ECSE 2010
Electric Circuits
Exam 2
Spring 2006

Name _____

Section (please circle one)

| MR | MR | MR |
|---|---|---|
| 10-12 | 2-4 | 4-6 |
| Millard | Salama | Kraft |

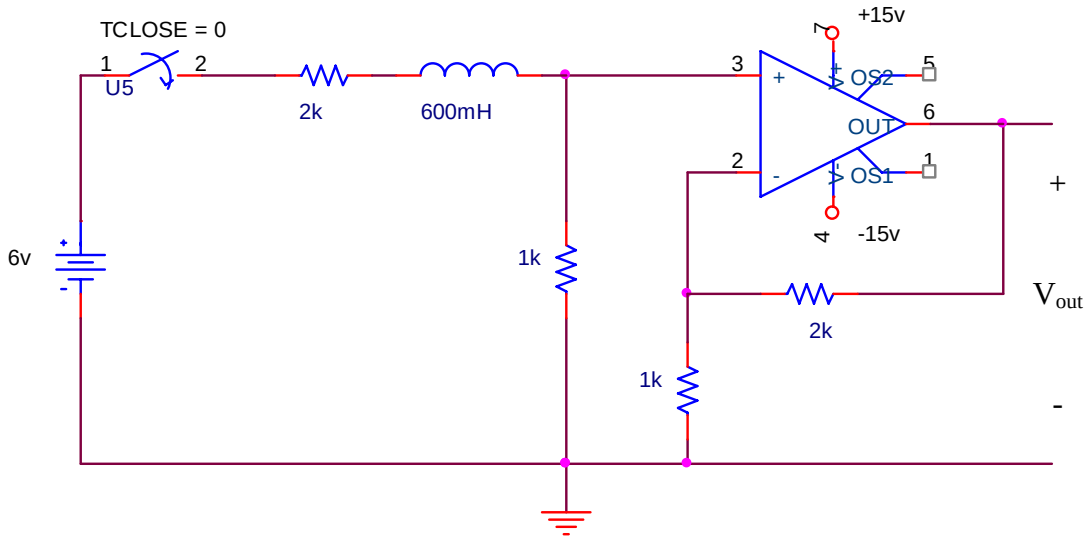
Please Note:

- Place all your answers in the spaces provided.
- You MUST show your work to receive any credit.
- Assume all resistances are in ohms, if not otherwise indicated.

| Problem No. | Pts. | Score |
|---|---|---|
| 1 | 20pts | |
| 2 | 20pts | |
| 3 | 20pts | |
| 4 | 20pts | |
| 5 | 20pts | |
| Total | 100pts | |

Problem 1 (20pts) Name _____

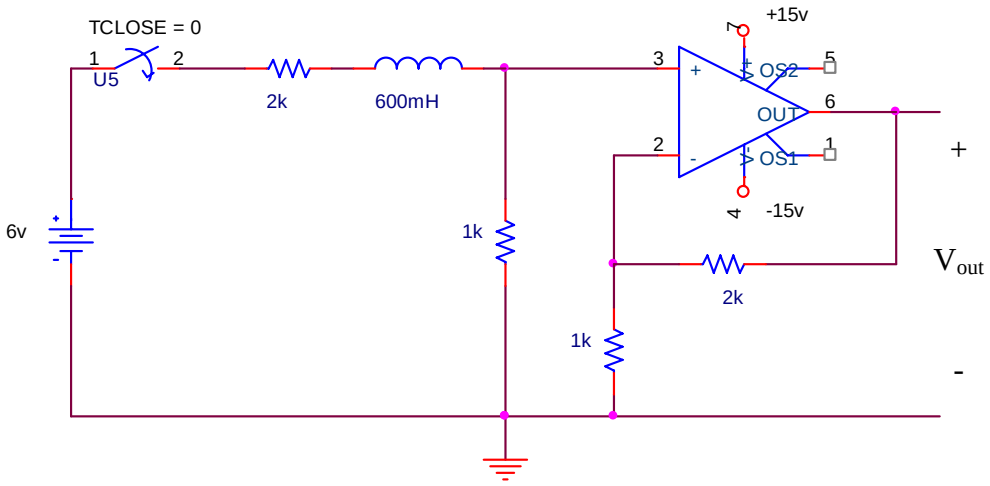
a) Find the differential equation for $V_{out}(t)$ for the circuit shown below. (assume that the op-amp has the correct supplies).




| $V_{out}(t)$ | |
|---|---|

Problem 1 (cont) Name _____

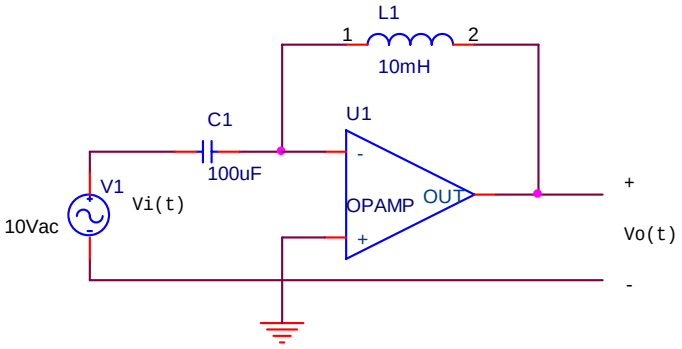
b) Sketch the $V_{out}(t)$ for the circuit shown below including all pertinent values (e.g time constants, etc.).




$V_{out}(t)$

Problem 2 (20pts) Name _____

a) For the circuit, find the differential equation relating $i_c(t)$ (the current in the capacitor) to $v_i(t)$ and the differential equation relating $i_L(t)$ (the current in the inductor) to $v_o(t)$. (assume that the op-amp has the correct supplies).




| | |
|---|---|
| $i_C(t)$ | |
| $i_L(t)$ | |

Problem 2 (cont) Name _____

b) Find an expression for $v_o(t)$ in terms of $v_i(t)$ for the circuit shown in part a.

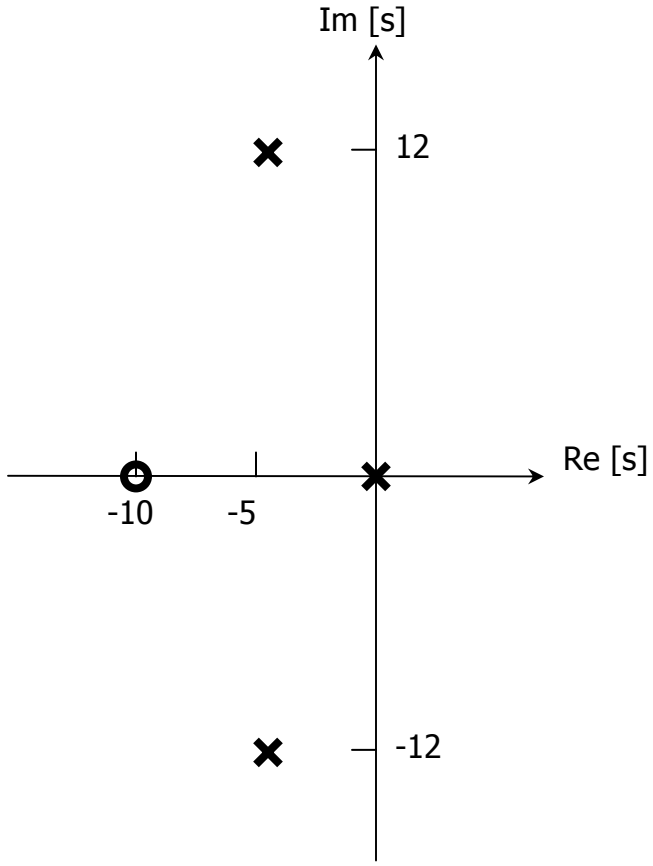
| | |
|---|---|
| $v_o(t)$ | |

c) What is $v_{out}(t)$ if the input is: $v_i(t) = 10\cos(1000t)$?

| | |
|---|---|
| $v_o(t)$ | |

Problem 3 (20pts) Name _____

a) The output Y(s) of a circuit is the product of the input X(s) and the network function H(s). The Y(s) for a circuit has the following pole/zero diagram. Find Y(s) as a ratio of polynomials in s. (Ignore any scaling or gain values.)




| | |
|---|---|
| Y(s) | |

Problem 3 (cont) Name _____

b) If Y(s) is the output when X(s) results from a unit step function 1u(t), classify the circuit's damping (please support your response):

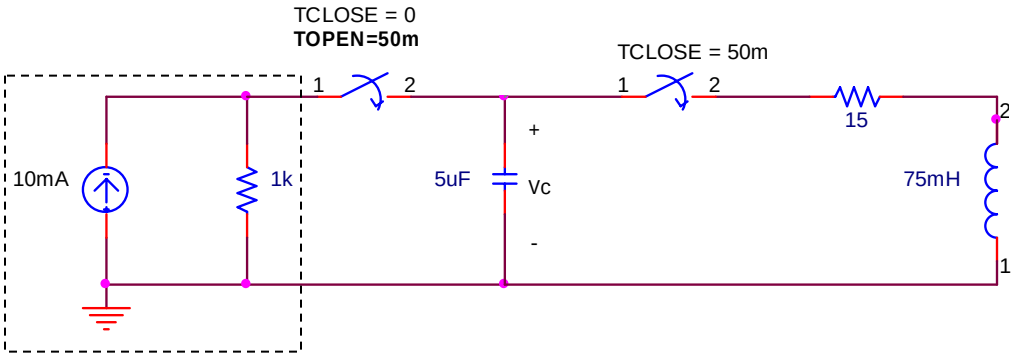
| | | | |
|---|---|---|---|
| OVERDAMPED | CRITICALLY DAMPED | UNDERDAMPED | OSCILLATOR |

c) Find the damping ratio $\zeta$, for the circuit.

d) Find y(t), the circuit's response and inverse Laplace transform of Y(s), if x(t) is still a unit step function 1u(t).

Problem 4 (20pts) Name _____

a) For the circuit find an expression for $v_C(t)$ for $0 \le t < 50ms$.
Assume that $v_C(0-) = 0V$ and the switches change state at t=50ms.




| | | |
|---|---|---|
| $v_C(t)$ | | $0 \le t < 50ms$ |

Problem 4 (cont) Name _____

b) At time t = 50ms the first switch opens and the second switch closes. Assuming the capacitor has charged to 10V at t = 50ms, find an expression for $v_C(t)$ for $t \geq 50ms$.

| | | |
|---|---|---|
| $v_C(t)$ | | $t \geq 50ms$ |

c) Find the differential equation relating $i_L(t)$ (the current in the inductor) for $t \geq 50ms$.

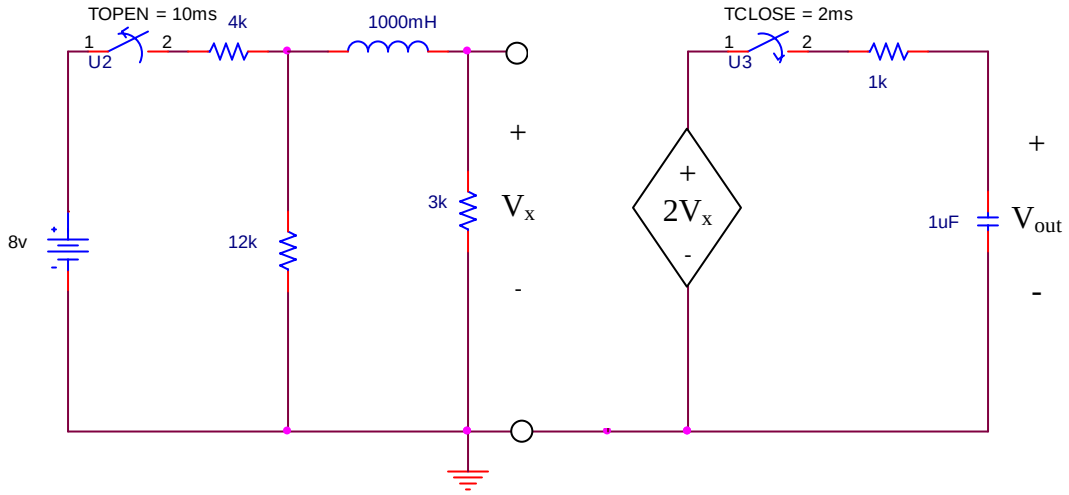
| | | |
|---|---|---|
| $i_L(t)$ | | $t \geq 50ms$ |

d) Classify the solution for $v_C(t)$ for $t \geq 50ms$. (circle one)

| | | | |
|---|---|---|---|
| OVERDAMPED | CRITICALLY DAMPED | UNDERDAMPED | OSCILLATOR |

Problem 5 (20pts) Name _____

a) Find the value of $V_x$ at t=3ms, given the circuit shown.



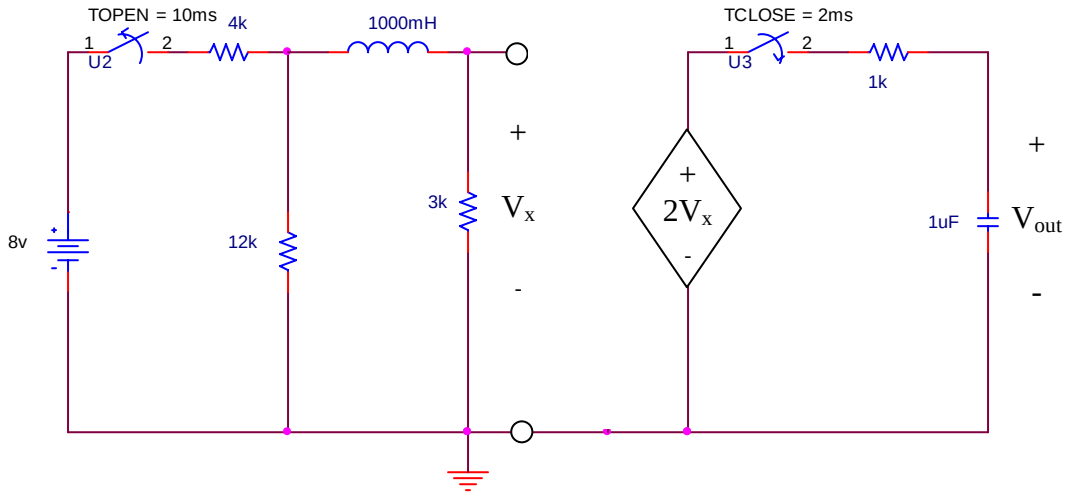

| $V_x$ (3ms) | |
|---|---|

b) Find $V_x$ at t = 10ms.

| $V_x$ (10ms) | |
|---|---|

Problem 5 (cont) Name _____

c) Find the differential equation for $V_{out}(t)$ (for 20ms > t ≥ 2ms) given the circuit shown.




d) Find $V_{out}$ at time t = 10ms.

| $V_{out}$ (10ms) | |
|---|---|

Extra space (if needed) Name _____

Extra space (if needed) Name _____