Gate Assignment 1

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Download latex-tikz codes from

https://github.com/KBVijayVarma/EE3900/tree/main/Gate_Assignment_1

Download python codes from

https://github.com/KBVijayVarma/EE3900/tree/main/Gate_Assignment_1/code

Problem (EC 2013 Q 1)

Two systems with impulse responses $h_1(t)$ and $h_2(t)$ are connected in cascade. Then the overall impulse response of the cascaded system is given by

1) product of $h_1(t)$ and $h_2(t)$
2) sum of $h_1(t)$ and $h_2(t)$
3) convolution of $h_1(t)$ and $h_2(t)$
4) subtraction of $h_2(t)$ from $h_1(t)$

Solution

Given Two systems with impulse responses $h_1(t)$ and $h_2(t)$ are connected in cascade.
We know that "when two systems are cascaded, then the resultant response is the convolution of the individual responses".
Let Input x for Cascaded System be as in the below figure.
Let $x = \begin{pmatrix} 0 & 0 & 1 & 0 & 0 \end{pmatrix}$

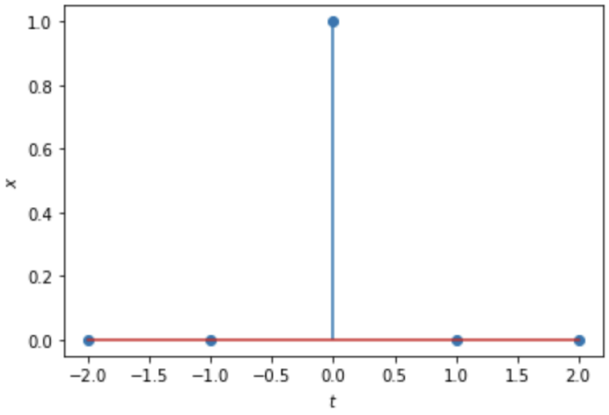

Fig. 4: Plot of x

$h_1[t]$ is given by $h_1 = \begin{pmatrix} 0 & 2 & 1 & 0 & 0 \end{pmatrix}$,

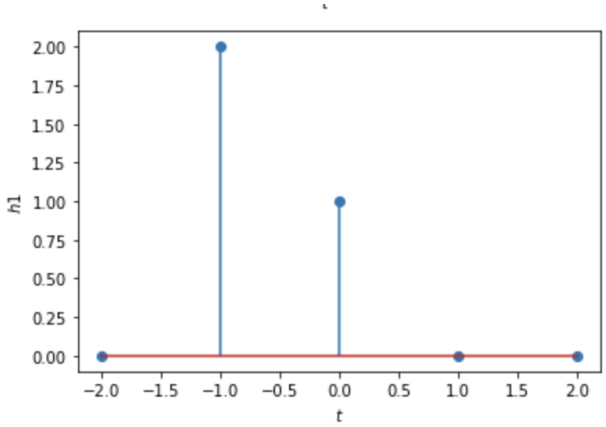

Fig. 4: Plot of $h1$

$h_2 2[t]$ is given by $h_2 = \begin{pmatrix} 0 & 1 & 2 & 0 & 0 \end{pmatrix}$,

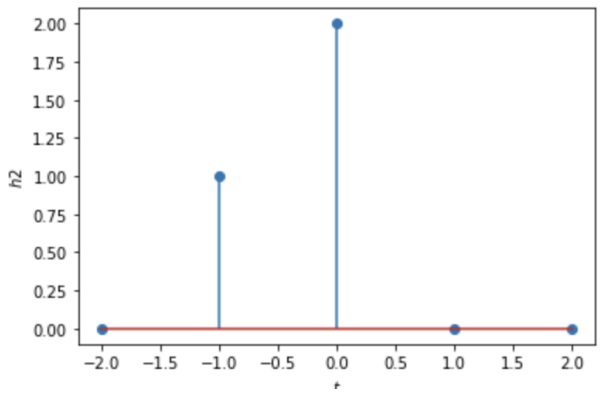

Fig. 4: Plot of $h2$

Now, for the cascaded system,

$$y_1[t] = x[t] * h_1[t] \tag{0.0.1}$$

$$y_2[t] = y_1[t] * h_2[t] \tag{0.0.2}$$

The final output $y_2[t]$ is given by $y_2 = \begin{pmatrix} 0 & 0 & 0 & 0 & 2 & 5 & 2 & 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$,

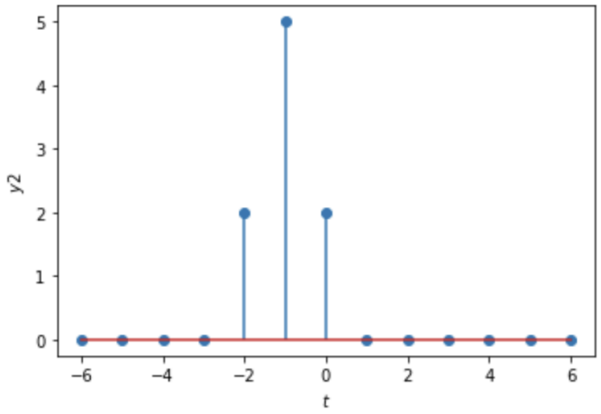

Fig. 4: Plot of $y2$

Now, by replacing the above method with Convolution of $h_1[t]$ and $h_2[t]$,

$$h[t] = h_1[t] * h_2[t] \tag{0.0.3}$$

$$y[t] = x[t] * h[t] \tag{0.0.4}$$

In this case, the final output $y[t]$ is given by $y = \begin{pmatrix} 0 & 0 & 0 & 0 & 2 & 5 & 2 & 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$,

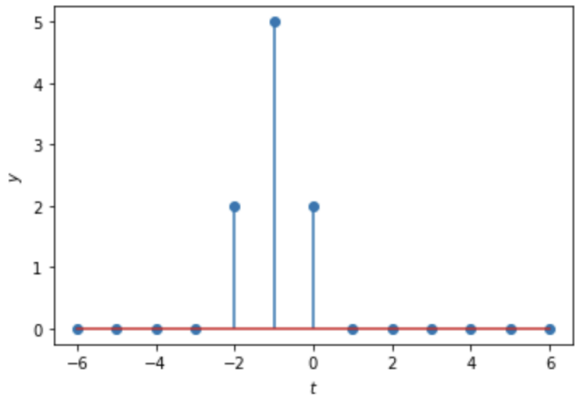

Fig. 4: Plot of y

Hence, from the figures 4, 4, the final output is the same.
Hence, the overall impulse response of the Cascaded system is given by **Convolution of h_1(t) and h_2(t)**. Therefore, **Option 3** is Correct.