GATE ASSIGNMENT 1

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Download all python codes from

https://github.com/AmulyaTallamraju/EE3900/blob/main/GATE_Assignment−2/codes/GATE_Assignment−2.py

and latex-tikz codes from

https://github.com/AmulyaTallamraju/EE3900/blob/main/GATE_Assignment−2/GATE_Assignment−2.tex

1 GATE EC 2010 Q.15

Two discrete time systems with impulse responses $h_1[n] = \delta[n-1]$ and $h_2[n] = \delta[n-2]$ are connected in cascade. The overall impulse response of the cascaded system is

2 Solution

When connecting LTI systems in cascade the impulse response of the overall system can be found using convolution . Two LTI systems with impulse responses $h_1(n)$ and $h_2(n)$ connected in cascade have as an overall impulse response

$$h(n) = [h_1 * h_2](n) = [h_2 * h_1](n) \tag{2.0.1}$$

Hence,

$$h[n] = h_1(n) * h_2(n) \tag{2.0.2}$$

$$= \sum_{m=-\infty}^{\infty} \delta[m-1]\delta[n-2-m] \tag{2.0.3}$$

$$= \delta[n-3] \tag{2.0.4}$$

Using $\mathcal{Z}$ transform- Let $H(z)$ be the $\mathcal{Z}$ transform of $h[n]$. Using convolution theorem we get

$$H(z) = H_1(z)H_2(z) \tag{2.0.5}$$

$\mathcal{Z}$ transform of $h[n]$ is defined as

$$\mathcal{Z}(h[n]) = \sum_{-\infty}^{\infty} h[n]z^{-n} \tag{2.0.6}$$

$$\implies H_1(z) = z^{-1} \tag{2.0.7}$$

$$\implies H_2(z) = z^{-2} \tag{2.0.8}$$

$$\implies H(z) = z^{-3} \tag{2.0.9}$$

Let $h[n]$ be such that

$$H(z) = \mathcal{Z}(h[n]) = \sum_{-\infty}^{\infty} h[n]z^{-n} \tag{2.0.10}$$

$$\implies z^{-3} = \sum_{-\infty}^{\infty} h[n]z^{-n} \tag{2.0.11}$$

$$\implies h[n] = \delta(n-3) \tag{2.0.12}$$

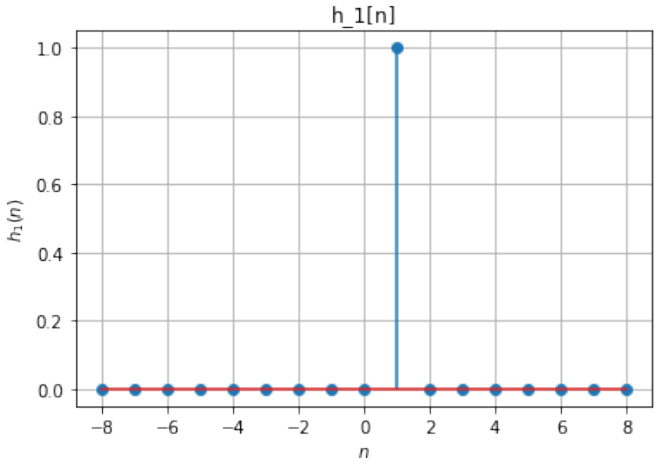

Fig. 0: Plot of $h_1[n]$

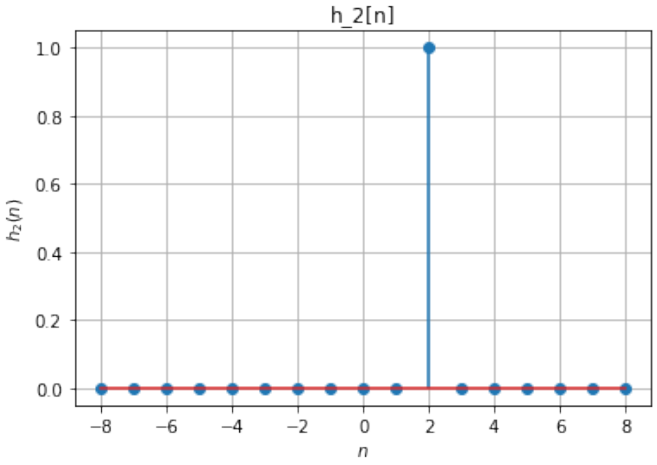

Fig. 0: Plot of $h_2[n]$

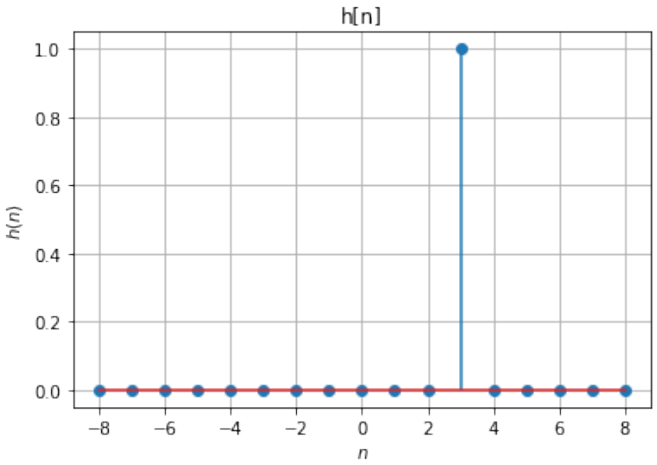

Fig. 0: Plot of $h[n]$