24-352 Dynamic Systems and Control: QUIZ - 4 April

Close book and notes. You have 45 minutes to complete the following questions.

NAME: _____ 4 April 2001

A. Operational Amplifier of Figure 1

Suppose you have the op amp circuit shown in figure 1. The impedance of element 1 is $Z_1(s)$ and the impedance of element 2 is $Z_2(s)$.

1. What assumptions do you use in analyzing the response of a circuit with an "ideal" op amp?
2. For this circuit, how is the Laplace transform of the output voltage related to the Laplace transform of the input voltage?
3. How would the output voltage, $e_o(t)$, be related to the input voltage, $e_i(t)$, if elements 1 and 2 had the properties described in the Table? (show your answer in the table).

B. Operational Amplifier of Figure 2

Consider the op amp circuit shown in Figure 2. How is the output voltage related to the input voltages $e_1(t)$ and $e_2(t)$?

Element 1	Element 2	$e_o(t)$
Resistor, R_1=1	Resistor, R_2=2	
Capacitor, C_1= 0.5	Resistor, R_2=2	
Inductor, L_1=2	Resistor, R_2=2	

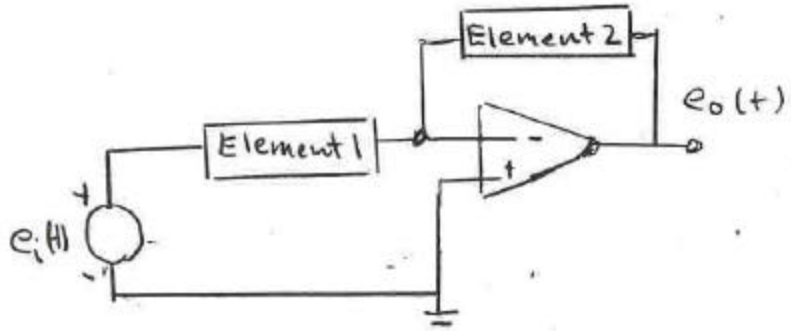


Figure 1

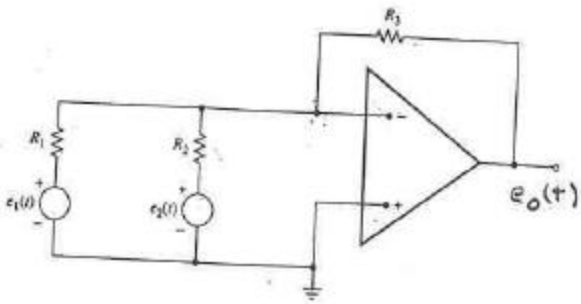


Figure 2

Total Points = 8

Solutions Quiz 4 April.

A

1. No current flow through the op-amp. ✓
(2) The voltage drop from the "+" to the "-" ✓
connections is zero.

2.

$$\frac{E_i(s)}{Z_1} = \frac{-E_o(s)}{Z_2} \Rightarrow E_o(s) = -\frac{Z_2}{Z_1} E_i(s) \quad \checkmark$$

(1)

3 Case #

1. $Z_1 = 1$, $Z_2 = 2 \Rightarrow E_o(s) = -2E_i \Rightarrow e_o(t) = -2e_i(t)$

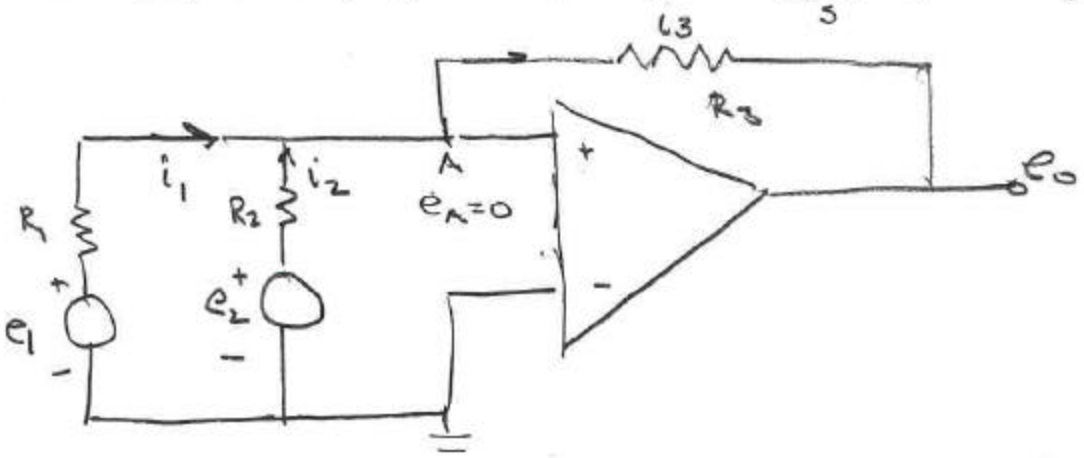
2. $Z_1 = \frac{1}{C_1 s} = \frac{2}{s}$, $Z_2 = 2 \Rightarrow E_o(s) = -\frac{2}{2/s} E_i(s) = -s E_i(s)$

(3)

$$\Rightarrow e_o(t) = -\frac{de_i(t)}{dt} \quad \checkmark$$

3 $Z_1 = 2s$, $Z_2 = 2 \Rightarrow E_o(s) = -\frac{E_i(s)}{s} \Rightarrow e_o(t) = -\int e_i(t)$ ✓

B.



(2)

$$i_1 + i_2 = i_3$$

$$\Rightarrow \frac{e_1}{R_1} + \frac{e_2}{R_2} = \frac{0 - e_o}{R_3} \Rightarrow e_o = -R_3\left(\frac{e_1}{R_1} + \frac{e_2}{R_2}\right)$$