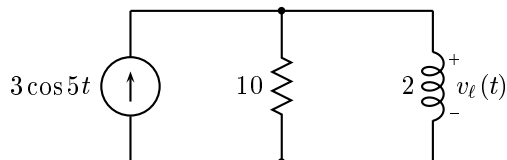


GEORGIA INSTITUTE OF TECHNOLOGY  
School of Electrical and Computer Engineering

ECE 2040  
**Circuit Analysis**

Quiz #4-Solutions

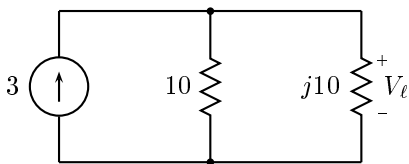
**Problem Q4.1:**



- (a) Sketch the circuit in the complex amplitude domain.
- (b) Determine the complex amplitude of the output voltage,  $v_\ell(t)$ .
- (c) Determine  $v_\ell(t)$  for all  $t$ . Express your answer as a single real sinusoid.

**Solution:**

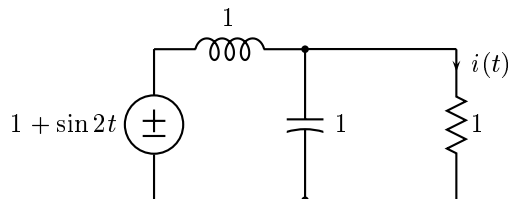
(a)



(b)  $V_\ell = j10 \cdot 3 \cdot \frac{10}{10+j10} = \frac{30j}{1+j}$

(c)  $v_\ell(t) = \frac{30}{\sqrt{2}} \cos(5t + \frac{\pi}{4})$

**Problem Q4.2:**



Compute  $i(t)$ .

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**Solution:**

$$H(j\omega) = \frac{\frac{1}{j\omega}}{1 + \frac{1}{j\omega}} = \frac{1}{j\omega + \frac{1}{j\omega}} = \frac{1}{-\omega^2 + j\omega + 1}$$

Since the input consists of a sum of two sinusoids, we shall have to use superposition.

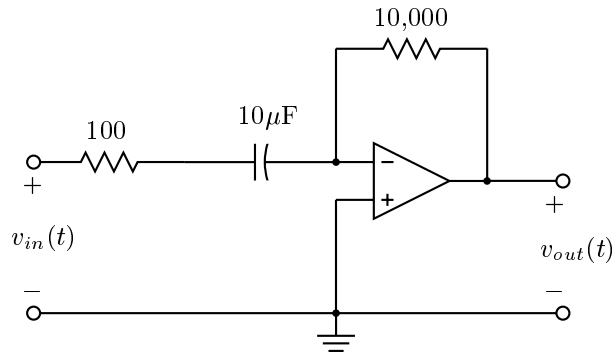
At  $\omega = 0$ ,  $H(j0) = 1$ .

At  $\omega = 2$ ,  $H(j2) = \frac{1}{j^2 - 4 + 1} = \frac{1}{\sqrt{13}} e^{j2.5536}$

Therefore,  $i(t) = 1 + \frac{1}{\sqrt{13}} \sin(2t - 2.5536) = 1 - \frac{1}{\sqrt{13}} \sin(2t + .588)$ .

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**Problem Q4.3:**



Calculate the frequency response of the above circuit.

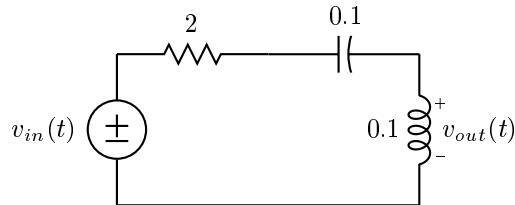
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**Solution:**

$$\begin{aligned} H(j\omega) &= -\frac{Z_f(j\omega)}{Z_i(j\omega)} = -\frac{10^4}{100 + \frac{1}{j10^{-5}\omega}} \\ &= -\frac{j(0.1)\omega}{j0.001\omega + 1} \end{aligned}$$

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**Problem Q4.4:**



- (a) Calculate the system function of the above circuit.  
(b) Draw the Bode magnitude plot for the circuit.

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**Solution:**

(a)

$$H(s) = \frac{Ls}{Ls + R + \frac{1}{Cs}} = \frac{LCs^2}{LCs^2 + RCs + 1} = \frac{s^2}{s^2 + \frac{R}{L}s + \frac{1}{LC}} = \frac{s^2}{s^2 + 20s + 100}$$

(b)

