Solution

EE101 Quiz 8, March 5, 2019

Name_____ Student ID Number_____

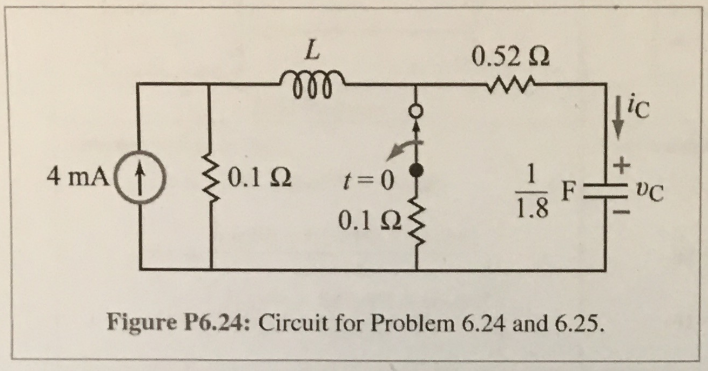


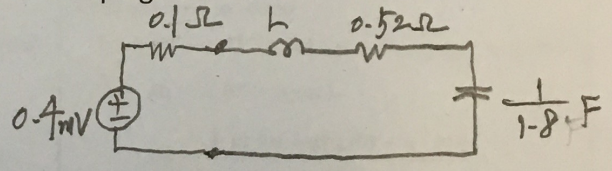
Figure P6.24: Circuit for Problem 6.24 and 6.25.

*6.25 Choose the value of the inductor in the circuit of **Fig. 6.24** so that v_C exhibits a critically damped response and determine $v_C(t)$ for $t \geq 0$.

See next page for critical damping.

Part A (5 points) Find the value of L for critical damping for t > 0.

(Answer) L = 0.0534 Henry



Show the details of your calculation

RLC circuit $\alpha = \frac{R}{2L}$ $\omega = \frac{1}{\sqrt{LC}}$

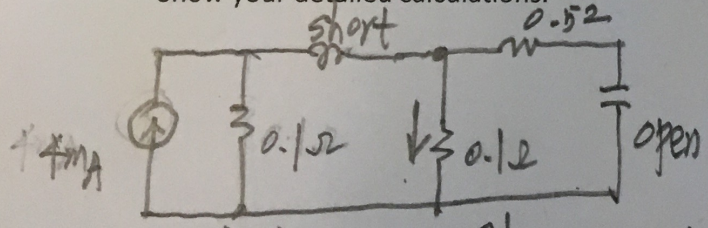
critically damped when $\alpha = \omega \Rightarrow \frac{R}{2L} = \frac{1}{\sqrt{LC}}$ $\left(\frac{R}{2L}\right)^2 = \frac{1}{LC} \Rightarrow \frac{R^2}{4L^2} = \frac{1}{LC} \Rightarrow \frac{R^2}{4L} = \frac{1}{C}$

or $L = \frac{R^2C}{4} = \frac{(0.52+0.1)^2 \frac{1}{1.8}}{4} = 0.0534$ H

Part B (5 points) Find initial conditions for $i_L(0)$ $v_C(0)$.

(Answer) $i_L(0)$ = 2 mA $v_C(0)$ = 0.2 mV

Show your detailed calculations.



$i_L(0) = 4\text{mA} \times \frac{0.1}{0.1+0.1} = 2\text{mA}$

$v_{0.1\Omega} = 2\text{mA} \times 0.1 = 0.2\text{mV} = v_C(0)$

$i_L(0) =$