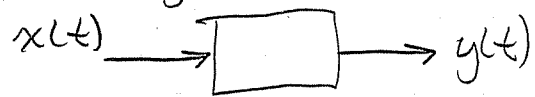


Consider the continuous-time system with excitation $x(t)$ and response $y(t)$



$$\text{where } y(t) = x(\sin(t))$$

(a) is this system causal

No, because the output at some time may depend on future inputs, For instance $y(-\pi) = x(\sin(-\pi)) = x(0)$
so $y(t)$ at $t = -\pi$ is a function of $x(t)$ at $t = 0$.

(b) Is this system linear

$$\text{Let } x_1(t) = g(t) \rightarrow y_1(t) = g(\sin(t))$$

$$\text{Let } x_2(t) = h(t) \rightarrow y_2(t) = h(\sin(t))$$

$$\begin{aligned} \text{Let } x_3(t) = \alpha g(t) + \beta h(t) &\rightarrow y_3(t) = x_3(\sin(t)) \\ &= \alpha g(\sin(t)) + \beta h(\sin(t)) \end{aligned}$$

therefore, the system is linear

(c) based on (a), the system has memory

(d) The system is time varying

$$\text{Let } x_1(t) = g(t) \rightarrow y_1(t) = g(\sin(t))$$

$$\text{Let } x_2(t) = g(t-t_0) \rightarrow y_2(t) = \underbrace{g(\sin(t) - t_0)}$$

this is not the same as
 $y_1(t-t_0) = g(\sin(t-t_0))$

(e) If I gave you $y(t)$ and asked you to give me $x(100)$, you couldn't do it because $y(t)$ is only a function of $x(\tau)$ from $-1 < \tau < +1$, so it's not invertible