EEL 3112c – Circuits 2

Quiz on Chapter 8

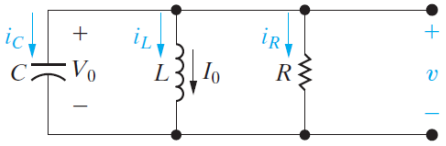
Notes:

- Write your name on all pages
- Time limit is 20 minutes
- The quiz is closed book and closed notes
- You are allowed to use a calculator
- Show your work not just the final answer
- Your answers must be organized and easy to follow

Problem 1: (5 points)

Suppose the inductor in the circuit shown below has a value of 10 mH. The voltage response for $t \geq 0$ is $v(t) = 40e^{-1000t} - 90e^{-4000t}$ Volts.

a) Determine the numerical value for $\omega_0, \alpha, C, and\ R$ (2 points)
b) Find the expression for $i_R(t)$ (2 points)
c) Determine whether this circuit is over, under, or critically damped (1 point)



Hint: $\alpha = \frac{1}{2RC}$, $\omega_0^2 = \frac{1}{LC}$

Solution:

[a] $-\alpha + \sqrt{\alpha^2 - \omega_o^2} = -1000$

$-\alpha - \sqrt{\alpha^2 - \omega_o^2} = -4000$

Adding the above equations, $\quad -2\alpha = -5000$

$\alpha = 2500\,\text{rad/s}$

$-2500 \pm \sqrt{2500^2 - \omega_0^2} = -1000 \quad$ so $\quad \sqrt{2500^2 - \omega_0^2} = 1500$

$\therefore \quad -\omega_0^2 = 1500^2 - 2500^2 \quad$ thus $\quad \omega_0 = 2000$ Rad/sec

$$\omega_0^2 = \frac{1}{LC} = \frac{1}{(0.01)C} = 2000^2 \quad \text{so} \quad C = \frac{1}{(0.01)2000^2} = 25\,\mu\text{F}$$

$$\alpha = \frac{1}{2RC} = \frac{1}{2R(25 \times 10^{-6})} = 2500 \quad \text{so} \quad R = \frac{1}{2(25 \times 10^{-6})(2500)} = 8\,\Omega$$

[b] $i_R = \frac{v(t)}{R} = 5e^{-1000t} - 11.25e^{-4000t}\,\text{A}, \qquad t \geq 0^+$

C)

The Circuit is	When	Qualitative Nature of the Response
Overdamped	$\alpha^2 > \omega_0^2$	The voltage or current approaches its final value without oscillation
Underdamped	$\alpha^2 < \omega_0^2$	The voltage or current oscillates about its final value
Critically damped	$\alpha^2 = \omega_0^2$	The voltage or current is on the verge of oscillating about its final value