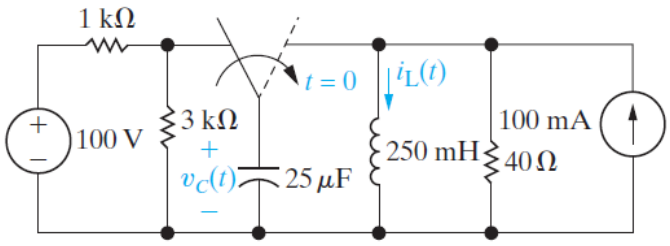
ECE222

Quiz 3

The switch in the circuit shown below has been in the left position for a long time before moving to the right position at $t = 0$. Find $i_L(t)$, $t \geq 0$. (Show all your work).

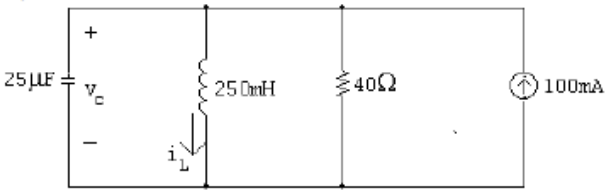


$t < 0$:

$$V_0 = v_o(0^-) = v_o(0^+) = \frac{3000}{4000}(100) = 75\,\text{V}$$

$$I_0 = i_L(0^-) = i_L(0^+) = 100\,\text{mA}$$

$t > 0$:



$$\alpha = \frac{1}{2RC} = \frac{1}{2(40)(25 \times 10^{-6})} = 500\,\text{rad/s}$$

$$\omega_o = \sqrt{\frac{1}{LC}} = \sqrt{\frac{1}{(250 \times 10^{-3})(25 \times 10^{-6})}} = 400$$

$\therefore \quad \alpha^2 > \omega_o^2$ overdamped

$$s_{1,2} = -500 \pm \sqrt{500^2 - 400^2} = -200, -800$$

$$i_L = I_f + A_1 e^{-200t} + A_2 e^{-800t}$$

$$I_f = 100\,\text{mA}$$

$$i_L(0) = 0.1 + A_1 + A_2 = 0.1 \qquad \text{so} \qquad A_1 + A_2 = 0$$

$$\frac{di_L}{dt}(0) = -200A_1 - 800A_2 = \frac{V_0}{L} = \frac{75}{0.25} = 300$$

Solving, $\quad A_1 = 0.5, \quad A_2 = -0.5$

$$\therefore \qquad i_L(t) = 0.1 + 0.5e^{-200t} - 0.5e^{-800t}\,\text{A}$$