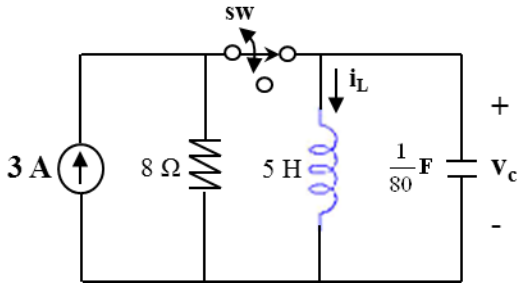
METU/EEED
EE 201

HOMEWORK X

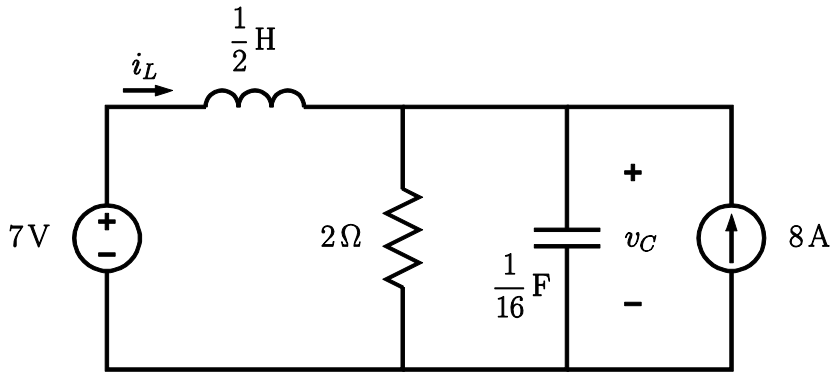
Question 1 The switch in the following circuit is opened at t = 0 and reclosed at t = $\frac{\pi}{4}$ sec. {The circuit is in the steady-state at t = 0^-.}



Find and sketch $v_C(t)$ and $i_L(t)$ for $t \geq 0$.

Answer *{T = π/4 sec.}* $i_L(t) = 3\cos(4t)$ A, $0 \leq t \leq T$; $i_L(t) = -8e^{-2(t-T)} + 2e^{-8(t-T)} + 3$ A, $t > T$.

Question 2 Consider the following circuit. Find and sketch $v_C(t)$ and $i_L(t)$ for $t \geq 0$.

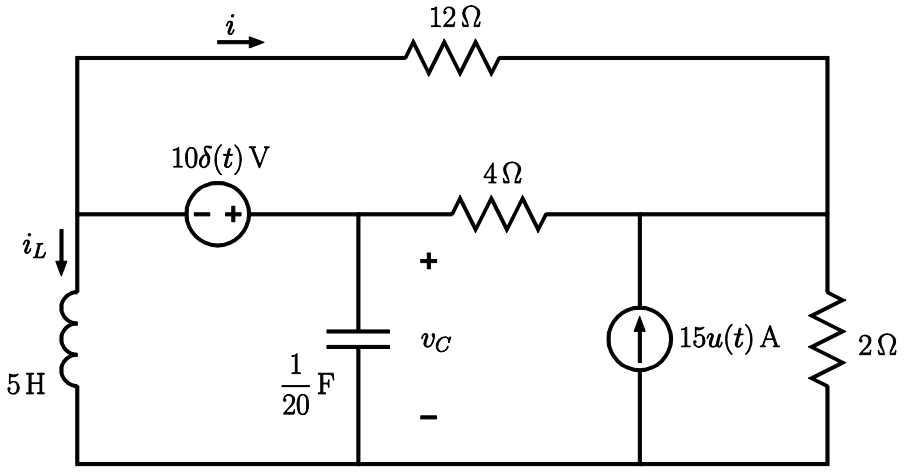


$v_C(0) = 5$ V, $i_L(0) = -3$ A.

Answer $v_C(t) = e^{-4t}[-2\cos(4t) + 8\sin(4t)] + 7$ V, $t \geq 0$;

$i_L(t) = e^{-4t}[1.5\cos(4t) + 2.5\sin(4t)] - 4.5$ A, $t \geq 0$.

Question 3 Consider the following circuit.



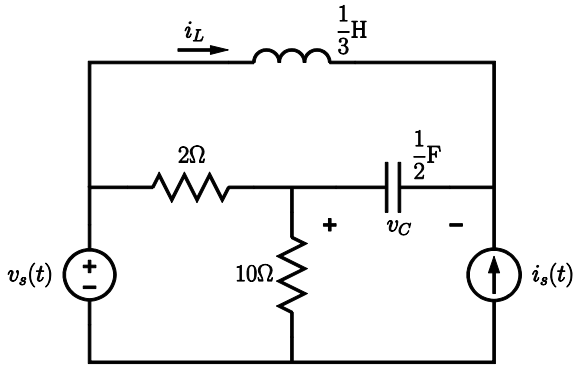
a) Given $v_C(0^-) = -5$ V and $i_L(0^-) = 3$ A, find and sketch $v_C(t)$ and $i_L(t)$ for $t > 0$.

b) Given $v_C(0^-) = 0$ and $i_L(0^-) = 0$, find i(t).

Answer *a)* $v_C(t) = (5 + 90t)e^{-2t}$ V, $i_L(t) = -(5 + 9t)e^{-2t} + 6$ A, $t > 0$.

b) $i(t) = -0.75\delta(t) + [(0.5 + 7t)e^{-2t} - 1.5]u(t)$ A.

Question 4 Consider the following circuit. Find and sketch $v_C(t)$ and $i_L(t)$ for $t > 0$.

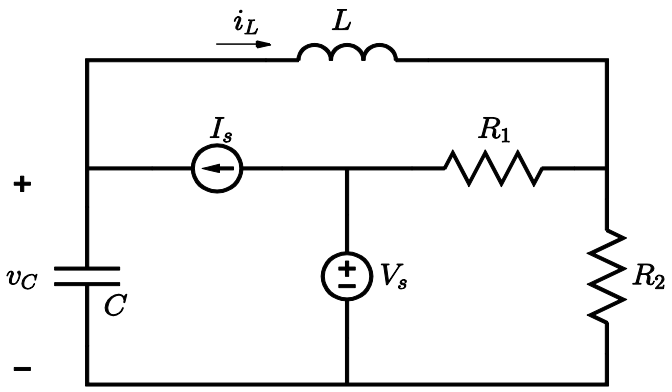


$v_C(0^-) = 2$ V, $i_L(0^-) = -3$ A;

$v_s(t) = 4\delta(t)$ V, $i_s(t) = 8u(t)$ A.

Answer $v_C(t) = -8e^{-2t} + 10e^{-3t}$ V, $i_L(t) = -8e^{-2t} + 15e^{-3t} - 8$ A, $t > 0$.

Question 5 For the circuit below, $v_C(t) = 6e^{-2t} - 3e^{-6t} + 6$ V for $t \geq 0$.
Find suitable values for R_1, R_2, L, C, V_s, I_s, V_o, and I_o.



$v_C(0) = V_o$, $i_L(0) = I_o$.

Question 6 A simple LTI second order circuit is composed of a resistor, R, a capacitor, C, an inductor, L, and an independent source. Under the unit step input, u(t), and the initial conditions $v_C(0^-) = V_o$ and $i_L(0^-) = I_o$, the capacitor voltage is observed to be

$$v_C(t) = 1 + \sqrt{5}\, e^{-2t}\cos[\sqrt{12}\, t - \tan^{-1}(2)] \text{ V}, \quad t > 0.$$

a) Sketch a proper circuit diagram and find suitable R, L, C values and initial conditions V_o and I_o.

b) Find the impulse response for $v_C(t)$ for the circuit of Part (a).