EE-202
Exam I
February 8, 2012

Name: ________________________________
(Please print clearly)

Student ID: ________________

CIRCLE YOUR DIVISION

Section 2021, 7:30 MWF	Section 2022, 3:30 MWF
Prof. DeCarlo	Prof. DeCarlo

INSTRUCTIONS

There are 12 multiple choice worth 5 points each and
there is 1 workout problem worth 40 points.

This is a closed book, closed notes exam. No scrap paper or calculators are permitted. A transform table will be handed out separately as well as the property table.

Carefully mark your multiple choice answers on the scantron form. Work on multiple choice problems and marked answers in the test booklet will not be graded

Nothing is to be on the seat beside you. Scantrons are to be under exam.

When the exam ends, all writing is to stop. This is not negotiable.

No writing while turning in the exam/scantron or risk an F in the exam.

All students are expected to abide by the customary ethical standards of the university, i.e., your answers must reflect only your own knowledge and reasoning ability. As a reminder, at the very minimum, cheating will result in a zero on the exam and possibly an F in the course.

Communicating with any of your classmates, in any language, by any means, for any reason, at any time between the official start of the exam and the official end of the exam is grounds for immediate ejection from the exam site and loss of all credit for this exercise.

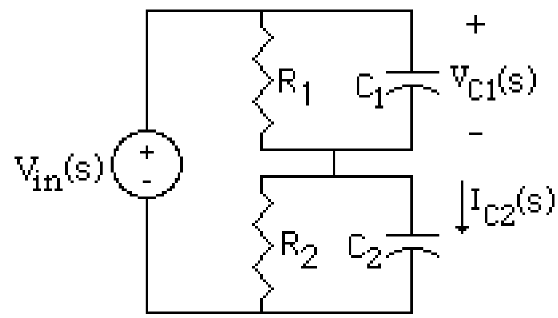
MULTIPLE CHOICE

1. Consider the figure below in which $R_1 = R_2 = 0.5\ \Omega$ and $C_1 = C_2 = 1$ F. $Z_{eq}(s) =$:

(1) $\dfrac{1}{(s+2)}$ **(2)** $\dfrac{2}{(s+0.5)}$ **(3)** $\dfrac{1}{(s+0.5)}$

(4) $\dfrac{2}{(s+2)}$ **(5)** $\dfrac{2}{(s+0.5)^2}$ **(6)** $\dfrac{2}{(s+2)^2}$

(7) $\dfrac{1}{(s+0.5)^2}$ (8) None of above



2. Reconsider the circuit of problem 1. Suppose $V_{in}(s) = \dfrac{16}{(s+2)(s+4)}$ and all initial capacitor voltages are ZERO. Then $i_{in}(t) =$ (in A):

(1) $8e^{-4t}u(t)$ **(2)** $4e^{-2t}u(t) - 4e^{-4t}u(t)$ **(3)** $16e^{-4t}u(t)$

(4) $4e^{-2t}u(t)$ **(5)** $8e^{-4t}u(t) + 16te^{-2t}u(t)$

(6) $8e^{-4t}u(t) + 16te^{-2t}u(t) - 8e^{-2t}u(t)$

(7) $8e^{-2t}u(t) - 8e^{-4t}u(t)$ (**8**) None of above

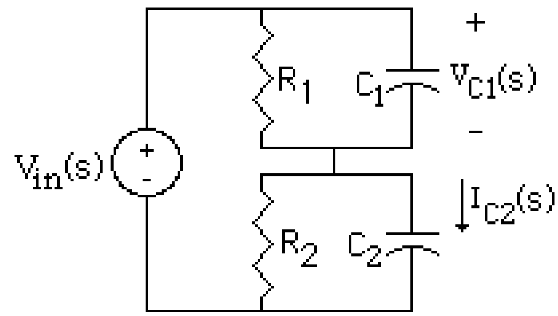
3. Again, reconsider the circuit of problem 1 in which $R_1 = R_2 = 0.5\ \Omega$ and $C_1 = C_2 = 1$ F. . Suppose $V_{in}(s) = \dfrac{16}{(s+2)(s+4)}$ and all initial capacitor voltages are ZERO. Then $v_{C1}(t) =$ (in V):

(1) $4e^{-2t}u(t)$ **(2)** $8e^{-4t}u(t) + 16te^{-2t}u(t)$ **(3)** $16e^{-4t}u(t)$

(4) $8e^{-4t}u(t)$ **(5)** $4e^{-2t}u(t) - 4e^{-4t}u(t)$

(6) $8e^{-4t}u(t) + 16te^{-2t}u(t) - 8e^{-2t}u(t)$

(7) $8e^{-2t}u(t) - 8e^{-4t}u(t)$ **(8)** None of above



4. Again, reconsider the circuit of problem 1. Suppose $v_{in}(t) = 0$, $v_{C1}(0^-) = 10$ V, and $v_{C2}(0^-) = 0$. Then $i_{C2}(t) =$ (in A):

(1) $e^{-2t}u(t)$ **(2)** $4e^{-2t}u(t) - 4e^{-4t}u(t)$ **(3)** $-5\delta(t) + 10e^{-2t}u(t)$

(4) $4e^{-2t}u(t) + 4e^{-4t}u(t)$ **(5)** $10e^{-2t}u(t)$ **(6)** $16e^{-4t}u(t)$

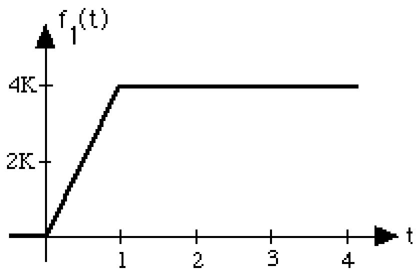
(7) $-5\delta(t)$ **(8)** None of above

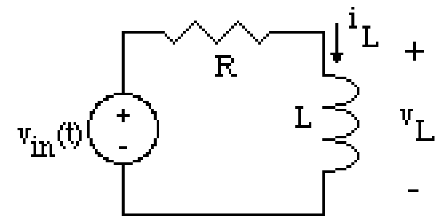
5. Consider the figure below in which $R = 10\ \Omega$, $L = 0.1$ H, and $i_L(0^-) = 0$. Suppose $v_{in}(t) = f_1(t)$ with $K = 25 \Rightarrow 4K = 100$ excites the given RL circuit. Then the value of $V_L(s)$ at $s = 100$ is:

(1) $\dfrac{1}{20}$ **(2)** $\dfrac{1}{200}$ **(3)** $\dfrac{1-e^{-100}}{20}$

(4) $\dfrac{1-e^{-100}}{200}$ **(5)** $\dfrac{1-e^{-100}}{100}$ **(6)** $\dfrac{1-e^{-1}}{20}$

(7) $\dfrac{1-e^{-1}}{100}$ **(8)** $\dfrac{1-e^{-1}}{200}$ **(9)** None of above





6. Reconsider the circuit of problem 5 in which $R = 10\ \Omega$, $L = 0.1$ H, $i_L(0^-) = 4$ A, and $v_{in}(t) = 0$. Then $i_L(t) =$ (in V):

(1) $0.4e^{-100t}u(t)$ **(2)** $4e^{-100t}u(t)$ **(3)** $4e^{-10t}u(t)$

(4) $-0.4e^{-100t}u(t)$ **(5)** $-4e^{-10t}u(t)$ **(6)** $-4e^{-100t}u(t)$

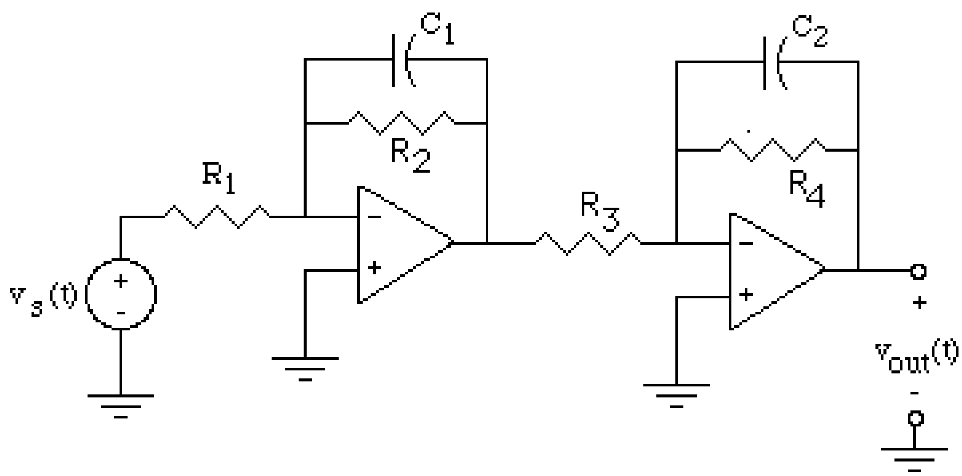
(7) $0.4e^{-10t}u(t)$ **(8)** $-0.4e^{-10t}u(t)$ **(9)** None of above

7. Suppose the transfer function of the op amp circuit below is $H(s) = \dfrac{V_{out}(s)}{V_s(s)} = \dfrac{18}{(s+3)^2}$. Then the step response of the circuit is:

(1) $18te^{-3t}u(t)$ (2) $2u(t) - 6te^{-3t}u(t)$ (3) $2u(t) - 2e^{-3t}u(t)$

(4) $6u(t) + 18e^{-3t}u(t) - 6te^{-3t}u(t)$ (5) $2u(t) - 2e^{-3t}u(t) - 6te^{-3t}u(t)$

(6) $6u(t) - 18e^{-3t}u(t) - 6te^{-3t}u(t)$ (7) none of above



8. Referring again to the op amp circuit of problem 7. Suppose the transfer function is as given in problem 7 and suppose $G_1 = \dfrac{1}{R_1} = 4.5$ S, $G_3 = \dfrac{1}{R_3} = 2$ S, $C_1 = 1$ F, and $C_2 = 0.5$ F. Then G_2 and G_4 (in S) respectively equal:

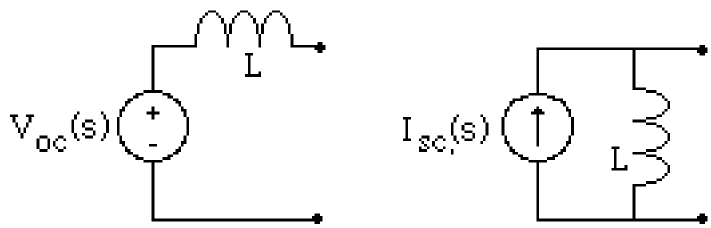
(1) 6, 3 (2) 3, 6 (3) 3, 3 (4) 3, 1.5

(5) 1.5, 3 (6) two of above (7) none of above

9. The circuit below on the left is to undergo a source transformation to become equivalent to the circuit on the right. $V_{oc}(s) = \dfrac{12s}{s^2+36}$ and $L = 0.5$ H. For the two circuits to be source transformations of each other $i_{sc}(t) =$ (in A):

(1) $4\cos(6t)u(t)$ (2) $24\sin(6t)u(t)$ (3) $6\sin(6t)u(t)$ (4) $2\sin(6t)u(t)$

(5) $12\cos(6t)u(t)$ (6) $24\cos(6t)u(t)$ (7) $4\sin(6t)u(t)$ (8) none of above

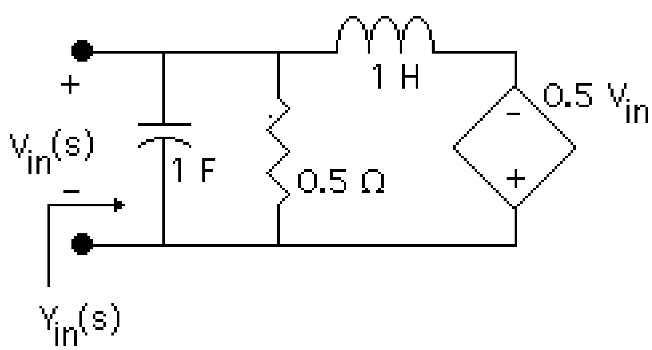


10. The Thevenin equivalent resistance seen at the terminals of the circuit below is $Z_{th}(s) =$:

(1) $\dfrac{s^2+0.5s+0.5}{s}$ **(2)** $\dfrac{s^2+2s+0.5}{s}$ **(3)** $\dfrac{s^2+2s+1.5}{s}$

(4) $\dfrac{s}{s^2+2s+0.5}$ **(5)** $\dfrac{s}{s^2+0.5s+0.5}$ **(6)** $\dfrac{s}{s^2+2s+1.5}$

(7) $\dfrac{s}{s^2+0.5s+1.5}$ (8) None of above



11. Considering the circuit below, having zero initial conditions, with the indicated labels and loop currents, which of the following equations are valid loop equations?

(1) $(L_1 s + R)I_1 - L_1 s + V_d = V_{in}$

(2) $-L_1 s I_1 + \left[(L_1 + L_2)s + \frac{C}{s}\right] I_2 - V_d = 0$

(3) $I_1 + (s-1)I_2 = 0$

(4) $L_1 s I_1 + \left[(L_1 + L_2)s + \frac{1}{Cs}\right] I_2 - V_d = 0$

(5) $(L_1 s + R)I_1 - L_1 s + V_d = -V_{in}$

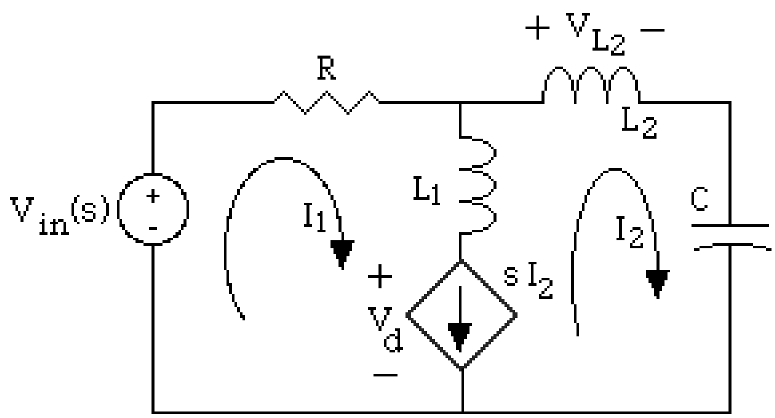
(6) $I_1 + (s+1)I_2 = 0$

(7) $I_1 - (s+1)I_2 = 0$

(8) (5) and (4) and (3)

(9) (5) and (2) and (3)

(10) (1) and (7)

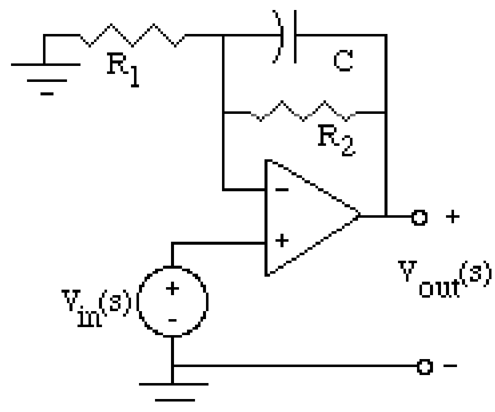


12. In the circuit below, suppose $C = 0.1\ \text{F}$, $R_2 = 10\ \Omega$, and $R_1 = 5\ \Omega$. The transfer function of the op amp circuit below is:

(1) $\dfrac{s+2}{s+3}$ **(2)** $\dfrac{s+2}{s+1}$ **(3)** $\dfrac{s+1}{s+2}$

(4) $\dfrac{s+3}{s+2}$ **(5)** $\dfrac{s+1}{s+3}$ **(6)** $\dfrac{s+3}{s+1}$

(7) $\dfrac{s+1}{s+4}$ (8) None of above



Workout problem. (40 pts) Consider the circuit below. You are to write a set of nodal equations, put in matrix form, and compute the various responses via Crammer's rule as indicated in the steps below.

(a) Assume $v_{C2}(0^-) \neq 0$. Assume all other initial conditions are ZERO. Draw the equivalent circuit in the s-domain accounting for $v_{C2}(0^-) \neq 0$.
(b) Write a set of 3 (modified) nodal equations in the variables $V_{C1}(s)$, $V_{C2}(s)$, and I_L, and the literal parameter values C_1, R_1, C_2, K_1, etc. After writing the three nodal equations, put in matrix form.
(c) Now suppose $K_1 = -19$, $K_2 = 2$, $K_3 = -1$, $C_1 = 2$ F, $C_2 = 0.5$ F, $R_1 = 10\ \Omega$, and $L = 1$ H. Further suppose that $I_{in}(s) = \dfrac{2s}{s+10}$ and $v_{C2}(0^-) = 4$ V. Rewrite the matrix equations of step (b) in matrix form using the given numbers.
(d) Solve the equations for the ZERO-STATE response assuming the response is $V_{C2}(s)$. Then find $v_{C2,zero-state}(t)$.
(e) Solve the equations for the ZERO-INPUT response, again assuming the response is $V_{C2}(s)$. Then find $v_{C2,zero-input}(t)$.
(f) (2 pts) What is the complete response?
(g) (2 pts) If the input is multiplied by 2, what happens to the ZERO-STATE response.