$$\frac{dx(t)}{dt} = 2x(t) + 3y(t) \quad ; \quad x(0) = 5$$

$$\frac{dy(t)}{dt} = x(t) + 4y(t) \quad ; \quad y(0) = -8$$

SG

$$x(t) = -3c_1 e^{t} + c_2 e^{5t}$$

$$y(t) = c_1 e^{t} + c_2 e^{5t}$$

$$x(0) \Rightarrow 5 = -3c_1 e^{(0)} + c_2 e^{(0)}$$

$$y(0) \Rightarrow -8 = c_1 e^{(0)} + c_2 e^{(0)}$$

$$-3c_1 + c_2 = 5$$

$$c_1 + c_2 = -8$$

$$3c_1 - c_2 = -5$$

$$4c_1 = -13$$

$$c_1 = \frac{-13}{4}$$

$$c_2 = -8 - c_1$$

$$c_2 = -8 + \frac{13}{4}$$

$$c_2 = -\frac{19}{4}$$

SP

$$x(t) = \frac{39}{4} e^{t} - \frac{19}{4} e^{5t}$$

$$y(t) = -\frac{13}{4} e^{t} - \frac{19}{4} e^{5t}$$

$$x(t) = \frac{39}{4} e^{t} - \frac{19}{4} e^{5t}$$

$$y(t) = -\frac{13}{4} e^{t} - \frac{19}{4} e^{5t}$$

$$x(t) = \frac{39}{4} e^{t} - \frac{19}{4} e^{5t}$$

$$y(t) = -\frac{13}{4} e^{t} - \frac{19}{4} e^{5t}$$

S(n) EDO(1) L cc H

EDO(n) L cc H.

$$\frac{d}{dt}\left[\bar{y}(t)\right] = \underset{n\times n}{A} \cdot \left[\bar{y}(t)\right] \Rightarrow \bar{y}(t) = \left[e^{A(t)}\right] \bar{y}(0)$$

$$\bar{y}(t) \qquad \frac{d^4 y(t)}{dt^4} + 5\frac{d^2 y(t)}{dt} - 4y(t) = 0 \qquad \begin{cases} y(0) = y_1(0) \\ y'(0) = y_2(0) \\ y''(0) = y_3(0) \\ y'''(0) = y_4(0) \end{cases}$$

$$\downarrow \qquad\qquad\qquad\qquad\qquad\qquad \uparrow$$

$$\begin{bmatrix} y_1(t) \\ y_2(t) \\ y_3(t) \\ y_4(t) \end{bmatrix} \qquad\qquad\qquad\qquad \bar{y}(0)$$

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

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

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

$$\frac{d^3 y(t)}{dt^3} \Rightarrow \frac{dy_3(t)}{dt} = y_4(t)$$

$$\frac{d^4 y(t)}{dt^4} \Rightarrow \frac{dy_4(t)}{dt} = -5y_3 + 4y_1(t)$$

$$\frac{d}{dt}\begin{bmatrix} y_1(t) \\ y_2(t) \\ y_3(t) \\ y_4(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 4 & 0 & -5 & 0 \end{bmatrix} \begin{bmatrix} y_1(t) \\ y_2(t) \\ y_3(t) \\ y_4(t) \end{bmatrix}$$

$$e^{A(t)} \quad n \times n \qquad\qquad e^{at}$$

$$\frac{d}{dt}\left[e^{A(t)}\right] = A \times \left[e^{A(t)}\right] \qquad \frac{d}{dt} e^{at} = a e^{at}$$

$$\left[e^{A(0)}\right] = I. \qquad\qquad e^{a(0)} = 1$$

$$\left[e^{A(t)}\right] \times \left[e^{A(-t)}\right] = I \qquad\qquad e^{a(t)} \cdot e^{a(-t)} = 1$$

$$\left[e^{A(t)}\right]^{-1}$$

$$e^{t} \Rightarrow 1 + \frac{t}{1!} + \frac{t^2}{2!} + \frac{t^3}{3!} + \cdots + \frac{t^k}{k!} + \cdots$$

$$\Rightarrow 1 + 1 + \frac{1}{2} + \frac{1}{6} + \frac{1}{24} + \cdots + \frac{1}{k!} + \cdots$$

$$2 + 0.5 + 0.16 + 0.0416$$

$$= 2.7016 \longrightarrow 2.72 \doteq$$

$$e^{at} = 1 + \frac{at}{1!} + \frac{(at)^2}{2!} + \frac{(at)^3}{3!} + \cdots + \frac{(at)^k}{k!} + \cdots$$

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

$$\left[e^{A(t)}\right] = I + \frac{A}{1!}t + \frac{A^2}{2!}t^2 + \frac{A^3}{3!}t^3 + \dots + \frac{A^k}{k!}t^k + \dots$$

Teorema Hamilton - Cayle

$$\lambda^n + a_1\lambda^{n-1} + a_2\lambda^{n-2} + \dots + a_{n-1}\lambda + a_n = 0$$

$$\lambda_1 \quad \lambda_2 \quad \lambda_3 \dots \lambda_n = 0$$

$$\begin{vmatrix} a_{11}-\lambda & a_{12} & a_{13} \dots a_{1n} \\ a_{21} & a_{22}-\lambda & a_{23} \dots a_{2n} \\ \vdots & & \\ a_{n1} & a_{n2} & a_{n3} \dots a_{nn}-\lambda \end{vmatrix} = 0 \qquad \det(A-\lambda I) = 0$$

$$A^n + a_1 A^{n-1} + a_2 A^{n-2} + \dots + a_{n-1}A + a_n I = [0]$$

$$e^{At} = \beta_0(t) I + \beta_1(t) A + \beta_2(t) A^2 + \dots + \beta_{n-1}(t) A^{n-1}$$

$A_{n\times n}$

$$A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \qquad e^{At} = \beta_0(t) I + \beta_1(t) A$$

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

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

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

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

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

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

$$\lambda_1 = 1 \quad \lambda_2 = 5$$

$$A^2 - 6A + 5I = [0]$$

$$A^2 = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \times \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \Rightarrow \begin{bmatrix} 4+3 & 6+12 \\ 2+4 & 3+16 \end{bmatrix} \Rightarrow \begin{bmatrix} 7 & 18 \\ 6 & 19 \end{bmatrix}$$

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

$$e^{A(t)} = B_0(t) I + B_1(t) A$$

$$\lambda_1 = 1 \quad e^{t} = B_0 + B_1$$

$$\lambda_2 = 5 \quad e^{5t} = B_0 + 5B_1$$

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

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

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

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

$$e^{A(t)} = \frac{1}{4}\begin{bmatrix} 3 & -3 \\ -1 & 1 \end{bmatrix} e^{t} + \frac{1}{4}\begin{bmatrix} 1 & 3 \\ 1 & 3 \end{bmatrix} e^{5t}$$

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