```
> restart
> AA := array([[2, 3], [1, 4]])
```

$$AA := \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \tag{1}$$

```
> II := array([[1, 0], [0, 1]])
```

$$II := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{2}$$

```
> with(linalg) :
> EcuacionPropia := det(evalm(AA - lambda·II)) = 0
```

$$EcuacionPropia := 5 - 6\,\lambda + \lambda^2 = 0 \tag{3}$$

```
> Propio := solve(EcuacionPropia)
```

$$Propio := 5,\ 1 \tag{4}$$

```
> Sistema := exp(Propio[1]·t) = B[0]·(1) + B[1]·Propio[1], exp(Propio[2]·t) = B[0]·(1) + B[1]·Propio[2] :
    Sistema[1]; Sistema[2]
```

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

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

```
> Parametro := solve({Sistema}, {B[0], B[1]}) : Parametro[1]; Parametro[2]
```

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

$$B_1 = -\frac{1}{4}\,e^{t} + \frac{1}{4}\,e^{5t} \tag{6}$$

```
> MatExp := evalm(rhs(Parametro[1])·II + rhs(Parametro[2])·AA)
```

$$MatExp := \begin{bmatrix} \frac{1}{4}\,e^{5t} + \frac{3}{4}\,e^{t} & -\frac{3}{4}\,e^{t} + \frac{3}{4}\,e^{5t} \\ -\frac{1}{4}\,e^{t} + \frac{1}{4}\,e^{5t} & \frac{3}{4}\,e^{5t} + \frac{1}{4}\,e^{t} \end{bmatrix} \tag{7}$$

```
> MatrizExponencial := exponential(AA, t)
```

$$MatrizExponencial := \begin{bmatrix} \frac{1}{4}\,e^{5t} + \frac{3}{4}\,e^{t} & -\frac{3}{4}\,e^{t} + \frac{3}{4}\,e^{5t} \\ -\frac{1}{4}\,e^{t} + \frac{1}{4}\,e^{5t} & \frac{3}{4}\,e^{5t} + \frac{1}{4}\,e^{t} \end{bmatrix} \tag{8}$$

```
> DerMatExp := map(diff, MatExp, t)
```

$$DerMatExp := \begin{bmatrix} \frac{5}{4}\,e^{5t} + \frac{3}{4}\,e^{t} & -\frac{3}{4}\,e^{t} + \frac{15}{4}\,e^{5t} \\ -\frac{1}{4}\,e^{t} + \frac{5}{4}\,e^{5t} & \frac{15}{4}\,e^{5t} + \frac{1}{4}\,e^{t} \end{bmatrix} \tag{9}$$

```
> AAA := map(rcurry(eval, t = '0'), DerMatExp)
```

(10)

$$AAA := \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \tag{10}$$

> $BB := array([0, 5\cdot\cos(3\,t)])$

$$BB := \begin{bmatrix} 0 & 5\cos(3\,t) \end{bmatrix} \tag{11}$$

> $Xcero := array([-10, 5])$

$$Xcero := \begin{bmatrix} -10 & 5 \end{bmatrix} \tag{12}$$

> $evalm(MatExp);$

$$\begin{bmatrix} \frac{1}{4}\,e^{5t} + \frac{3}{4}\,e^{t} & -\frac{3}{4}\,e^{t} + \frac{3}{4}\,e^{5t} \\ -\frac{1}{4}\,e^{t} + \frac{1}{4}\,e^{5t} & \frac{3}{4}\,e^{5t} + \frac{1}{4}\,e^{t} \end{bmatrix} \tag{13}$$

> $MatExpTau := map(rcurry(eval, t='t - tau'), MatExp)$

$$MatExpTau := \begin{bmatrix} \frac{1}{4}\,e^{5t-5\tau} + \frac{3}{4}\,e^{t-\tau} & -\frac{3}{4}\,e^{t-\tau} + \frac{3}{4}\,e^{5t-5\tau} \\ -\frac{1}{4}\,e^{t-\tau} + \frac{1}{4}\,e^{5t-5\tau} & \frac{3}{4}\,e^{5t-5\tau} + \frac{1}{4}\,e^{t-\tau} \end{bmatrix} \tag{14}$$

> $BBtau := map(rcurry(eval, t='tau'), BB)$

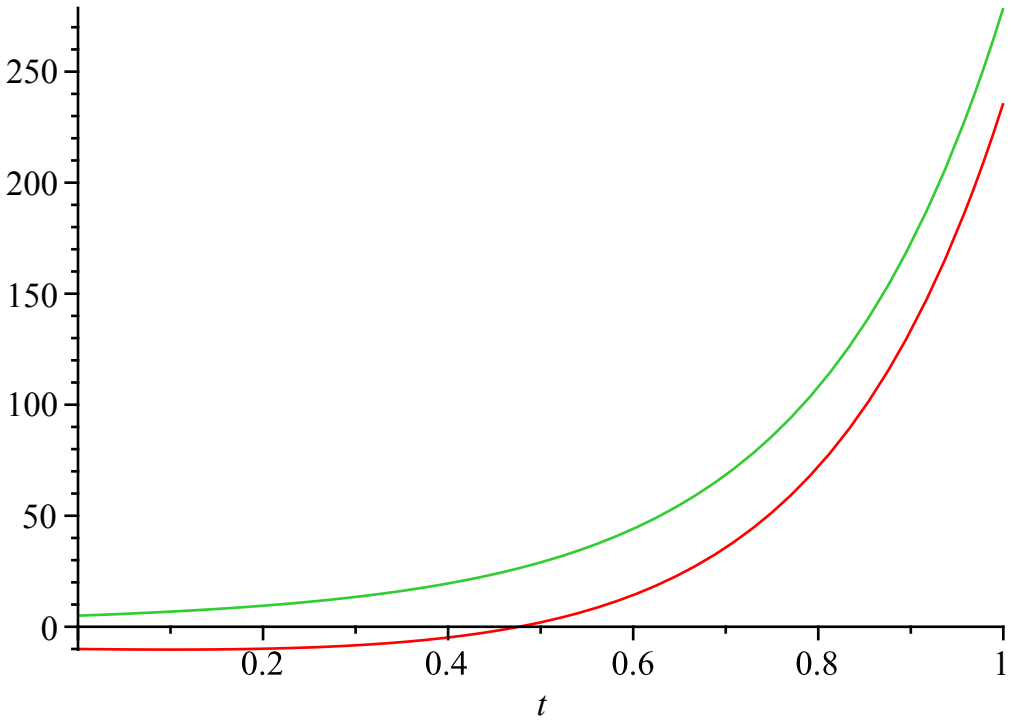
$$BBtau := \begin{bmatrix} 0 & 5\cos(3\,\tau) \end{bmatrix} \tag{15}$$

> $SOL := simplify(evalm(evalm(MatExp\ \&*\ Xcero) + map(int, evalm(MatExpTau\ \&*\ BBtau), tau = 0..t))) : x_1(t) = SOL_1; x_2(t) = SOL_2$

$$x_1(t) = \frac{245}{136}\,e^{5t} - \frac{93}{8}\,e^{t} - \frac{12}{17}\cos(t)^3 - \frac{54}{17}\cos(t)^2\sin(t) + \frac{9}{17}\cos(t) + \frac{27}{34}\sin(t)$$

$$x_2(t) = \frac{31}{8}\,e^{t} + \frac{245}{136}\,e^{5t} - \frac{46}{17}\cos(t)^3 + \frac{48}{17}\cos(t)^2\sin(t) + \frac{69}{34}\cos(t) - \frac{12}{17}\sin(t) \tag{16}$$

> $plot([SOL_1, SOL_2], t = 0..1)$



> $SISTEMA := diff(x_1(t), t) = 2\,x_1(t) + 3\,x_2(t),\ diff(x_2(t), t) = x_1(t) + 4\,x_2(t) + 5\cos(3\,t)$

$$SISTEMA := \frac{d}{dt}x_1(t) = 2\,x_1(t) + 3\,x_2(t),\ \frac{d}{dt}x_2(t) = x_1(t) + 4\,x_2(t) + 5\cos(3\,t) \quad \textbf{(17)}$$

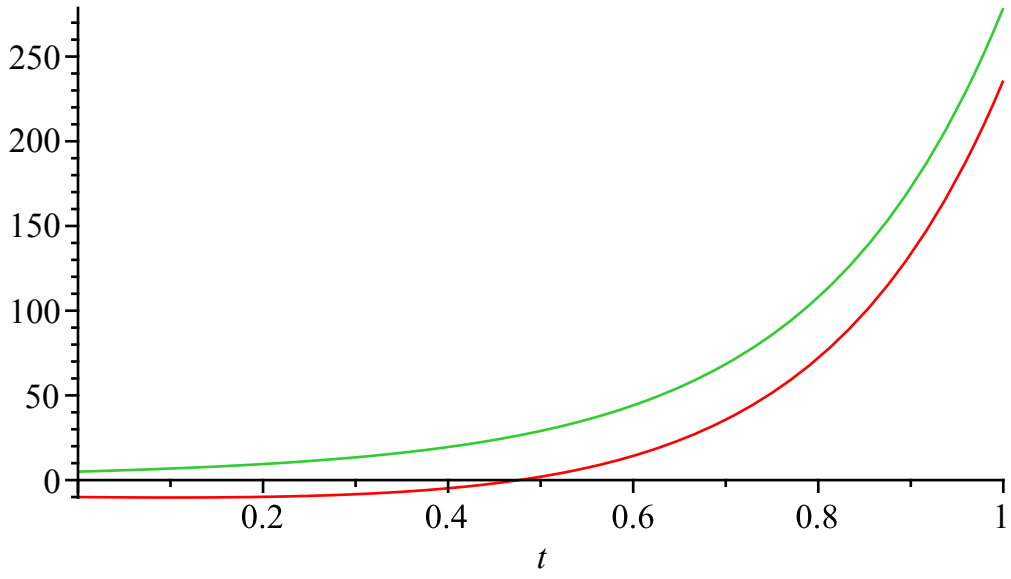
> $CONDICIONES := x_1(0) = -10, x_2(0) = 5;$

$$CONDICIONES := x_1(0) = -10, x_2(0) = 5 \quad \textbf{(18)}$$

> $SOLSOL := dsolve(\{SISTEMA, CONDICIONES\})$

$$SOLSOL := \left\{x_1(t) = -\frac{93}{8}e^{t} + \frac{245}{136}e^{5t} - \frac{3}{17}\cos(3\,t) - \frac{27}{34}\sin(3\,t), x_2(t) = \frac{31}{8}e^{t} + \frac{245}{136}e^{5t} + \frac{12}{17}\sin(3\,t) - \frac{23}{34}\cos(3\,t)\right\} \quad \textbf{(19)}$$

> $plot([rhs(SOLSOL_1), rhs(SOLSOL_2)], t = 0..1)$


250
200
150
100
50
0
0.2
0.4
0.6
0.8
1
t