

Linear System

$$u_1(t) \rightarrow y_1(t)$$

$$u_2(t) \rightarrow y_2(t)$$

Temporally Causal

$$a u_1(t) + b u_2(t) \rightarrow a y_1(t) + b y_2(t)$$

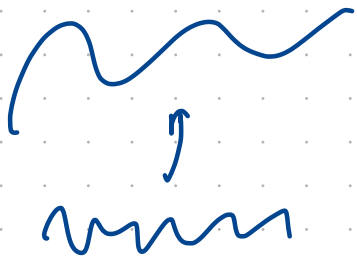
$$y(t_1) \left[ u_{-\infty} \dots u_{t_1} \right]$$

$x(t) \leftarrow$  Summary of all the history of the sy until  $t$   
 $(-\infty, t)$

$$y(t) \leftarrow$$

$$y(t_2) \quad t_2 > t_1 \rightarrow x(t_1), u_{t_1} \dots u_{t_2} \rightarrow y(t_2)$$

Linear :

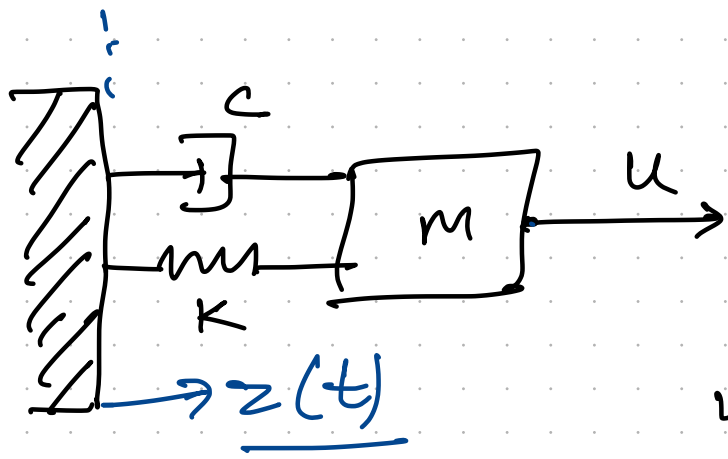


$$u(t) \Rightarrow$$

Continuous

$$\sum_{l=0}^{\infty} c_l$$

$$\underbrace{a_c \sin(i\omega t)}_{f_c(t)} + \underbrace{b_c \cos(i\omega t)}_{f_s(t)}$$



$$F = m \cdot a.$$

$$m \cdot \frac{d^2 z(t)}{dt^2} + c \frac{dz(t)}{dt} + K z(t) = u$$

ODE, order: 2

$$z_1(t) = z(t) = z$$

$$z_2(t) = \frac{dz(t)}{dt} = z'$$

$$M z'' + C z' + K z = u$$

$$\rightarrow \underline{M z_2' + C z_2 + K z_1 = u} \leftarrow$$

ODE  $k^{th}$  order

$\xrightarrow{K}$  1<sup>st</sup> ODE

$$\begin{bmatrix} z_1' \\ z_2' \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -K/m & -C/m \end{bmatrix} \begin{bmatrix} z_1 \\ z_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1/m \end{bmatrix} u$$

$$\dot{x}(t) = A \cdot x(t) + B \cdot u$$

$$\dot{x}(t) = Ax(t) + Bu.$$