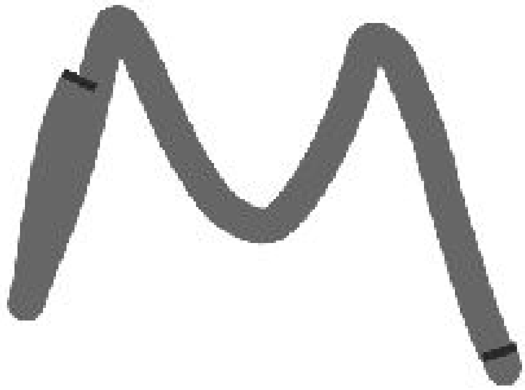
1) Convolve $\chi_{(2,5)}(t) + 2\chi_{(5,6)}(t)$ with $\chi_{(0,3)}(t)$. Plot your result.

2) Filter the signal



$$\begin{matrix} 1 & 3 & 3 & 1 \\ \underline{0} & 0 & 2 & 3 \\ 0 & 1 & 0 & 1 \\ 1 & 5 & 3 & 0 \end{matrix}$$

with the filter

$$\begin{matrix} 1 & 0 & 0 \\ 0 & \underline{1} & 1 \\ 1 & 0 & 0 \end{matrix}$$

Use periodic boundary conditions.

3) a) Plot the signal $f(t)$

$$f(t) = \sum_{k=-2}^{2} (t - 2k + 1)\chi_{(0,1)}(t - 2k)$$

b) Plot $\frac{df(t)}{dt}$

1) Consider a discrete LTI system. When the input is $\underline{-1}$, 3, 2, 4, the output is $\underline{0}$, -2, 7, 1, 6, -4, 0, 0. If the input is 4, $\underline{0}$, -2, -7, 1, 0, 2 what will be the output?

2) Convolve $tU(t)$ with $-tU(t)$. Evaluate the integrals and plot the result.

3) Compute the Fourier transform of $1 + e^{-3|t|}(2U(t) - 1)$.

4) Consider the signal $f(t)$ whose Fourier transform is

$$F(\omega) = (\omega + 100\pi)\chi_{[-100\pi,0]}(\omega) + (100\pi - \omega)\chi_{[0,100\pi]}(\omega)$$

Draw the signal $f(t)\cos(300\pi t)$ in frequency domain.

Dear Students,

Solving the questions below will prepare you well for the coming exams.. None of the questions can be considered difficult, with the exception of Question 3. Even in that case, you are only required to remember the formulas for the summation of geometric series and the complex representation of $\sin(x)$, ie,

$$\sin(x) = \frac{e^x - e^{-x}}{2i} \tag{1}$$

1) Let us have an LTI system. I enter $\chi_{[0,1]}(t)$ to the system as input and I receive $e^{-2t}U(t)$ as output. If I enter $3\chi_{[4,5]}(t) - 7\chi_{[8,9]}(t)$ as input, what will be the output?

2) Convolve $t\chi_{[0,2]}(t)$ with itself.

3) Prove that

$$\sum_{k=-N}^{N} e^{2\pi ikt} = \frac{\sin[(2N+1)\pi t]}{\sin(\pi t)} \tag{2}$$

4) Let $f(t) = t\chi_{[0,2]}(t) + 2\chi_{[2,3]}(t) + (5-t)\chi_{[3,5]}(t)$.

...a) Plot $f(t)$

...b) Plot $2f(2t+1)+1$

5) Convolve $(t+5)\chi_{[-5,0]}(t) + (5-t)\chi_{[0,5]}(t)$ with

...a)

$$\sum_{k=-\infty}^{\infty} \delta(t-11k) \tag{3}$$

...b)

$$\sum_{k=-\infty}^{\infty} \delta(t-8k) \tag{4}$$

Plot your results.

6) Consider a LTI system whose impulse response is $e^{-5t}U(t)$. If I enter $\chi_{[2,5]}(t)$ to this system as input, what will be its output?

7) Find the Fourier transform of $t\chi_{[0,2]}(t) + U(t)$. Show all your work.

HW

8) Find the fourier transform of $2 + \delta(t-3)$. Show all your work.

9) Consider a signal $f(t)$ whose Fourier Transform is $f(\omega) = \chi_{[-20,20]}(\omega)$. Let us modulate this signal with $\cos(2\pi 30t)$.

...a) Draw the modulated signal in frequency domain.

...b) What would you do to demodulate this signal?

10) Let us sample $f(t)$ given in Question 9 with

...a) 5 Hz.

...b) 30 Hz.

In both cases, draw the sampled signal in frequency domain. In which case(s) we can recover the original signal from the sampled signal?

Note: $\omega = 2\pi f$, where f is frequency, measured in Hertz.

11) Convolve 2 0 5 3 1 -4 6 with itself.

12) Filter the signal

1 2 4 1
2 0 4 3
1 1 1 1
1 0 4 2

with the filter

1 0 1
0 2 0
1 0 1

Use periodic boundary conditions.

CSE 348 Homework. Due: July 1, 2020

Dear Students,

Solving the questions below will prepare you well for the final exam.. Please draw a box around your final resuls.

1) Compute $\tan(i)$ where $i = \sqrt{-1}$.

2) Convolve $\chi_{[0,2]}(t)$ with $tU(t)$. Evaluate the integrals and plot the result.

3) Compute the Fourier transform of $te^{-3t}U(t)$. Hint: Use an integral table to evaluate the integral..

4) Let us have a function $f(t)$ whose Fourier transform is $F(\omega)$. Prove that the Fourier transform of $\frac{d}{dt}f(t)$ is $i\omega F(\omega)$

5) Consider a signal $f(t)$ whose Fourier Transform is $f(\omega) = \chi_{[-100,100]}(\omega)$. We want to sample this signal. What is the lowest rate of sampling we can use if we dont want any aliasing?

6) Filter the signal

$\underline{1}$ 2 4 1
2 0 4 3
1 1 1 1
1 0 4 2

HW2

with the filter

1 0 1
0 $\underline{2}$ 0
1 0 1

Use **zero boundary conditions.**