Department of Electrical Engineering
School of Science and Engineering

EE310 Signals and Systems

TUTORIAL 10

Information:

- $$\mathcal{F}\{\alpha^n u[n]\} = \frac{1}{1-\alpha e^{-j\omega}}, \quad |\alpha| < 1.$$
- The Fourier transform of the following signal
$$x[n] = \frac{\sin(nW)}{\pi n}, \quad W \leq \pi$$
is given by (in the range $-\pi \leq \omega \leq \pi$)
$$X(e^{j\omega}) = \begin{cases} 1 & |\omega| < W, \\ 0 & |\omega| > W. \end{cases}$$

Tutorial 10-1

Consider a discrete-time LTI system characterized by the difference equation

$$y[n] - \frac{5}{4}y[n-1] - \frac{3}{8}y[n-2] = x[n] - \frac{1}{4}x[n-1],$$

where $x[n]$ and $y[n]$ denotes the input and output of the system respectively.

(a) Determine the frequency response of the system.

(b) Determine the impulse response of the system.

(c) Determine the output of the system for an input $x[n]$ given by

$$x[n] = \left(\frac{1}{2}\right)^n u[n],$$

Tutorial 10-2

Consider a discrete-time low-pass filter with cut-off frequency W, $W \leq \pi$ as an LTI system (System 1) with impulse response denoted by $h_1[n]$. Consider another LTI system (System 2), with input $x[n]$ and output $y[n]$, which are related by

$$y[n] = z[n]\Big(h_1[n] * \big(z[n]x[n]\big)\Big), \tag{1}$$

where $z[n] = (-1)^n$.

Determine the frequency response and impulse response of the System 2.

Tutorial 10-3

Consider a discrete-time LTI system with impulse response

$$h[n] = \sin\Big(\frac{\pi n}{8}\Big) - 2\cos\Big(\frac{\pi n}{4}\Big).$$

Determine the output of the system for an input $x[n]$ given by

$$x[n] = \frac{\sin(\pi n/6)}{\pi n} + \frac{\sin(\pi n/2)}{\pi n}.$$

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