Homework #3, EECS 206, Fall 2002. Due Fri. Sep. 27, by 4:30PM

Notes

- Review the HW policies on HW1!
- Reading: Sections 2.5, 2.6, 2.8, 3.1-3.4, and Appendix A in textbook, and “Part 3” lecture notes.

Skills and Concepts

- sinusoidal signals
- complex arithmetic
- linear combinations of sinusoidal signals
- phasors

Problems

1. [10] Text 2.8. (Signal from Matlab code.)
2. [10] Text 2.9. (sin+cos)
5. [10] Text 2.17. (sums of cosines / phasors.)
7. [10] Prove that if $A$ and $B$ are positive, then $A \cos(t) + B \sin(t) = \sqrt{A^2 + B^2} \cos[t - \tan^{-1}(B/A)]$. 
   Hint: $\cos(a - b) = \cos(a) \cos(b) + \sin(a) \sin(b)$.
8. [20] Let $x(t)$ and $y(t)$ be the input and output signals, respectively, of a system. Assume that the following input/output relationship describes the system: $y(t) = x(t) - x(t - 1)$.
   (a) [10] If $x(t) = A \cos(\omega t + \theta)$ show that the output $y(t)$ can be written as $B \cos(\omega 2t + \phi)$. Relate $B$, $\phi$ and $\omega$ to $A$, $\theta$ and $\omega$.
   (b) [10] Assume that the input $x(t)$ is periodic with period 4 and $x(t) = 1$ for $0 < t < 2$ and $x(t) = 0$ for $2 < t < 4$. Sketch $x(t)$ and $y(t)$.
   (c) [0] Comment on your results for parts (a) and (b).
9. [35] (a) [15] Convert the following complex numbers from cartesian form to complex exponential form and plot in the complex plane.
   - $z_1 = 1 + 2j$
   - $z_2 = 2 + 3j$
   - $z_3 = 1 - j$
   (b) [10] Evaluate the product of $z_1$, $z_2$ and $z_3$ by:
     - Performing multiplication entirely in cartesian coordinates
     - Performing multiplication entirely with the exponential forms of these complex variables.
   (c) [10] Evaluate the ratio $z_1/z_2$ by:
     - Performing division by first converting $z_1$ and $z_2$ to exponential form.
     - Performing division by multiplying the numerator and denominator of $z_1/z_2$ by $z_2^*$.
   (d) [0] Which form is easier for multiplication and division? What about for addition and subtraction?