Homework 2

Date Assigned: Monday, August 27, 2007
Date Due: Wednesday, August 29, 2007

Reading: Please continue to review your texts and notes from ELEC 120 and ELEC 225-226. In particular, review the concepts of phasors and impedance for circuits that contain capacitors, inductors, and resistors. Also review operational amplifiers and frequency response of filters. Please review Sections B.1-B.3 in the Lathi text on complex numbers and sketching signals.

Problems: Please work on the following problems for Wednesday. Do your best to solve the problems, and come to class with questions. We will review the solutions in class on Wednesday.

1. Consider the low-pass RC circuit filter that we discussed in class.

   (a) What is the formula for the "complex frequency response" $H(\omega)$?

   (b) What are the formulas for the magnitude $|H(\omega)|$ and the phase $\angle H(\omega)$ of the frequency response?

   (c) For the values $R = 1.1$ $k\Omega$ and $C = 0.22$ μF considered in class, produce rough sketches of $|H(\omega)|$ and $\angle H(\omega)$ versus ω. What is the "amplitude gain" of the circuit at low frequencies?

   (d) Use your formula for $|H(\omega)|$ and the definition of *cutoff frequency* ω_c to derive an expression for ω_c as a function of R and C. This is the expression that is required in order to *design* a filter (i.e., choose R and C) to achieve a specified cutoff frequency.

   Hint: The cutoff frequency ω_c is defined as the value of frequency that produces amplitude gain $1/\sqrt{2}$, i.e., $|H(\omega_c)| = 1/\sqrt{2}$.