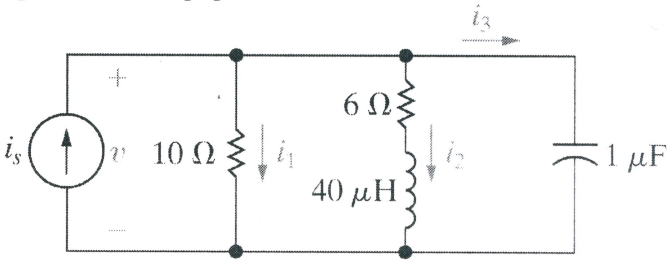
Name: UW ID#: Section: Version A

Exam 1 — EE 233

Fall 2016

The test is closed book, with one sheet of notes and standard calculators (no communications) allowed. Show all work. Be sure to state all assumptions made and check them when possible. Include units with your answers. The number of points per problem are indicated in parentheses. Total of 50 points in 3 problems on 3 pages.

1. In the circuit at right, $i_s(t) = 20\cos(2\times10^5 t - 30^\circ)$ A.



(a) Determine the phasor domain values (with units) for each of the five circuit elements. (6)

$\omega = 2\times10^5$ rad/s

$\dot{I}_s = 20\angle -30^\circ$ A

$Z_{R_1=10\Omega} = 10\Omega = 10\angle 0^\circ\ \Omega$

$Z_{R_2=6\Omega} = 6\Omega = 6\angle 0^\circ\ \Omega$

inductor: $Z_L = j(\omega L) = j\cdot(2\times10^5)\times(40\times10^{-6}) = (j\cdot 8)\Omega = 8\angle 90^\circ\Omega$

capacitor: $Z_C = -j\left(\frac{1}{\omega C}\right) = -j\frac{1}{(2\times10^5)(1\times10^{-6})} = (-j\cdot 5)\Omega = 5\angle -90^\circ\Omega$

(b) Determine $i_3(t)$. (10)

Method 1: The total impedance of this circuit is

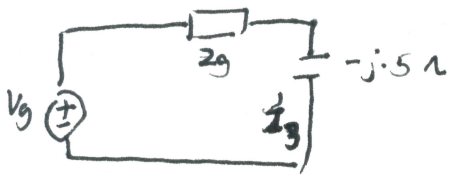
$$Z_{total} = 10 \,||\, (6+Z_L) \,||\, Z_C$$
$$= 10 \,||\, (6+j\cdot 8) \,||\, (-j\cdot 5)$$
$$= \frac{10\cdot(6+8j)}{10+(6+j8)} \,||\, (-j\cdot 5)$$
$$= (5+j\cdot 2.5) \,||\, (-j\cdot 5) = (4-3j)\Omega = 5\angle -37^\circ\Omega$$

Voltage across capacitor $V = I_s \cdot Z_{total}$

$$\dot{V}_3 = I_s\cdot\frac{Z_{total}}{Z_C} = 20\angle -30^\circ\cdot\frac{5\angle -37^\circ}{5\angle -90^\circ} = 20\angle 23^\circ \text{ A}$$

in Time domain $i_3(t) = 20\cos(2\times10^5 t + 23^\circ)$ A

Method 2: We do source transform



$$Z_g = (10\Omega) \,||\, (6+j\cdot 8) = (5+j\cdot 2.5)\Omega$$

$$V_g = I_s\cdot Z_g = 20\angle -30^\circ\ (5+j\cdot 2.5)\ V$$

$$\dot{I}_3 = \frac{V_g}{Z_g+Z_C} = \frac{20\angle -30^\circ\ (5+j\cdot 2.5)}{5+j\cdot 2.5-j\cdot 5} = 20\cdot\angle -30^\circ\cdot\frac{3+4j}{5}$$
$$= 20\angle -30^\circ\cdot 1\angle 53^\circ$$
$$= 20\angle 23^\circ \text{ A}$$

in Time domain $i_3(t) = 20\cos(2\times10^5 t + 23^\circ)$ A