ECE 360
HOMEWORK #5
Due October 16, 2002

- Read 11.6, 12.1 and 8.1 from Ambardar.
- Office Hours: M,T 10:00-11:30 am, F 12:00-1:30 pm.

1. [16] 11.15 b,d from Ambardar.

2. [10] A linear time-invariant system has transfer function $H(s) = \dfrac{s+2}{(s+1)^2+4}$. The input $x(t) = C\cos(\omega_0 t + \theta)$ is applied to the system with zero initial energy. The resulting steady-state response $y_{ss}(t) = 6\cos(t + 45^0)$. Compute C, ω_0, θ.

3. [30] Consider the second circuit (Second-order Butterworth filter) in 12.2 from Ambardar.

   a) Find $H(\omega)$, the frequency response of this system.
   b) Find the magnitude and phase response.
   c) Find the half-power frequency for this filter.
   d) Sketch the magnitude and the phase responses.
   e) Use the following MATLAB code for plotting the magnitude and phase responses.

   % If $H(s) = \dfrac{b_0 s^n + b_1 s^{n-1} + \cdots + b_n}{a_0 s^m + a_1 s^{m-1} + \cdots + a_m}$, then define two vectors;

   % $\begin{array}{l} b = [b_0 \quad b_1 \cdots b_n]; \\ a = [a_0 \quad a_1 \cdots a_m]; \end{array}$

   % define a vector of frequencies over which you want to plot the magnitude
   % and phase response, e.g. w=[0:0.1:2*pi];
   % the following command will give you the magnitude and phase responses;
   freqs(b,a,w);

4. [12] Sketch the magnitude response for a system with. $H(s) = \dfrac{s^2+2}{(s+2)^2}$. (Hint: You can do this by just looking at the pole-zero diagram of the system.)

5. [18] A linear time-invariant system has transfer function H(s) with H(0)=3. The transient response resulting from the step function input with the system at rest at t=0 has been determined to be $y_{tr}(t) = (-2e^{-t} + 4e^{-3t})u(t)$. (Hint: The transient response is just the natural response of the system)

   a. Find the forced response for this system.
   b. Compute the system's transfer function $H(s)$.
   c. Compute the steady-state response when the system's input is equal to $2\cos(3t + 60^0)$.

6. [14] 8.44 from Ambardar.