

GEORGIA INSTITUTE OF TECHNOLOGY  
School of Electrical and Computer Engineering

Course ECE 2040

Circuit Analysis

Assigned: September 29, 2000

Due: October 6, 2000

## Problem Set #6

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**Reading:** Read the following sections from the class notes:

Chapter 4, Section 4.3

Chapter 5, Sections 5.1–5.5.1

**Reading:** Read the following sections from Dorf and Svoboda:

Chapter 6, Section 6.6; (opamp examples)

Chapter 14, Sections 14.3, 14.5, 14.12.

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**Announcement:** Quiz #2 will be held during the class hour on Friday, October 6, 2000. It will be a closed book test, although calculators are permitted. It will cover problem sets 3–5.

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### Problem 6.1:

- (a) Design a circuit with four inputs  $v_1(t)$ ,  $v_2(t)$ ,  $v_3(t)$  and  $v_4(t)$  containing a single operational amplifier, such that the output voltage  $v_{out}(t)$  satisfies

$$v_{out}(t) = k_5[k_1v_1(t) + k_2v_2(t) - k_3v_3(t) - k_4v_4(t)]$$

for positive values of the four constants. *Hint:* You might begin by designing a circuit that combines features of the differential amplifier configuration and the summing amplifier configuration.

- (b) Prove that your design in (a) works correctly.
- (c) State any additional constraints that need to be imposed on the five constants for the circuit to be buildable.

**Problem 6.2:** Express the output voltage  $v_{out}(t)$  in terms of the input voltage  $v_{in}(t)$  for the circuit in Figure 1.

**Problem 6.3:** Determine the Laplace transforms of the following time waveforms.

(a)  $x_a(t) = \begin{cases} 1, & 0 \leq t \leq T \\ 0, & \text{otherwise} \end{cases}$

(b)  $x_b(t) = t^2 e^{-3t}, \quad t > 0$

(c)  $x_c(t) = e^{-4t} \sin 5t, \quad t > 0$

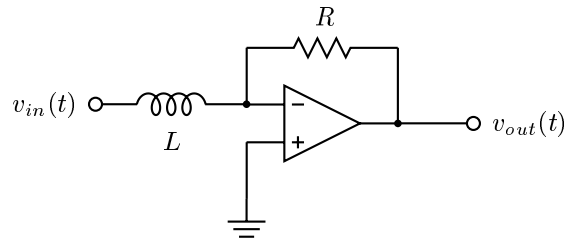


Figure 1: Circuit for Problem 6.2.

(d)  $x_d(t) = t, t > 0$

**Problem 6.4:** Find the inverse Laplace transform of

$$X(s) = \frac{2s + 6}{s(s^2 + 3s + 2)}.$$