$$\begin{cases} \dfrac{dx_1(t)}{dt} = 2x_1(t) + 3x_2(t) \\[2ex] \dfrac{dx_2(t)}{dt} = x_1(t) + 4x_2(t) \end{cases}$$

S(2)EDOL(1)CCH.

$\downarrow$

EDOL(2)CCH.

$$x_1(t) = \frac{dx_2(t)}{dt} - 4x_2(t)$$

$$\frac{dx_1(t)}{dt} = \frac{d^2x_2(t)}{dt^2} - 4\frac{dx_2(t)}{dt}$$

$$\left(\frac{d^2x_2(t)}{dt^2} - 4\frac{dx_2(t)}{dt}\right) = 2\left(\frac{dx_2(t)}{dt} - 4x_2(t)\right) + 3x_2(t)$$

$$\frac{d^2x_2(t)}{dt^2} - 6\frac{dx_2(t)}{dt} + 5x_2(t) = 0$$

$$\frac{d^3y(t)}{dt^3} + \frac{d^2y(t)}{dt^2} + \frac{dy(t)}{dt} + y(t) = 4e^t$$

EDOL (3) cc NH.

$\downarrow$

S(3) $\underbrace{\text{EDOL (1) cc. NH}}$

$$y(t) = y_1(t)$$

$$\frac{dy(t)}{dt} = \boxed{\frac{dy_1(t)}{dt} = y_2(t)}$$

$$\frac{d^2y(t)}{dt^2} = \boxed{\frac{dy_2(t)}{dt} = y_3(t)}$$

$$\frac{dy_3(t)}{dt} + y_3(t) + y_2(t) + y_1(t) = 4e^t$$

$$\boxed{\begin{aligned} \frac{dy_1(t)}{dt} &= y_2(t) \\ \frac{dy_2(t)}{dt} &= y_3(t) \\ \frac{dy_3(t)}{dt} &= -y_1(t) - y_2(t) - y_3(t) + 4e^t \end{aligned}}$$

S(3) EDOL (1) cc NH.

$$\frac{d}{dt}\begin{bmatrix} y_1(t) \\ y_2(t) \\ y_3(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -1 & -1 \end{bmatrix} \begin{bmatrix} y_1(t) \\ y_2(t) \\ y_3(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 4e^t \end{bmatrix}$$

$$\bar{X} = e^{At} \cdot \bar{X}_0 + \int_0^t e^{A(t-z)} S(z)\, dz.$$

$$\frac{d}{dt}\bar{X} = A\bar{X}$$

$$\mathcal{L}\left\{\frac{d}{dt}\bar{x}\right\} = A\mathcal{L}\{\bar{x}\}$$

$$\left[s\mathcal{L}\{\bar{x}\} - \bar{x}_0\right] = A\mathcal{L}\{\bar{x}\}$$

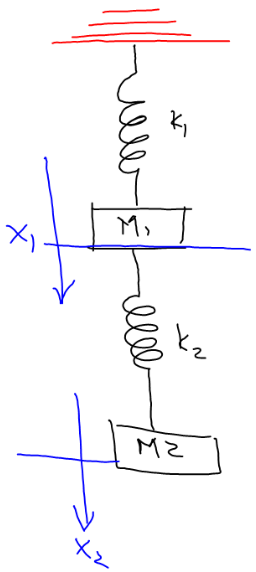
$$s\mathcal{L}\{\bar{x}\} - A\mathcal{L}\{\bar{x}\} = \bar{x}_0$$

$$(sI - A)\mathcal{L}\{\bar{x}\} = \bar{x}_0$$

$$\mathcal{L}\{\bar{x}\} = (sI - A)^{-1}\bar{x}_0$$

$$\bar{x} = \mathcal{L}^{-1}\left\{(sI - A)^{-1}\right\}\bar{x}_0$$

$$\boxed{e^{At} = \mathcal{L}^{-1}\left\{(sI - A)^{-1}\right\}}$$



$$M_1 \frac{d^2x_1}{dt^2} = -k_1 x_1 + k_2(x_2 - x_1)$$

$$M_2 \frac{d^2x_2}{dt^2} = -k_2(x_2 - x_1)$$

$$\boxed{\begin{aligned} \frac{dx_1}{dt} &= x_3 \\ \frac{dx_2}{dt} &= x_4 \\ \frac{dx_3}{dt} &= \left(-\frac{k_1}{M_1} - \frac{k_2}{M_1}\right)x_1 + \left(\frac{k_2}{M_1}\right)x_2 \\ \frac{dx_4}{dt} &= \frac{k_2}{M_2}x_1 - \frac{k_2}{M_2}x_2 \end{aligned}}$$

$k_1 = 6 \qquad k_2 = 4$

$M_1 = 1 \qquad M_2 = 1$

$x_1(0) = \frac{4}{3} \qquad x_1'(0) = 0$

$x_2(0) = 2 \qquad x_2'(0) = 0$

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

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

$$\frac{dx_3}{dt} = -10x_1 + 4x_2$$

$$\frac{dx_4}{dt} = 4x_1 - 4x_2$$

$k_1 = 4 \qquad k_2 = 6$

$x_1(0) = 3$

$x_2(0) = 2$

$= -10x_1 + 6x_2$

$= 6x_1 - 6x_2$