Signals and Systems

Assignment 6

Fall 2019 - Group 1

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Question 1

Determine the Fourier Transform for the following signals:

(a) $x[n] = 3 + sin(\frac{\pi}{6}n + \frac{\pi}{8})$

(b) $x[n] = u[n] - u[n-15]$

(c) $x[n] = \frac{sin(\frac{\pi}{3}n)}{\pi n}$

(d) $x[n] = \left(\frac{1}{3}\right)^{|n|} u[-n-6]$

(e) $x[n] = 3^n sin(\frac{\pi}{6}n)u[-n]$

Question 2

Determine the Fourier Transform for the following signals in terms of $X(e^{j\omega})$:

(a) $x[2-n]+x[-3-n]$

(b) $(n-1)^3 x[n]$

Question 3

Determine the Inverse Fourier Transform for the following signals:

(a) $\hat{X}(e^{j\omega}) = \begin{cases} 1 & \frac{\pi}{4} < |\omega| < \frac{3\pi}{4} \\ 0 & otherwise \end{cases}$

(b) $X(e^{j\omega}) = 1 + 3e^{-j\omega} + 8e^{j6\omega}$

(c) $X(e^{j\omega}) = \frac{1-\frac{1}{3}e^{-j\omega}}{1-\frac{1}{4}e^{-j\omega}-\frac{1}{8}e^{-j2\omega}}$

Question 4

Consider a system consisting of the cascade of two LTI systems with frequency responses

$$H_1(e^{j\omega}) = \frac{2 - e^{-j\omega}}{1 + \frac{1}{2}e^{-j\omega}}$$

and

$$H_2(e^{j\omega}) = \frac{1}{1 - \frac{1}{2}e^{-j\omega} + \frac{1}{4}e^{-j2\omega}}$$

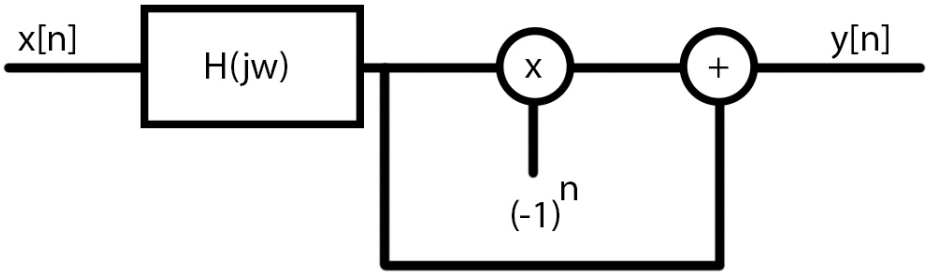
(a) Find the difference equation describing the overall system.

(b) Determine the impulse response of the overall system.

Question 5

Determine the output for $x[n] = \delta[n]$.

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

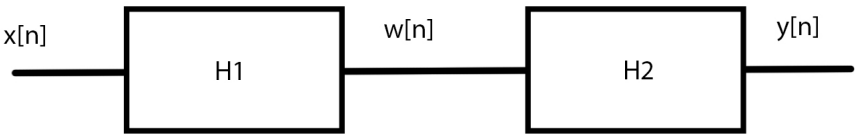


Question 6

Determine the output of an LTI system with impulse response $h[n] = \frac{sin(\frac{\pi}{6}n)sin(\frac{\pi}{3}n)}{\pi^2 n^2}$ if the input is $x[n] = sin(\frac{\pi}{8}n) - 2cos(\frac{\pi}{4}n)$.

Question 7

Consider the following LTI system:



$$w[n] = x[n] - x[n-2]$$

$$H_2(e^{j\omega}) = \frac{sin(\frac{\pi}{2}n)}{\pi n}$$

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

(a) Determine $W(e^{j\omega})$

(b) Determine $H_1(e^{j\omega})$

(c) Determine $H_{eq}(e^{j\omega})$

(d) Determine $X(e^{j\omega})$

(e) Determine $Y(e^{j\omega})$

(f) Determine $y[n]$