

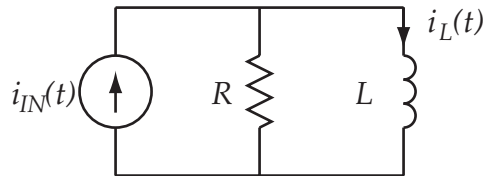
Inter American University of Puerto Rico
Bayamón Campus
School of Engineering
Department of Electrical Engineering

ELEN 3301 – Electric Circuits I

Problem Set 10 Solutions

Due Wednesday, November 24

Problem 1: Find the sinusoidal steady-state of $i_L(t)$ if $i_{IN}(t) = I_{IN} \cos(\omega t)$ in the circuit shown below.



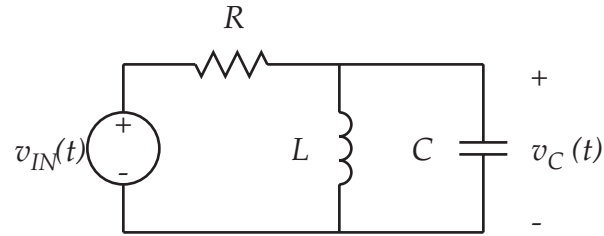
Using impedances and a current divider, the complex amplitude \tilde{I}_L can be expressed as

$$\tilde{I}_L = \frac{R}{R + jL\omega} I_{IN}$$

Taking the magnitude and phase yields

$$i_L(t) = \frac{R}{\sqrt{R^2 + (L\omega)^2}} I_{IN} \cos\left(\omega t - \tan^{-1} \frac{L\omega}{R}\right)$$

Problem 2: Find the sinusoidal steady-state of $v_C(t)$ if $v_{IN}(t) = V_{IN} \cos(\omega t)$ in the circuit shown below.



Using impedances and a voltage divider, the complex amplitude \tilde{V}_C can be expressed as

$$\tilde{V}_C = \frac{jL\omega \parallel \frac{1}{jC\omega}}{R + jL\omega \parallel \frac{1}{jC\omega}} V_{IN} = \frac{jL\omega}{R - RLC\omega^2 + jL\omega} V_{IN}$$

Taking the magnitude and phase yields

$$v_C(t) = \frac{L\omega}{\sqrt{(R - RLC\omega^2)^2 + (L\omega)^2}} V_{IN} \cos\left(\omega t + \frac{\pi}{2} - \tan^{-1} \frac{L\omega}{R - RLC\omega^2}\right)$$