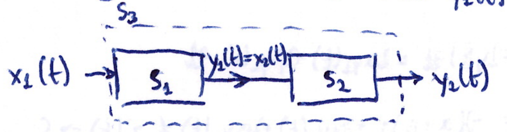
1.42.

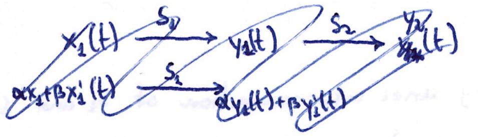
a) Is the following statement true or false?

The series interconnection of two ~~linear~~ linear time-invariant systems is a linear time-invariant system.

Let S_1 and S_2 be two linear time invariant systems ~~defined by the input~~ of inputs $x_1(t)$ and $x_2(t)$, and outputs $y_1(t)$ and $y_2(t)$. The system S_3 is the series connection of both, with input $x_3(t) = x_1(t)$ and output $y_3(t) = y_2(t)$, ~~connecting~~ made by connecting S_1 and S_2 such that $y_1(t) = x_2(t)$



~~linear~~



For simplicity, let's define the ~~system~~ system as so:

$$x(t) \xrightarrow{S_1} y(t) \xrightarrow{S_2} z(t) \quad , \quad x(t) \xrightarrow{S_3} z(t)$$

- If both S_1 and S_2 are linear, then:

$$\alpha x(t) + \beta x'(t) \xrightarrow{S_1} \alpha y(t) + \beta y'(t) \xrightarrow{S_2} \alpha z(t) + \beta z'(t) \quad , \text{ where } x'(t) \xrightarrow{S_1} y'(t) \xrightarrow{S_2} z'(t)$$

Therefore, the system S_3 is linear

- If S_1 and S_2 are time invariant, then:

$$x(t) \xrightarrow{T.S.} x'(t) = x(t+k) \xrightarrow{S_1} y'(t) = y(t+k) \xrightarrow{S_2} z'(t) = z(t+k) \Rightarrow x(t) \xrightarrow{T.S.} x'(t) = x(t+k) \xrightarrow{S_3} z'(t) = z(t+k)$$

$$x(t) \xrightarrow{S_1} y(t) \xrightarrow{S_2} z(t) \xrightarrow{T.S.} z'(t) = z(t+k) \Rightarrow x(t) \xrightarrow{S_3} z(t) \xrightarrow{T.S.} z(t+k) = z'(t)$$

Therefore, the global system is time invariant

$\boxed{\text{The statement is true}}$