Due: March 30, 2006

Use engineering paper. Work only on one side of the paper. Use this sheet as your cover sheet, placed on top of your work and stapled in the top left-hand corner. Number the problems at the top of the page, in the center of the sheet. Do neat work. Underline your answers. Show how you got your equations. Be sure to show how you got your answers. Each problem counts 10 points.

9.6 Answers: (a) $i(t)$ leads $v(t)$ by 20° (b) $v_2(t)$ leads $v_1(t)$ by 170° (c) $\hat{v}(t)$ leads $x(t)$ by 9.24°

9.13 Work (a) and (b): See text for answers.

9.34 $\Omega = 100$ rad/sec

9.43
4.6 In the following, determine which signal leads and by how much.

(a) $V_1 = 10 \cos (4t - 60^\circ)$
$\quad \quad I = 4 \sin (4t + 50^\circ)$

(b) $V_1 = 4 \cos (3\pi t + 10^\circ)$
$V_2 = -20 \cos 3\pi t$

(c) $X = 13 \cos 2t + 5 \sin 2t$
$\quad \quad Y = 15 \cos (2t - 118^\circ)$

$X = 13.93 \cos (2t - 21^\circ)$

$Y \quad \text{leads} \quad X \quad \text{by} \quad 9.83^\circ$
4.13 Evaluate the following

(a) \[ \frac{(2+3j)}{(1-j6)} + \frac{(7-8j)}{(1-5j11)} \]
\[ -1.275 + j0.152 \]

(b) \[ \frac{(5\sqrt{10})(10-40)}{(4\sqrt{1})(-6\sqrt{5})} \]
\[ -2.083 + j1.215 \]
$V_0$ will be zero when the series impedance of the $5\mu F$ capacitor and the $2\Omega$ coil is zero. In other words, when

$$j\omega L - \frac{j}{\omega C} = 0$$

or

$$\omega L = \frac{1}{\omega C}$$

can be solved for

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{2\times10^{-3} \times 5\times10^{-3}}}$$

$$W = \frac{1000}{\sqrt{100}} = 100 \text{ var}$$(or)}
4.43 Given the following circuit:

\[ 2ab = 50 + \frac{(80 + 400)(100 - j40)}{100 + j80 - j40} \]

\[ 2ab = 50 + \frac{(80 + 400)(100 - j40)}{(100 + j40)} \]

\[ = (107.17 + j57.73) \approx 120.07 \angle 28.85^\circ \]

\[ I = \frac{600}{120.07} \angle 28.85^\circ \]

\[ I = 4.997 \angle 28.85^\circ \text{ A} \]

\[ I = 499.7 \angle 28.85 \text{ mA} \]
\( v_c(t) = [V_i + (R + jLω) e^{-\alpha t}] \quad t > 0 \)

\( \alpha = \omega_0 \)

\( R = \frac{1}{jL\omega_0} \Rightarrow \frac{R^2}{4L^2} = \frac{1}{LC} \Rightarrow R = \frac{\sqrt{4L}}{C} = 2\sqrt{\frac{L}{C}} \)