Lecture 42, Tuesday, April 12, 2022

- Impulse:

    - Fourier transform

$$\mathcal{F}\left\{\delta(t)\right\} = 1$$

    - Inverse Fourier transform

$$\mathcal{F}^{-1}\left\{\delta(\omega)\right\} = \frac{1}{2\pi}$$

    - Doublet

$$\delta'(t) = \frac{d}{dt}\delta(t) \;\Rightarrow\; f(t) * \delta'(t) = f'(t)$$

- Recall that

$$f(t) \longrightarrow \boxed{\mathrm{h(t)}} \longrightarrow y_{ZS}(t) = f(t) * h(t)$$

    - $h(t)$ is called the *impulse response,* because it is the response to an impulse:

$$\delta(t) \longrightarrow \boxed{\mathrm{h(t)}} \longrightarrow y_{ZS}(t) = \delta(t) * h(t) = h(t)$$

    - Each LTI system has an $h(t)$ such that $y_{ZS}(t) = f(t) * h(t)$ for any $f(t)$

- We can use the impulse to represent in frequency signals with infinite energy, e.g.

$$\mathcal{F}\left\{\cos(\omega_c t)\right\} = \pi\delta(\omega - \omega_c) + \pi\delta(\omega + \omega_c)$$