Signal & Systems
Lecture #11

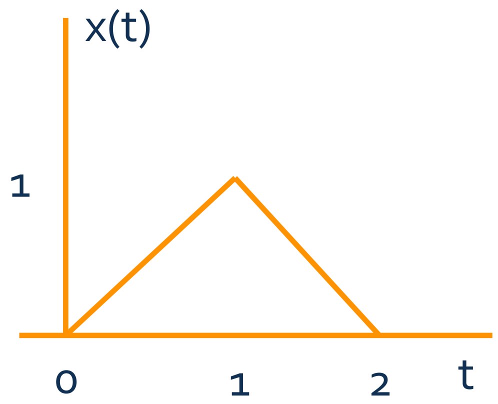
29th May 18

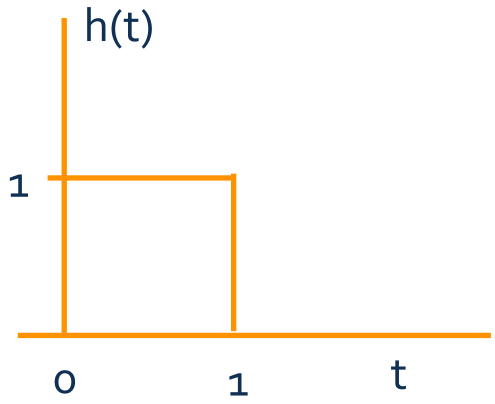
Revision

Convolution

Practice Problem #1

- Convolve the following continuous signals:





Fourier Series

Problem #2

- For the continuous-time periodic signal:

$$x(t) = 2 + \cos\left(\frac{2\pi}{3}t\right) + 4\sin\left(\frac{5\pi}{3}t\right)$$

- Determine the fundamental frequency ω_o and the Fourier series coefficients a_k such that:

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t}$$

Problem #3

- Each of the two sequences $x_1[n]$ and $x_2[n]$ has a period N=4, and the corresponding Fourier series coefficients are specified as:

$$x_1[n] \leftrightarrow a_k, \quad x_2[n] \leftrightarrow b_k$$

- Where,

$$a_0 = a_3 = \frac{1}{2}a_1 = \frac{1}{2}a_2 = 1$$

$$and$$

$$b_0 = b_1 = b_2 = b_3 = 1$$

- Using the multiplication property in Table 3.1, determine the Fourier series coefficients c_k for the signal $g[n]=x_1[n]\, x_2[n]$.

Discrete Time Fourier Trasnfrom

Problem #4

- An LTI system with impulse response $h_1[n]=(1/3)^n\, u[n]$ is connected in parallel with another causal LTI system with impulse response $h_2[n]$. The resulting parallel interconnection has the frequency response:

$$H\left(e^{j\omega}\right)=\frac{-12+5e^{-j\omega}}{12-7e^{-j\omega}+e^{-2j\omega}}$$

- Determine $h_2[n]$.

Problem #5

- Consider a causal and stable LTI system S whose input x[n] and output y[n] are related through the second-order difference equation:

$$y[n]-\frac{1}{6}y[n-1]-\frac{1}{6}y[n-2]=x[n]$$

- (a): Determine the frequency response $H(e^{j\omega})$ for the system S.
- (b): Determine the impulse response h[n] for the system S.

Z-Transform

Problem #6

- Consider the signal:

$$x[n] = \left(\frac{1}{5}\right)^n u[n-3]$$

- Evaluate the z-transform of this signal and specify the corresponding region of convergence.

Problem #7

- Consider the following algebraic expression for the z-transform X(z) of a signal x[n]:

$$X(z) = \frac{1+z^{-1}}{1+\frac{1}{3}z^{-1}}$$

- Assuming the ROC to be $|z| > 1/3$, use long division to determine the values of x[0], x[1] and x[2].

- Assuming the ROC to be $|z| < 1/3$, use long division to determine the values of x[0], x[-1] and x[-2].

Problem #8

- Using the Partial fractions, determine the sequence that goes with the following z-transform:

$$X(z) = \frac{1 - 2z^{-1}}{1 - \frac{5}{2}z^{-1} + z^{-2}}$$

- And x[n] is absolutely summable.

Thank You!