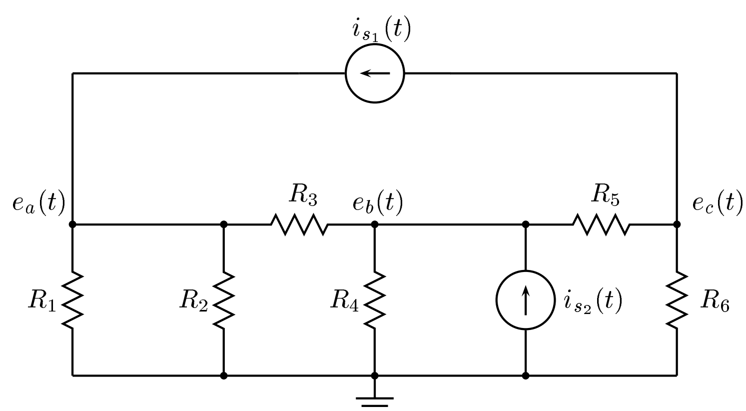

Figure 2: Circuit for Problem 2.2.

Problem 2.3: Determine the voltage at each connection point in the circuit in Figure 3 with respect to the indicated ground.

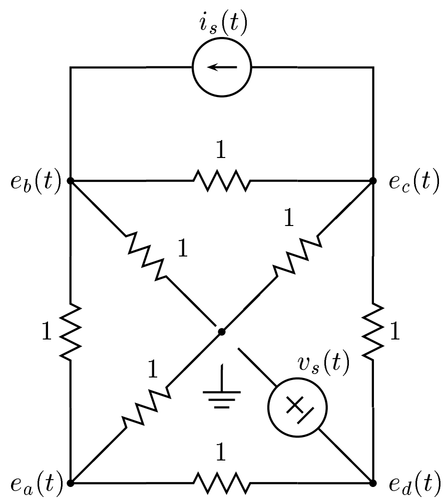

Figure 3: Circuit for Problem 2.3

Problem 2.4: Find all of the element voltages and currents in the circuit of Figure 4 using the mesh method. Be sure to identify the variables clearly.

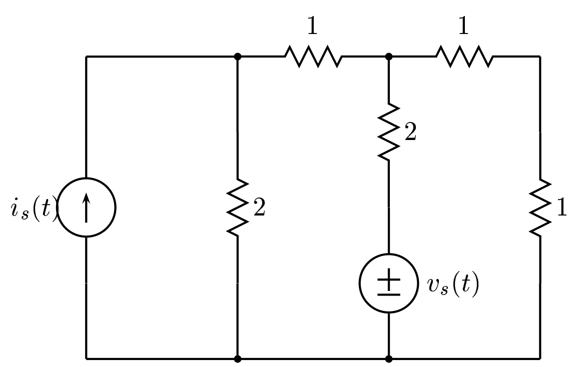

Figure 4: Circuit for Problem 2.4.

Problem 2.5: 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 5.

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

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

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

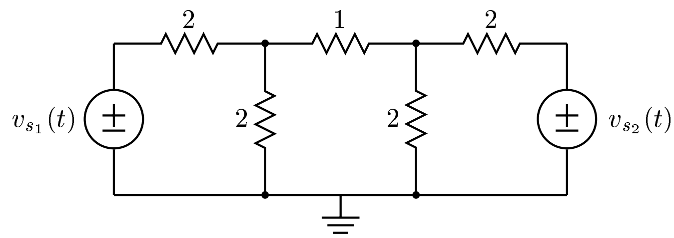

Figure 5: Circuit for Problem 5.

(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

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

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

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