GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

Course ECE 2040

Circuit Analysis

Assigned: March 17, 2000
Due: March 24, 2000

Problem Set #9

Reading: Read the following sections from the class notes:
Chapter 6, Section 6.4
Chapter 7, Sections 7.1–7.3
Reading: Read the following sections from Irwin and Wu:
Chapter 14, Section 14.4

Reminder: Quiz # 3 will be held on Monday, March 27, 2000 during the class hour. The class will be *closed book, closed notes,* but you are permitted to bring a calculator and one 8.5 inch × 11.0 in sheet of handwritten notes. Coverage will include material up to the lecture on March 17.

Problem 9.1: Find $v_{out}(t)$ for $t > 0$ when $v_{in}(t) = \cos(1000t)$ and $v_{out}(0) = 0$ for the circuit in Figure 1.

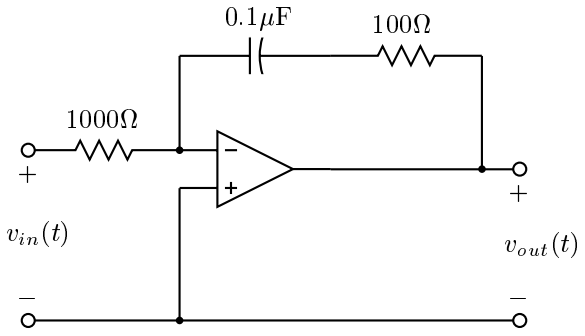

Figure 1: Circuit for Problem 9.1.

Problem 9.2: (a) For the circuit in Figure 2 determine the system function $H(s)$ that relates the output $i(t)$ to the input $i_s(t)$, i.e. find

$$H(s) = \frac{I(s)}{I_s(s)}$$

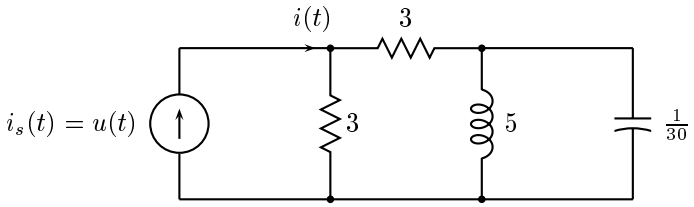

Figure 2: Circuit for Problem 9.2.

(b) Determine $i(t)$ for all values of t if $i_s(t) = u(t)$. Assume that the circuit is at initial rest for $t < 0$.

Problem 9.3: Find the system function $H(s) = V_{out}(s)/V_{in}(s)$ for the circuit in Figure 3.

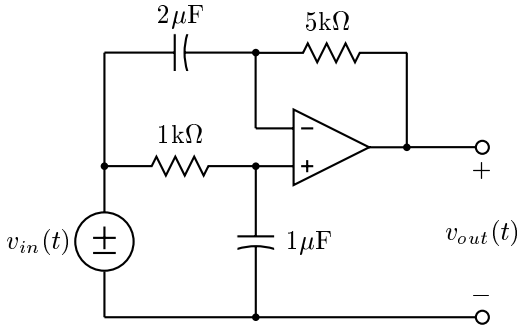

Figure 3: Circuit for Problem 9.3.

Problem 9.4: The network of Figure 4 is initially at rest. Determine the voltage $v(t)$ for each of the inputs below:

(a) $i_s(t) = u(t)$

(b) $i_s(t) = (\sin t)u(t)$

(c) $i_s(t) = tu(t)$

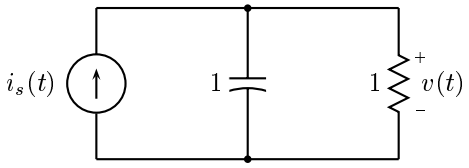

Figure 4: Circuit for Problem 9.4.

Problem 9.5: (a) For the circuit in Figure 5 determine the system function that relates $V_c(s)$ and $V_s(s)$.

(b) Find $v_c(t)$ for all time if the circuit is at initial rest and $v_s(t) = u(t)$.

(c) Find $v_c(t)$ for all time if the circuit is at initial rest and $v_s(t) = 2\delta(t)$.

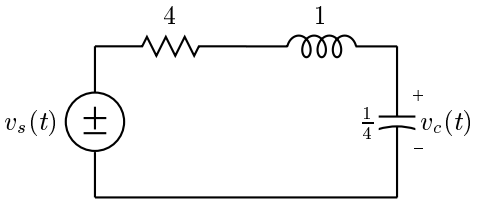

Figure 5: Circuit for Problem 9.5.

Problem 9.6: A parallel RC circuit is connected in series with an unknown circuit N excited by a current source as shown in Figure 6(a). The current source waveform is shown in Figure 6(b). The goal of the problem is to design the network N so that the voltage $v(t)$ will be that shown in Figure 6(c).

(a) Use Laplace transform methods to determine the voltage $v_2(t)$.

(b) Sketch $v_1(t)$ for $t \geq 0$.

(c) Determine the impedance $Z_1(s)$ of the circuit N.

(d) Determine the circuit N.

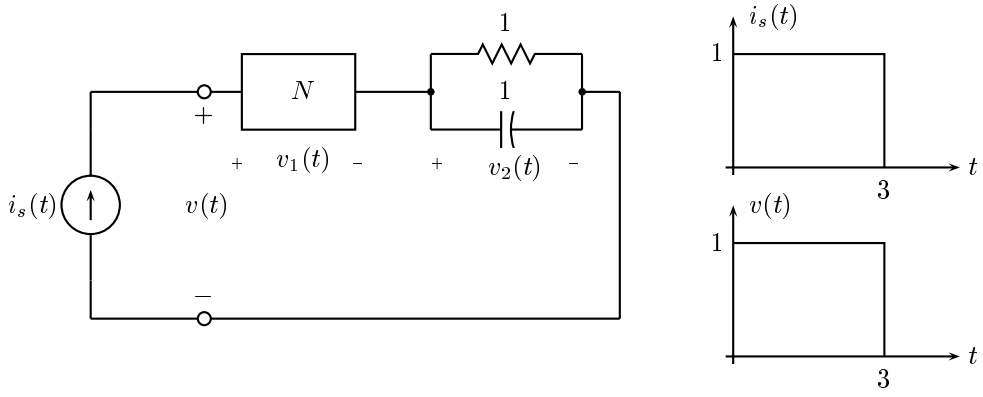

Figure 6: Circuit for Problem 9.6 with the current excitation and voltage response shown. The voltage $v_1(t)$ and the circuit N are to be determined.