ASSIGNED: March 16, 2001. **Read:** Sects. 9.6-9.12 (skip Sect. 9.10) of text. Start Chap. 10 (power).
DUE DATE: March 23, 2001. **In Lab Book:** Read Unit #5, Lab Lecture #5 and Lab Experiment #5.

THIS WEEK: *Phasor analysis of linear circuits in the sinusoidal steady-state.*

1. Text #9.10. Simple phasor circuit. Note the inductor and capacitor impedances partially *cancel*.
2. Text #9.16. The *admittance* "seen" by the (source+150 Ohms) should be purely real (why?).
3. Text #9.17. What impedance should be "seen" by the source? Watch the "sin" and "mA" in i_o. You will get a quadratic equation for frequency, but only one root will be positive.
4. Text #9.19. Just combining in series and parallel, but now using impedances and admittances.
5. Text #9.26. Compare to #9.25: note equating admittances instead of impedances makes easier.
6. Text #9.31. Voltage divider using impedances and phasors. Watch signs: phase is NOT zero.
7. Text #9.37. Thevenin equivalent using impedances and phasors. V_{TH}=350+j0; R_{TH}=100(1+j).
8. Text #9.49. 1 Node eqn. using impedances and phasors. Watch the "sin" in v_{g2}. V_o=12+j0.

EECS 210 SOLUTIONS TO PROBLEM SET #8 Winter 2001

Note: $M\angle\theta = Me^{j\theta}$; angles in degrees; impedances in Ω throughout.

1a. $500\angle 60; 400; j(8000)(0.0875) = j700; 1/[j(8000)(312.5\times 10^{-9})] = -j400$ in series.

1b. $I = (500\angle 60)/(400 + j700 - j400) = 1\angle 23.13$. **1c.** $i(t) = \cos(8000t + 23.13)A$.

2a. $Y = j\omega(0.004) + \frac{1}{10+j\omega(2)} = \frac{10}{100+4\omega^2} + j[\omega(0.004) - \frac{\omega(2)}{100+4\omega^2}]$.
Want $0 = Im[Y] = \omega(0.004) - \frac{\omega(2)}{100+4\omega^2} \rightarrow \omega = 10 \rightarrow 1.59Hz$ (ω cancels).

2b. $Y = \frac{10}{100+4(10)^2} = 0.02 \rightarrow I = \frac{10}{(1/0.02)+150} = 0.05 \rightarrow i_o(t) = 0.05\cos(10t)A$.

3. **Sources:** $V = 50\angle -45$; $I = 0.1\angle -8.13 \rightarrow Z = \frac{V}{I} = 500\angle -36.87 = 400 - j300$.
Impedance: $Z = 400 + j[\omega(0.04) - 1/(\omega(4\times 10^{-7}))] = 400 - j300$ if $\omega = 5000$.
Quadratic eqn: $\omega(0.04) - 10^7/(4\omega) = -300 \rightarrow \omega^2 + 7500\omega - (62,500,000) = 0$.

4. Y of parallel branches: $Y = \frac{1}{6-j2} + \frac{1}{4+j12} + \frac{1}{5} + \frac{1}{j10} = \frac{3-j}{8}$. (50 millisiemens$\angle 36.87$).
$Z_{ab} = -j12.8 + \frac{8}{3-j} + 13.6 = 16 - j12 = 20\angle -36.87 \rightarrow Y_{ab} = 0.05\angle 36.87 = 0.04 + j0.03$.

5. Need $Y_2 = \frac{1}{R_2} - \frac{j}{\omega L_2} = Y_1 = \frac{1}{R_1 + j\omega L_1} = \frac{R_1 - j\omega L_1}{R_1^2 + \omega^2 L_1^2} \rightarrow \frac{1}{R_2} = \frac{R_1}{R_1^2+\omega^2 L_1^2}$; $\frac{1}{\omega L_2} = \frac{\omega L_1}{R_1^2+\omega^2 L_1^2}$
$\rightarrow R_2 = (R_1^2 + \omega^2 L_1^2)/R_1$ and $L_2 = (R_1^2 + \omega^2 L_1^2)/(\omega^2 L_1)$ as desired.

6. $Z_1 = 600 - j/[(5000)(0.25\times 10^{-6})] = 600 - j800$. $Z_2 = 300 + j(5000)(0.4) = 300 + j2000$.
$V_o = (75\angle 0)\frac{600-j800}{(600-j800)+(300+j2000)} = (75)\frac{1000\angle -53.13}{1500\angle 53.13} = 50\angle -106.26$ (voltage divider).
$v_o(t) = 50\cos(5000t - 106.26)$.

7. Parallel branches: $Z = (100 + j(1000)(0.1))||(-j100) = \frac{10000(1-j)}{100+j100-j100} = 100(1-j)$.
$V_{OC} = (247.49\angle 45)\frac{100(1-j)}{j100+100(1-j)} = (247.49\angle 45)(\sqrt{2}\angle -45) = 350\angle 0$.
$R_{TH} = (j100)||100(1-j) = \frac{(j100)100(1-j)}{j100+100(1-j)} = 100(1+j)$.

8. Sources: $V_{g1} = 10\angle 53.13 = 6 + j8$. $V_{g2} = 8\angle -90 = -j8$. $Z_c = \frac{-j}{(5000)(0.00005)} = -j4$.
$\frac{V_o-(6+j8)}{j(5000)(0.0004)} + \frac{V_o}{6} + \frac{V_o-8j}{-j4} = 0 \rightarrow V_o = 12 \rightarrow v_o(t) = 12\cos(5000t)$.