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

Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

Quiz No. 11 **4/8/05**

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

Problem 1 Elementary phasors, (10 points)

Use phasors to combine the following sinusoidal functions into a single trigonometric expression. Your answer should be expressed as a real function.

$y = 40\cos(\omega t + 60°) + 80\sin(\omega t + 135°) - 100\cos(\omega t + 270°)$;

(1) cosine conversion: $y = 40\cos(\omega t + 60°) + 80\cos(\omega t + 45°) - 100\cos(\omega t + 270°)$

(3) polar conversion: $y = 40e^{j60} + 80e^{j45} - 100e^{j270}$

(3) math:

$y = 40\cos(60) + j40\sin(60) + 80\cos(45) + j80\sin(45) - 100\cos(270) - j100\sin(270)$

$y = 40(1/2) + j40(\sqrt{3}/2) + 80(\sqrt{2}/2) + j80(\sqrt{2}/2) - 100(0) - j100(-1)$

$y = 20 + j20\sqrt{3} + 40\sqrt{2} + j40\sqrt{2} + j100$

$y = (20 + 40\sqrt{2}) + j(20\sqrt{3} + 40\sqrt{2} + 100)$

(2) conversion to polar:

$y = 76.57 + j(191.21)$

$y = 206.0e^{68.2j}$

(1) answer: $\boxed{y = 206\cos(\omega t + 68°)}$

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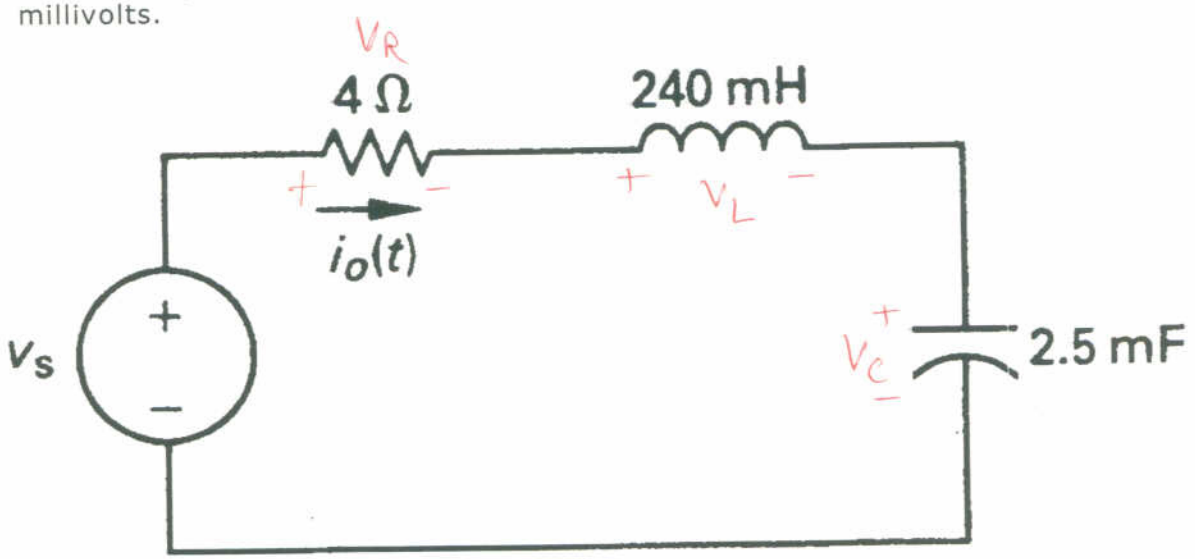
Problem 2 Phasor circuits, (10 points)
Find the steady state expression for $i_o(t)$ in the circuit below if $v_s(t)=100\sin(50t)$ millivolts.



$V_s(t) = 0.1\sin(50t)$

conversion ← (1) $V_s(t) = 0.1\cos(50t-90°)$

$V_s(t) = 0.1e^{-j90}$

math and conversions ← (3)

$V_R = 4 + j0$

$V_L = j\omega L = j(50)(0.240H) = j12 = 0+j12$

$V_C = \frac{1}{j\omega C} = \frac{1}{j(50)(2.5\times10^{-3}F)} = j8 = 0-j8$

ALTERNATE WAY (EASIER)

$\frac{0.1e^{-j90}}{4\sqrt{2}e^{j45}} = 0.0177e^{-j135}$

$I_o(t) = 0.0177\cos(50t-135)$ A

(3) → same as other way

(3) math and answer

$Z_{eq} = V_R + V_L + V_C$

$Z_{eq} = 4 + j12 - j8$

$Z_{eq} = 4 + j4$

$V = IZ$

(2) math and ohm's law

$I = \frac{V}{Z} = \frac{0.1e^{-j90}}{4+j4} = \frac{0.1(\cos(-90)+j\sin(-90))}{4+j4} =$

$I = \frac{-0.1j(4-j4)}{4+j4(4-j4)} = \frac{-0.4j-0.4}{16+16} = \frac{-0.4(j+1)}{32}$

$I = -0.0125-0.0125j = 0.0177e^{-j135}$

answer ← (1) $\boxed{I_o(t) = 0.0177\cos(50t-135)\text{ A}}$