ASSIGNED: Jan. 13, 2006. **READ:** Part 2 of Official Lecture Notes (available on-line).
DUE DATE: Jan. 20, 2006. **TOPICS:** Sinusoids, complex numbers, phasors.

Show work on separate sheets of paper. Include all hand and Matlab plots and code.

[20] 1. For each of these 4 signals, compute amplitude[2], period[2], phase[1]:

(a) $3\cos(0.8\pi t + 2)$ (b) wallsocket(t)=$170\cos(377t - 1)$ volts.
(c) $3\cos(0.8\pi n + 2)$ (d) $3\cos(\pi t - \frac{\pi}{6}) + 4\cos(\pi t + \frac{\pi}{3})$ (use phasors).

Hint: Continuous-time (a) and discrete-time (c) have different answers!

[20] 2. *Complex numbers:* Give your answers in both polar and rectangular forms:
[10] (a) Compute $(4 + j3)(5 + j12)$ and **(b)** $(4 + j3)/(5 + j12)$.
[10] (c) Compute $(4 + j3)^4$ and **(d)** $\sqrt{4 + j3}$ (there are 2 square roots).

You will be doing *lots* of computations like this later this term (and in EECS 215).

[20] 3. *Phasors: Representing $A\cos(\omega t + \theta)$ with complex number $Ae^{j\theta}$:*
[05] (a) Use phasors to simplify the signal in problem #4a of problem set #1.
[05] (b) Use phasors to simplify the signal in problem #1d of problem set #2.
You can use trig or you can use your R⇔P key–you make the call!
[10] (c) 3-phase current (still used in some rural areas) features the sum of 3 currents:
$170\cos(377t + \theta) + 170\cos(377t + \theta + 120^o) + 170\cos(377t + \theta + 240^o)$.
Show these three currents sum to zero, so no return current is needed.

[30] 4. *More complex complex mathematical expressions:*
[05] (a) Find the solution θ to $Re[(1 - j)e^{j\theta}] = -1$.
[05] (b) Find the solution x to $Im[(1 + jx)e^{-j\pi/3}] = 0$
[10] (c) Show $\frac{e^{j2\omega}-1}{e^{j2\omega}+1} = j\tan\omega$. HINT: $e^{j2\omega} + 1 = e^{j\omega}(e^{j\omega} + e^{-j\omega})$.
[10] (d) Show $|\frac{a+jb}{c+jd}| = \sqrt{\frac{a^2+b^2}{c^2+d^2}}$ and $\angle[\frac{a+jb}{c+jd}] = \tan^{-1}(\frac{b}{a}) - \tan^{-1}(\frac{d}{c})$ if $ac > 0$.

[10] 5. *Phasors in electrical circuits:*
A motor is modelled by coil inductance of 0.2 henries and coil resistance of 50 ohms.
Huh? In English, the **rms** phasor of the current is $I = 110/[50 + j2\pi60(0.2)]$ amps.
[5] (a) Will this current blow a 1.5 amp fuse (is the maximum current>1.5 amps)?
[5] (b) The power dissipated by the motor is $Re[(110)I^*]$ watts. Compute this number.

"I used to have a rock collection. Then I got a slingshot"–Dennis the Menace