Name : _____ Section:_____ CWRU e-mail:_____

CASE WESTERN RESERVE UNIVERSITY
Case School of Engineering
Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

Quiz No. 11 4/09/04

PUT ANSWERS IN THE SPACE PROVIDED AND SHOW YOUR WORK IF APPROPRIATE
BE SURE TO STATE ALL ASSUMPTIONS

Problem 1 Elementary phasors (10 points)

(a) Evaluate the complex number expression $\frac{61.7\angle -27^o}{19+j33}$. Your answer should be in rectangular form.

$$\frac{61.7\angle -27^o}{19+j33}=\frac{61.7\angle -27^o}{38.08\angle 60.07^o}=1.62\angle -87.07^o=0.08-j1.62$$ (4 points)

(b) Convert the sinusoid $v(t)=36\cos(754t+80^o)$ to a phasor.

The phasor representation of v(t) is:

$$V=36e^{j80^o}=36\cos(80^o)+j36\sin(80^o)=6.25+j35.45$$ (3 points)

(c) Convert the phasor $(-1+j)$ to a real time-dependent function. Assume the frequency ω is in your answer.

$$-1+j=\sqrt{2}(-\frac{\sqrt{2}}{2}+j\frac{\sqrt{2}}{2})=\sqrt{2}[\cos(135^o)+j\sin(135^o)]=\sqrt{2}e^{135^o}$$

So $v(t)=\mathrm{Re}\{\sqrt{2}e^{j135^o}\}=\sqrt{2}\cos(\omega t+135^o)$ (3 points)

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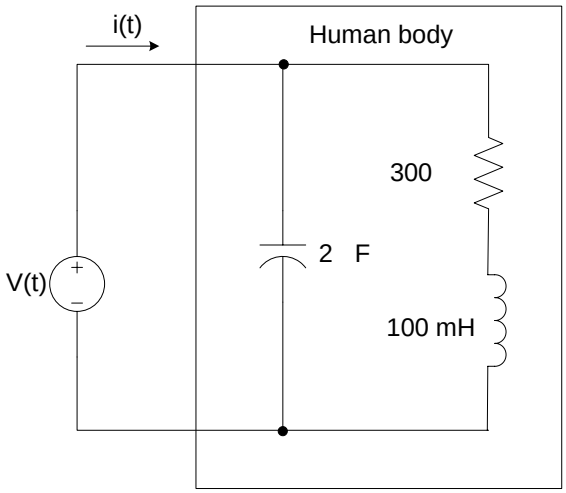
Problem 2 Simple circuit analysis using phasors (10 points)

There are 500 to 1000 deaths each year in the United States from electric shock. If a person makes a good contact whit his/her hands, the resulting electrical circuit can be represented by the figure below where $v(t) = 160\cos(\omega t)$ volts and $\omega = 377$.



(a) Redraw the above circuit replacing all real quantities by their phasor equivalents. Use numerical values for all impedances.

Resistor: $Z_R = R = 300\Omega$; (1 point)

Inductor: $Z_L = j\omega L = j377 \cdot 100mH = j37.7\Omega$; (1 point)

Capacitor: $Z_C = \dfrac{1}{j\omega C} = \dfrac{1}{j377 \cdot 2\mu F} = -j1326.3\Omega$; (1 point)

(b) What is the complex impedance of the human body as seen by the voltage source? Your answer should be a numerical value.

The complex impedance is:

$$Z = -j1326.3 // (300 + j37.7) = \frac{-j1326.3 \cdot (300 + j37.7)}{-j1326.3 + (300 + j37.7)} = 301.47 - j31.38;$$ (3 points)

(c) What is the steady-state current $i(t)$ flowing through the human body for the give $v(t)$?

$Z = 301.47 - j31.38 = 303.1\angle -5.9^0$

And $V = 160\angle 0^o$, so $I = \dfrac{V}{R} = \dfrac{160\angle 0^o}{303.1\angle -5.9^o} = 0.53\angle 5.9^o$

We can get $i(t) = 0.53\cos(377t + 5.9^o)$; (4 points)