Signals and systems
Homework #6

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◉ Homeworks will not be accepted after the deadline.

◉ For theoretical problems, gather them in a single ***.pdf** file.

◉ For the matlab problems, provide both these materials:

  ▸ **codes [*.m files]**

  ▸ a simple **report** that includes all plots and screenshots.

◉ Notice that the homeworks will be **checked by plagiarism detectors**, avoid any similarities.

◉ Matlab problems and theoretical problems will be graded separately (both will be graded out of 100), but their weights may be different and is determined by the course professor.

Question 1

compute the fourier transform of the following signals

(a) $x[n] = \cos\left(\dfrac{\pi}{3}n + \dfrac{\pi}{6}\right)$

(b) $x[n] = \begin{cases} 1 & 0 \le n \le 10 \\ 0 & O.W. \end{cases}$

(c) $x[n] = \dfrac{\sin\left(\dfrac{\pi}{6}n\right)}{\pi n}$

(d) $x[n] = (0.5)^{|n|} u[-n-5]$

(e) $x[n] = 2^n \sin\left(\dfrac{\pi}{4}n\right) u[-n]$

Imagine x[n] with fourier transform of $X(e^{jw})$. determine the fourier transform of the following signals with respect to $X(e^{jw})$

(a) $x[1-n] + x[-1-n]$

(b) $(n-1)^2 x[n]$

(c) $x*[-n]$ (signal is real)

Question 3

A DTLTI system is characterized by the difference equation:
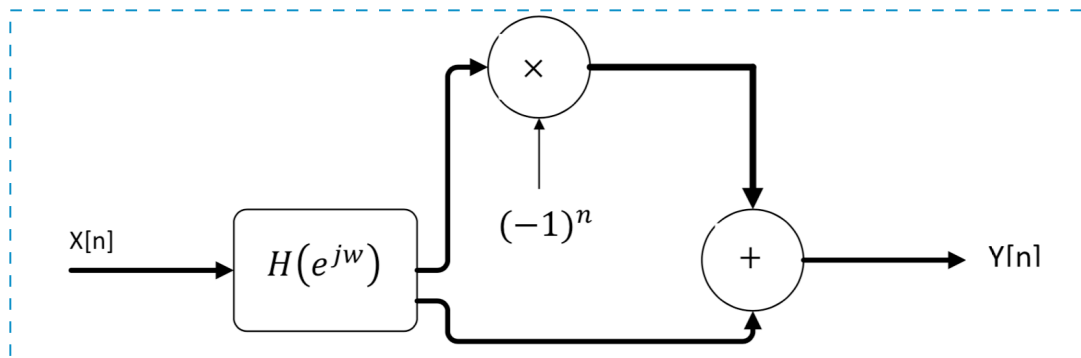
$$y[n] + y[n-1] + 0.89\, y[n-2] = x[n] + 2\, x[n-1]$$

Determine the steady-state response of the system to the following input signals:

(a) $x[n] = e^{j0.2\pi n}$

(b) $x[n] = \cos(0.2\pi n)$

(c) $x[n] = 2\sin(0.3\pi n)$

(d) $x[n] = 3\cos(0.1\pi n) - 5\sin(0.2\pi n)$

Question 4

for the following system, determine output for $x[n] = \delta[n]$.
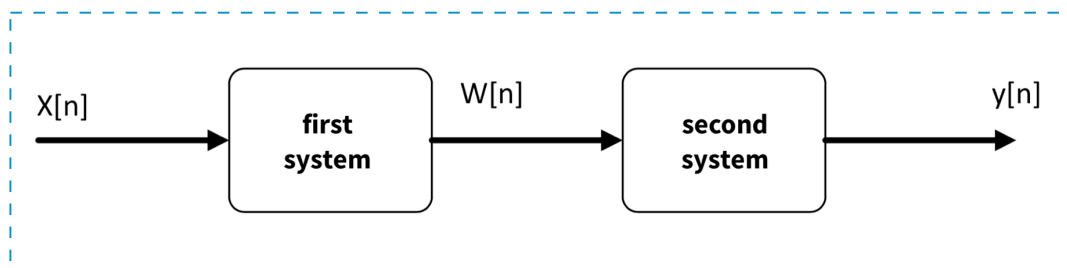

$$H\left(e^{j\omega}\right) = \begin{cases} 1 & |w| < \frac{\pi}{2} \\ 0 & \frac{\pi}{2} \le |w| \le \pi \end{cases}$$

Question 5

Consider the following LTI systems,

first system can be described by the following differential equation

$$w[n] = x[n] - x[n-1]$$

and second system can be described by

$$h_2[n] = \frac{\sin(0.5\pi n)}{\pi n}$$

if we apply the following input, determine the output.

$$x[n] = \cos(0.4\pi n) + \sin(0.6\pi n) + 2\delta[n-2]$$

Matlab exercise

In this exercise, you have to develop a Matlab function to implement DTFS and inverse DTFS. Note that you are not allowed to use Matlab default functions for Fourier transform such as fft.

Validate your functions with appropriate input data and draw the outputs.