ECE 321 - Quiz 2: Name _____

Phasors, Poles, Zeros, Frequency Response - November 19, 2015
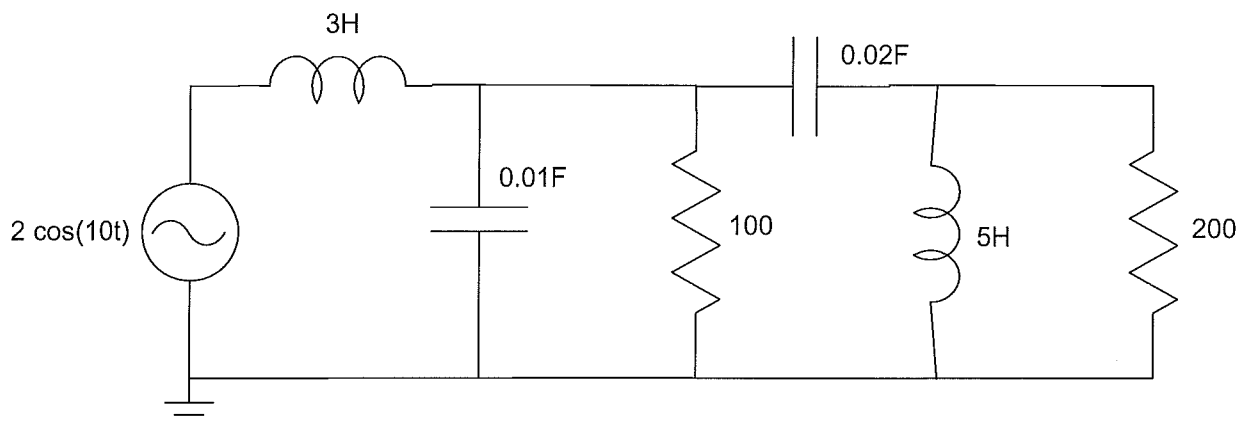
$$R \to R \qquad\qquad L \to j\omega L \qquad\qquad C \to \frac{1}{j\omega C}$$
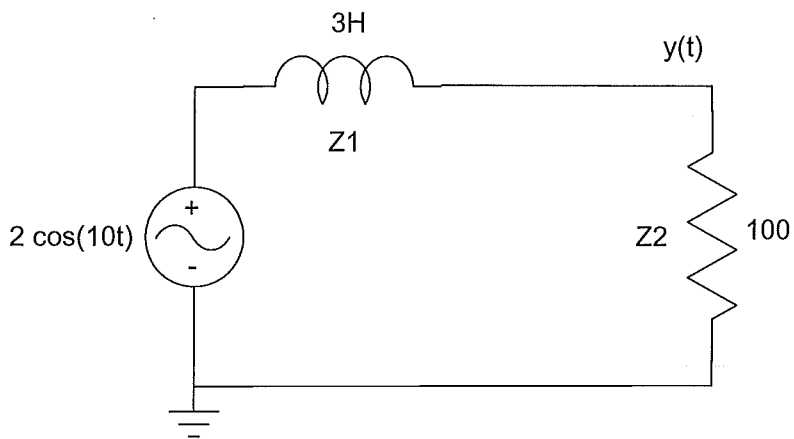
1) Determine the phasor impedances for the following circuit for the input given

| 3H Inductor	0.01F Capacitor	100 Ohm resistor	0.02F Capacitor	5H Inductor
$+j30$	$-j10$	100	$-j5$	$j50$

2) Determine the phasor impedances of Z1 and Z2, the gain of the filter, and determine y(t) for the following circuit. (note: for voltage division, the gain is $\left(\frac{Z_2}{Z_1+Z_2}\right)$)

Z1	Z2	gain
$j30$	100	$\frac{100}{100+j30} = .957\angle{-16.7^\circ}$
y(t) =	$1.915 \cos(10t - 16.7^\circ)$	

3H

y(t)

Z1

2 cos(10t)

+
−

Z2   100

3) The gain of an inverting amplifier is $\left(\dfrac{-Z_1}{Z_2}\right)$. For the following op-amp circuit, determine the impedances at 10 rad/sec, the gain, and the output, y(t)

Z1	Z2	gain
$4 - j5$ $6.40\ \angle{-51.3°}$	$13 - j9$ $15.81\ \angle{-34.7°}$	$.405\ \angle{163.3°}$

y(t) =	$1.214\ \cos\left(10t + 163°\right)$

3 cos(10t)

$-j10$
0.01F

10   30

Z2

4   $-j5$
0.02F

Z1

$-$

$+$
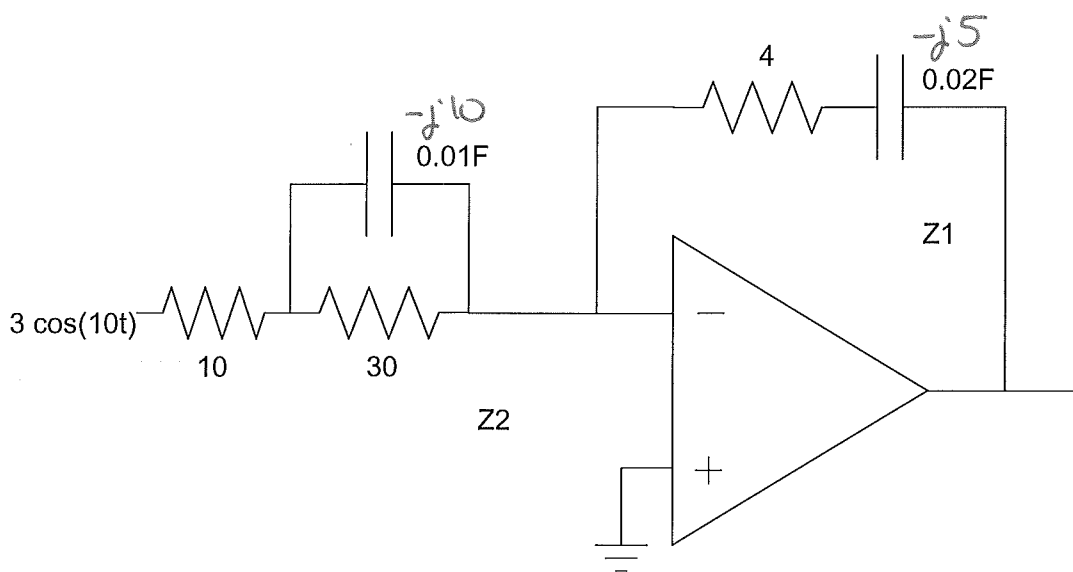
4) A filter has the following transfer function

$$Y = \left(\frac{3s}{s^2+8s+20}\right) X$$

Determine the gain of this filter at $s = j6$ as well as y(t) if x(t) = 3 cos(6t)

Gain @ s = j6	y(t) for x(t) = 3 cos(6t)
$.355 \angle -18.4°$	$1.067 \cos(6t - 18.4°)$

5) A filter has the following transfer function

$$Y = \left(\frac{10}{(s+1)(s+3)} \right) X = \left(\frac{10}{s^2+4s+3} \right) X$$

5a) What is the differential equation relating X and Y?

$$y'' + 4y' + 3y = 10x$$

$$(s^2 + 4s + 3)Y = (10)X$$

5b) Find the input, x(t), assuming

$$y(t) = 3\cos(6t)$$

$x(t) =$ $12.24 \cos(6t + 143°)$

$$\left(\frac{10}{s^2+4s+3} \right) \quad X = \left(\frac{s^2+4s+3}{10} \right) y$$

$$= \left(4.08 \angle 143° \right) \left(3\cos(6t) \right)$$

Colbert Trivia: When Acro-Cats came to the Colbert show, what happened?
- The cats got into a fight on-stage
- The cats hurled on the stage (stage nerves)
- The cats wouldn't come out of their cages and ignored their 'trainers'
- Colbert started sneezing uncontrollably (allergic to cats)
- Two of the cats got away and clawed several audience guests