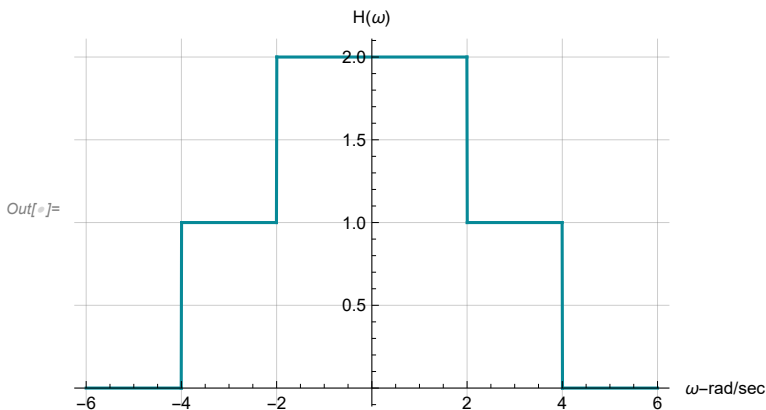


EECS 361  
Homework #10

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 Q 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. Given a frequency response shown below.

- a. Find the system output  $y(t)$  for  $x(t) = 0.5\cos(t) + \cos(3t)$
- b. Find the system impulse response,  $h(t)$ .



8. Let  $H(f) = \text{tri}(f/5000)$ 
  - a. Find the first zero bandwidth.
  - b. Find the 3dB bandwidth.
  - c. Find the equivalent rectangular bandwidth
9. Let  $x(t) = 10^4 \text{sinc}^2(10^4 \pi t)$  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  $|f| < 5000\text{Hz}$ ?
  - c. What are the barriers to building the filter described in part a)
10. Give  $x(t)$  below with for  $\tau = 0.1\mu\text{s}$  and  $T_0 = 1.0\mu\text{s}$ . Design (specify) a system (filter) to convert  $x(t)$  to  $y(t) = A\cos(2\pi f_a t + \phi)$  where  $f_a = 3\text{ MHz}$  and  $A \neq 0$ .

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

11. Given a pulse  $x(t) = u(t)10e^{-\frac{t}{0.01}}$

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  $y(t)$ .  
such that  $y(t)$  contains 99% of the energy in  $x(t)$ .

Find E

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  $20\log(|H(f)|)$  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  $x(t) = \cos(2\pi 17375t)$  find A in  
 $\cos(2\pi 17375t + \phi)$ . What is the attenuation in dB relative to the resonant frequency.

$y(t) = A$

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

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