$$\bar{X} = \begin{bmatrix} x_1(t) \\ x_2(t) \\ \vdots \\ x_n(t) \end{bmatrix} \qquad \frac{d}{dt}\bar{X} = \begin{bmatrix} \frac{dx_1}{dt} \\ \frac{dx_2}{dt} \\ \vdots \\ \frac{dx_n}{dt} \end{bmatrix} \qquad A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & & a_{2n} \\ \vdots & & & \\ a_{n1} & a_{n2} & & a_{nn} \end{bmatrix}$$

S(n) EDO(1) L CC H.

$$\frac{d}{dt}\bar{X} = A\bar{X} \qquad \bar{X} = \left[e^{At}\right]\bar{X}(0) \qquad \bar{X}(0) = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{bmatrix}$$

$$\frac{dx}{dt} = ax \qquad \frac{d}{dt}\bar{x} = A\bar{x}$$

$$\frac{dx}{dt} - ax = 0 \qquad \bar{x} = \left[e^{At}\right]\bar{x}(0)$$

$$(D-a)x = 0$$

$$x = c_1 e^{at}$$

$$e^{t} = 1 + t + \frac{t^2}{2!} + \frac{t^3}{3!} + \dots + \frac{t^k}{k!} + \dots\dots + \frac{t^n}{n!} \qquad n \to \infty$$

$$= 1 + 1 + \frac{1}{2} + \frac{1}{6} + \frac{1}{24} + \dots\dots$$

$$= 1 + 1 + 0{,}5 + 0{,}17 + \dots \Rightarrow 2{,}72\dots$$

$$e^{at} = 1 + at + \frac{a^2}{2!}t^2 + \frac{a^3}{3!}t^3 + \dots\dots \infty$$

$$\left[e^{At}\right] = I + At + \frac{A^2}{2!}t^2 + \frac{A^3}{3!}t^3 + \dots + \frac{A^k}{k!}t^k + \dots \infty$$

TEOREMA HAMILTON-CAYLE

toda A satisface su ecuación característica

$$A_{2\times 2} \qquad \lambda^2 + b_1\lambda + b_2 = 0 \qquad A^2 + b_1 A + b_2 I = [0]$$

$$A^2 = -b_2 I - b_1 A.$$

$$A^3 = -b_2 A - b_1 A^2$$

$$A^3 = -b_2 A - b_1(-b_2 I - b_1 A)$$

$$A^3 = b_1 b_2 I + (b_1^2 - b_2)A$$

$$A^3 = c_1 I + c_2 A.$$

$$A^4 = c_1 A + c_2 A^2$$

$$A^4 = d_1 I + d_2 A.$$

$$\left[e^{At}\right] = I + At + \frac{A^2}{2!}t^2 + \frac{A^3}{3!}t^3 + \ldots\ldots + \frac{A^k}{k!}t^k + \ldots$$

$$A_{2\times 2} = I + At + \frac{A^2}{2!}t^2 + \ldots\ldots$$

$$\boxed{e^{At} = B_0(t)I + B_1(t)A.}$$

$$A^2 = -b_1 I - b_2 A$$

$$A^2 = c_1 I + c_2 A$$

$$A^3 = a_1 I + d_2 A.$$

$$\vdots$$

$$A^k = n_1 I + n_2 A.$$

$$\frac{dx_1}{dt} = 2x_1 + 3x_2$$

$$\frac{dx_2}{dt} = x_1 + 4k_2$$

$$A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$$

$$\det(A - \lambda I) = 0$$

$$\begin{vmatrix} (2-\lambda) & 3 \\ 1 & (4-\lambda) \end{vmatrix} = 0$$

$$(2-\lambda)(4-\lambda) - (1)(3) = 0$$

$$\lambda^2 - 6\lambda + 8 - 3 = 0$$

$$\lambda^2 - 6\lambda + 5 = 0.$$

$$(\lambda - 1)(\lambda - 5) = 0 \quad \lambda_1 = 1$$

$$\lambda_2 = 5.$$

$$\begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}\begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} - 6\begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} + 5\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 7 & 18 \\ 6 & 19 \end{bmatrix} - \begin{bmatrix} 12 & 18 \\ 6 & 24 \end{bmatrix} + \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix} = [0]$$

$$\begin{matrix} (7-12+5) & (18-18) \\ (6-6) & (19-24+5) \end{matrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$[e^{At}] = B_0(t)\, I + B_1(t)\, A.$$

$\lambda_1 = 1 \qquad \lambda_2 = 5$

$$e^{t} = B_0(t)(1) + B_1(t)(1) \qquad B_0(t) = e^{t} - \left(\frac{e^{5t} - e^{t}}{4}\right)$$

$$e^{5t} = B_0(t)(1) + B_1(t)\,5 \qquad = -\frac{e^{5t}}{4} + \frac{5e^{t}}{4}$$

$$e^{5t} - e^{t} = 4B_1(t) \qquad B_1(t) = \frac{e^{5t} - e^{t}}{4}$$

$$[e^{At}] = B_0(t) I + B_1(t) A.$$

$$[e^{At}] = \left(-\frac{e^{5t}}{4} + \frac{5e^{t}}{4}\right)\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + \left(\frac{e^{5t}}{4} - \frac{e^{t}}{4}\right)\begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$$

$$\boxed{e^{At} = \begin{bmatrix} \frac{1}{4} & +\frac{3}{4} \\ \frac{1}{4} & \frac{3}{4} \end{bmatrix} e^{5t} + \begin{bmatrix} \frac{3}{4} & -\frac{3}{4} \\ -\frac{1}{4} & \frac{1}{4} \end{bmatrix} e^{t}}$$

$$A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \qquad [e^{At}]_{t=0} = I \qquad \frac{d}{dt} e^{At} = A e^{At}$$

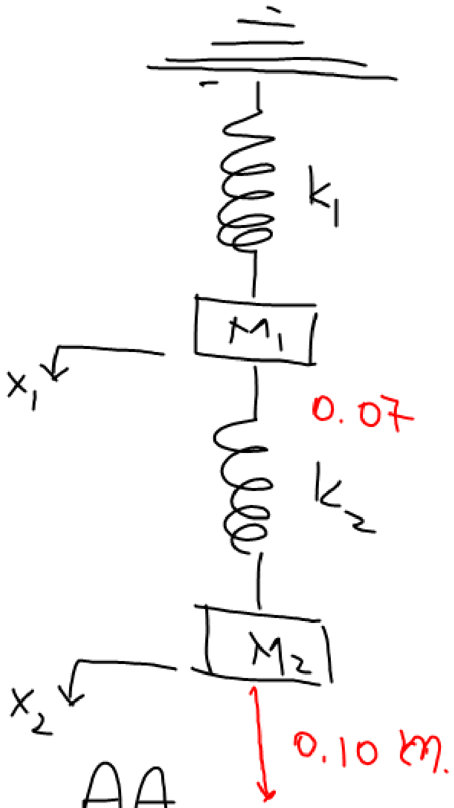
$$[e^{At}]^{-1} = e^{A(-t)} \qquad e^{At} \times [e^{At}]^{-1} = I$$

$m_1 = 2$

$m_2 = 1$

$k_1 = 5$

$k_2 = 7$



$$\boxed{\begin{aligned} m_1 \frac{d^2x_1}{dt^2} &= -k_1 x_1 + k_2(x_2 - x_1) \\ m_2 \frac{d^2x_2}{dt^2} &= -k_2(x_2 - x_1) \end{aligned}}$$

$$\frac{dx_1}{dt} = x_3$$

$$\frac{dx_3}{dt} = \left(-\frac{k_1}{m_1} - \frac{k_2}{m_1}\right)x_1 + \frac{k_2}{m_1}x_2$$

$$\frac{dx_2}{dt} = x_4$$

$$\frac{dx_4}{dt} = \frac{k_2}{m_2}x_1 - \frac{k_2}{m_2}x_2$$

AA

$$\frac{d}{dt}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -6 & \frac{7}{2} & 0 & 0 \\ 7 & -7 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$

$$\frac{d}{dt}\bar{x} = A\bar{x} \longrightarrow \bar{x} = e^{At}\bar{x}(0)$$

S(n) EDO(1) Lcc H.

$$\frac{d}{dt}\bar{x} = A\bar{x} + \bar{b}(t) \qquad \bar{x} = e^{At}\bar{x}(0) + \int_0^t e^{A(t-\tau)}\bar{b}(\tau)\,d\tau.$$

S(n) EDO(1) Lcc NH.