

GEORGIA INSTITUTE OF TECHNOLOGY  
School of Electrical and Computer Engineering

Course ECE 2040  
Circuit Analysis

Assigned: February 18, 2000

Due: February 25, 2000

Problem Set #6

---

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

Chapter 4, Section 4.3

Chapter 5, Sections 5.3, 5.4, 5.5.1

**Reading:** Read the following sections from Irwin and Wu:

Chapter 3, Section 3.3 (operational amplifiers)

Chapter 13, Sections 13.1, 13.3, 13.4, 13.5 (Laplace transforms)

---

**Reminder:** Quiz #2 will be held in class on Friday, February 25, 2000. It will be a *closed book* test covering the material in class lectures 8–15. Calculators and one *handwritten* sheet of notes are permitted.

---

**Problem 6.1:** Express  $v_{out}(t)$  in terms of  $v_{in}(t)$  for the circuit in Figure 1.

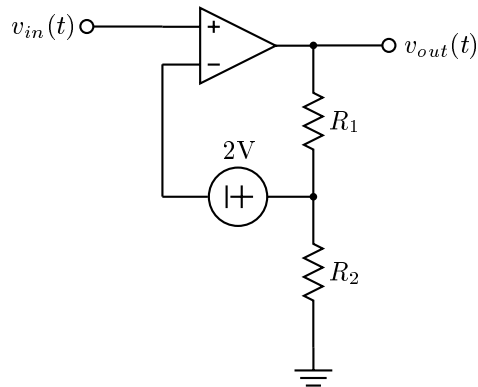


Figure 1: Circuit for Problem 6.1.

**Problem 6.2:** Find  $v_o(t)$  for the circuit in Figure 2 in terms of the input voltages  $v_a(t)$  and  $v_b(t)$ . The potentials at all of the terminals are measured with respect to a ground that is not shown.

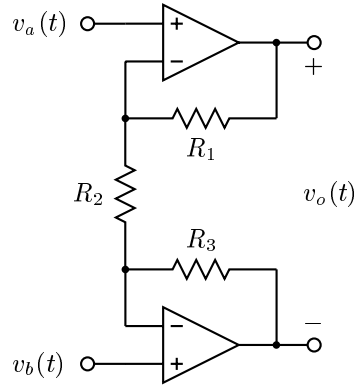


Figure 2: Circuit for Problem 6.2.

**Problem 6.3:** Design a circuit containing a single operational amplifier that will produce an output voltage,  $v_{out}(t)$  that is the derivative of the difference of two input voltages  $v_a(t)$  and  $v_b(t)$ . Verify that your circuit works.

**Problem 6.4:** 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)  $x_c(t) = e^{-4t} \sin 5t, \quad t > 0$
- (d)  $x_d(t) = t, \quad t > 0$

**Problem 6.5:** Find the inverse Laplace transform of

$$X(s) = \frac{2s^2 + 6s + 6}{s(s^2 + 5s + 6)}.$$