EECS 360
Homework #10

1. Section 5.2 Participation Activities
   - 5.2.1: Lowpass and highpass magnitude spectral responses.
   - 5.2.2: Bandpass and bandreject magnitude spectral responses.
   - 5.2.3: RC circuit lowpass filter (capacitor output).
   - 5.2.4: RC circuit highpass filter (resistor output).
   - 5.2.6: Ratio to dB conversions.
   - 5.2.7: dB to voltage ratio conversions.

2. Exercise 5.2.5

3. Exercise 5.2.6

4. Section 5.3 Participation Activities
   - 5.3.1: Examples of bandpass filter responses and Q factor.
   - 5.3.2: Designing a bandpass filter for resonant frequency MHz and factor .
   - 5.3.5: RLC highpass filter.
   - 5.3.7: First order lowpass filter transmission spectrum.

5. Challenge activity
   5.3.1: Bandpass filters.

6. Section 5.4 Participation Activities
   - 5.4.1: Brick-wall lowpass filter response to odd square-wave input.
   - 5.4.3: Brick wall filter impulse responses.
   - 5.4.4: Brick wall bandpass response to odd square wave.
   - 5.4.5: Brick wall bandpass response to rectified sine wave

7. Exercise 5.4.1

8. Let H(f) = tri(f/1000)
   a. Find the first zero bandwidth.
   b. Find the 3dB bandwidth.
   c. Find the equivalent rectangular bandwidth

9. Let x(t)=10^4 sinc^2 (10^4 πt) is input to an ideal lowpass filter with a bandwidth of B kHz
   a. Find the smallest B such that the filter introduces no distortion.
   b. Find the % energy in x(t) in the frequency range |f|<5000Hz?
   c. What are the barriers to building the filter described in part a)

10. Give x(t) below with for τ=0.33ms and T_0 =1.0ms. Design (specify) a system (filter) to convert x(t) to y(t) = Acos(2 $\pi f_a t + \phi$) where f_a=2 kHz and A≠0.

$$x(t) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{t - kT_0}{\tau}\right)$$

11. Given a pulse x(t)=u(t)$e^{\frac{-t}{0.01}}$
    a. Find the 6dB bandwidth (in rad/sec and Hz) of this signal.
    b. The signal x(t) is the input to a ILPF with a bandwidth B (in rad/sec and Hz) to produce an output y(t). Find B such that y(t) contains 99% of the energy in x(t).

12. The transfer function for the voltage across the resistor in a series R, L, C circuit is given

$$H(f) = \frac{j2\pi fRC}{1 + j2\pi fRC - LC(2\pi f)^2}$$

    a. Plot 20log(|H(f)|) with R=100 Ohm, L=0.001 Henry, C=0.000001 Farad.
    b. Find the the resonant frequency.
    c. For R=100 Ohm, L=0.001 Henry, C=0.000001 Farad, given x(t)=cos(2π17375t) find A in y(t)=A

$\cos(2\pi 17375t+\phi)$. What is the attenuation in dB relative to the resonant frequency.

d. Find the 3dB bandwidth of H(f).

Hint: use Transfer Function for Series RLC circuit from the class web page.