```
> restart
> Ecuacion := diff(y(t), t$2) - 2·diff(y(t), t) + 2·y(t) = 4·exp(2·t)
```

$$Ecuacion := \frac{d^2}{dt^2} y(t) - 2\left(\frac{d}{dt} y(t)\right) + 2\,y(t) = 4\,e^{2t} \quad (1)$$

```
> Condiciones := y(0) = -4, D(y)(0) = 3
```

$$Condiciones := y(0) = -4,\ D(y)(0) = 3 \quad (2)$$

```
> EcuaHom := lhs(Ecuacion) = 0; Q := rhs(Ecuacion)
```

$$EcuaHom := \frac{d^2}{dt^2} y(t) - 2\left(\frac{d}{dt} y(t)\right) + 2\,y(t) = 0$$

$$Q := 4\,e^{2t} \quad (3)$$

Método de Parámetros Variables

```
> EcuaCarac := m··2 - 2·m + 2 = 0
```

$$EcuaCarac := m^2 - 2\,m + 2 = 0 \quad (4)$$

```
> Raiz := solve(EcuaCarac)
```

$$Raiz := 1 + I,\ 1 - I \quad (5)$$

```
> SolUno := y(t) = exp(Re(Raiz[1])·t)·cos(Im(Raiz[1])·t); SolDos := y(t) = exp(Re(Raiz[1])·t)
      ·sin(Im(Raiz[1])·t)
```

$$SolUno := y(t) = e^{t}\cos(t)$$

$$SolDos := y(t) = e^{t}\sin(t) \quad (6)$$

```
> SolHom := y(t) = C[1]·rhs(SolUno) + C[2]·rhs(SolDos)
```

$$SolHom := y(t) = C_1\,e^{t}\cos(t) + C_2\,e^{t}\sin(t) \quad (7)$$

```
> SolNoHom := y(t) = A·rhs(SolUno) + B·rhs(SolDos)
```

$$SolNoHom := y(t) = A\,e^{t}\cos(t) + B\,e^{t}\sin(t) \quad (8)$$

```
> with(linalg) :
> WW := wronskian([rhs(SolUno), rhs(SolDos)], t)
```

$$WW := \begin{bmatrix} e^{t}\cos(t) & e^{t}\sin(t) \\ e^{t}\cos(t) - e^{t}\sin(t) & e^{t}\sin(t) + e^{t}\cos(t) \end{bmatrix} \quad (9)$$

```
> RR := array([0, Q])
```

$$RR := \begin{bmatrix} 0 & 4\,e^{2t} \end{bmatrix} \quad (10)$$

```
> SOL := simplify(linsolve(WW, RR)) : Aprima := SOL[1]; Bprima := SOL[2]
```

$$Aprima := -4\,e^{t}\sin(t)$$

$$Bprima := 4\,e^{t}\cos(t) \quad (11)$$

```
> A := int(Aprima, t) + C[1]; B := int(Bprima, t) + C[2]
```

$$A := 2\,e^{t}\cos(t) - 2\,e^{t}\sin(t) + C_1$$

$$B := 2\,e^{t}\cos(t) + 2\,e^{t}\sin(t) + C_2 \quad (12)$$

```
> SolucionGeneral := expand(simplify(SolNoHom))
```

$$SolucionGeneral := y(t) = 2\,(e^{t})^2 + C_1\,e^{t}\cos(t) + C_2\,e^{t}\sin(t) \quad (13)$$

> $Sistemita := subs(t=0, rhs(SolucionGeneral) = rhs(Condiciones_1)), subs(t=0, rhs(diff(SolucionGeneral, t)) = rhs(Condiciones_2)) : Sistemita_1; Sistemita_2$

$$2 + C_1 = -4$$

$$4 + C_1 + C_2 = 3 \quad \textbf{(14)}$$

> $Parametro := solve(\{Sistemita\}) : Parametro_1; Parametro_2$

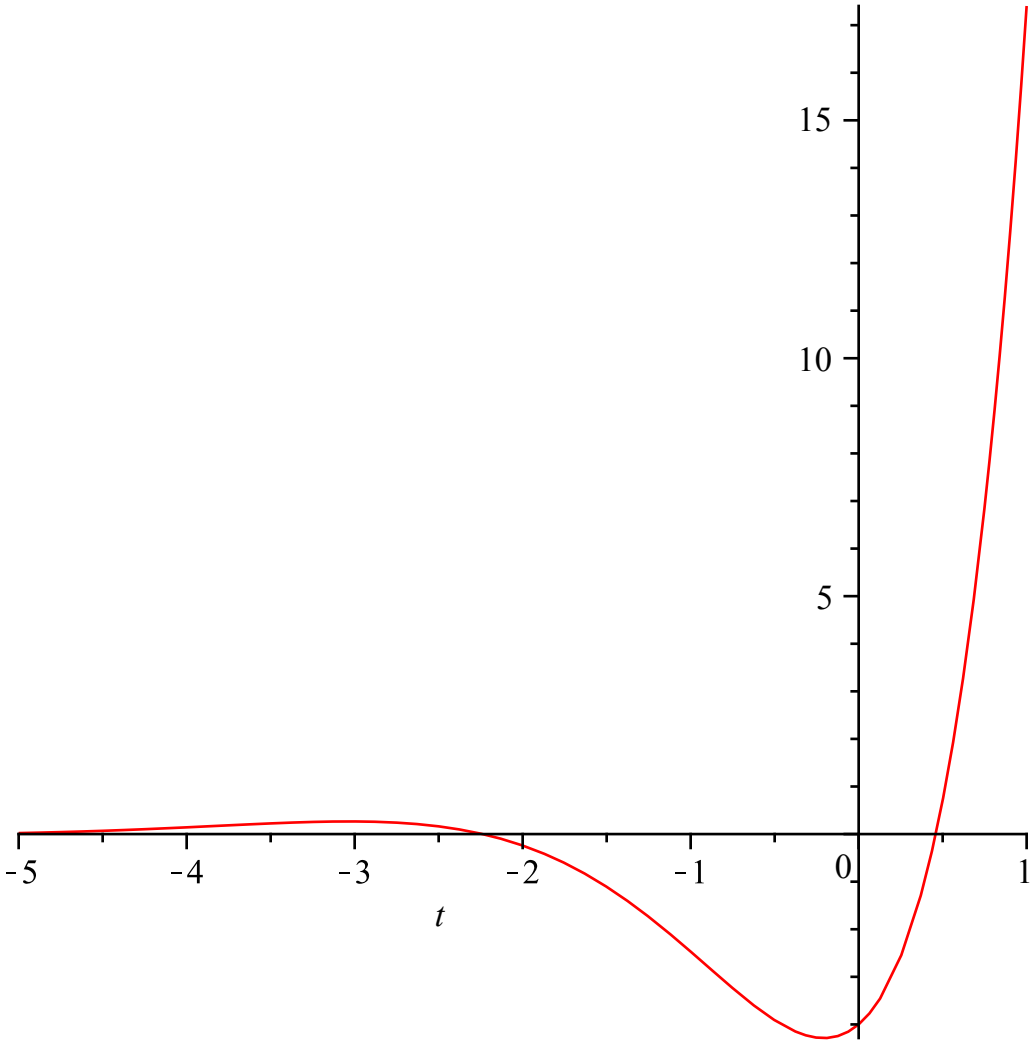
$$C_1 = -6$$

$$C_2 = 5 \quad \textbf{(15)}$$

> $SolucionParticular := subs(C_1 = rhs(Parametro_1), C_2 = rhs(Parametro_2), SolucionGeneral)$

$$SolucionParticular := y(t) = 2\,(e^t)^2 - 6\,e^t \cos(t) + 5\,e^t \sin(t) \quad \textbf{(16)}$$

> $plot(rhs(SolucionParticular), t = -5..1)$



>

Sistema de Ecuaciones Diferenciales

> $Sistema := diff(y_1(t), t) = y_2(t), diff(y_2(t), t) = -2 \cdot y_1(t) + 2 \cdot y_2(t) + 4 \cdot \exp(2\,t) : Sistema_1; Sistema_2$

$$\frac{d}{dt} y_1(t) = y_2(t)$$

$$\frac{d}{dt} y_2(t) = -2\, y_1(t) + 2\, y_2(t) + 4\, e^{2t} \tag{17}$$

> $Condicion := y_1(0) = -4, y_2(0) = 3$

$$Condicion := y_1(0) = -4, y_2(0) = 3 \tag{18}$$

> $AA := array([[0, 1], [-2, 2]])$

$$AA := \begin{bmatrix} 0 & 1 \\ -2 & 2 \end{bmatrix} \tag{19}$$

> $Ycero := array([-4, 3])$

$$Ycero := \begin{bmatrix} -4 & 3 \end{bmatrix} \tag{20}$$

> $MatExp := exponential(AA, t)$

$$MatExp := \begin{bmatrix} e^t \cos(t) - e^t \sin(t) & e^t \sin(t) \\ -2\, e^t \sin(t) & e^t \sin(t) + e^t \cos(t) \end{bmatrix} \tag{21}$$

> $SOLHOM := evalm(MatExp \&* Ycero) : SOLHOM_1; SOLHOM_2$

$$-4\, e^t \cos(t) + 7\, e^t \sin(t)$$
$$11\, e^t \sin(t) + 3\, e^t \cos(t) \tag{22}$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & 4\, e^{2t} \end{bmatrix} \tag{23}$$

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

$$MatExpTau := \begin{bmatrix} e^{t-\tau}\cos(t-\tau) - e^{t-\tau}\sin(t-\tau) & e^{t-\tau}\sin(t-\tau) \\ -2\, e^{t-\tau}\sin(t-\tau) & e^{t-\tau}\sin(t-\tau) + e^{t-\tau}\cos(t-\tau) \end{bmatrix} \tag{24}$$

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

$$BBtau := \begin{bmatrix} 0 & 4\, e^{2\tau} \end{bmatrix} \tag{25}$$

> $ProdTau := evalm(MatExpTau \&* BBtau) : ProdTau_1; ProdTau_2$

$$4\, e^{t-\tau}\sin(t-\tau)\, e^{2\tau}$$
$$4\left(e^{t-\tau}\sin(t-\tau) + e^{t-\tau}\cos(t-\tau)\right) e^{2\tau} \tag{26}$$

> $IntTau := simplify(map(int, ProdTau, tau = 0..t)) : IntTau_1; IntTau_2$

$$-2\, e^t \sin(t) - 2\, e^t \cos(t) + 2\, e^{2t}$$
$$-4\, e^t \cos(t) + 4\, e^{2t} \tag{27}$$

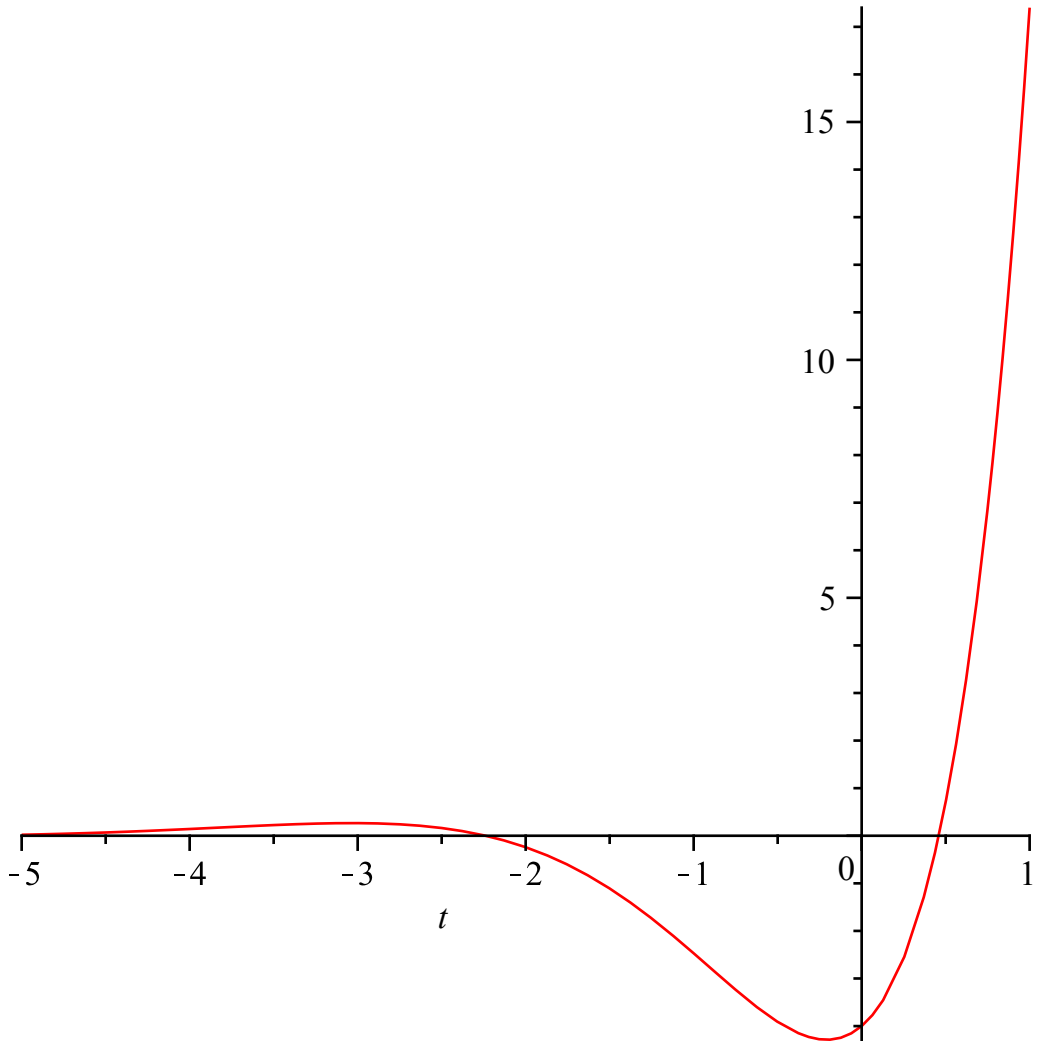
> $Ceros := map(rcurry(eval, t = '0'), IntTau)$

$$Ceros := \begin{bmatrix} 0 & 0 \end{bmatrix} \tag{28}$$

> $SolMat := evalm(SOLHOM + IntTau) : VecUno := yy_1(t) = SolMat_1; VecDos := yy_2(t) = SolMat_2$

$$VecUno := yy_1(t) = -6\, e^t \cos(t) + 5\, e^t \sin(t) + 2\, e^{2t}$$
$$VecDos := yy_2(t) = 11\, e^t \sin(t) - e^t \cos(t) + 4\, e^{2t} \tag{29}$$

```
> plot(rhs(VecUno), t=-5..1)
```




```
> SolucionSistema := dsolve({Sistema, Condicion}) : SolucionSistema[1]; SolucionSistema[2]
```

$$y_1(t) = -6\,e^t\cos(t) + 5\,e^t\sin(t) + 2\,e^{2t}$$

$$y_2(t) = 11\,e^t\sin(t) - e^t\cos(t) + 4\,e^{2t} \quad \textbf{(30)}$$

```
> VecUno; VecDos;
```

$$yy_1(t) = -6\,e^t\cos(t) + 5\,e^t\sin(t) + 2\,e^{2t}$$

$$yy_2(t) = 11\,e^t\sin(t) - e^t\cos(t) + 4\,e^{2t} \quad \textbf{(31)}$$

```
> SolPartOriginal := dsolve({Ecuacion, Condiciones})
```

$$SolPartOriginal := y(t) = -6\,e^t\cos(t) + 5\,e^t\sin(t) + 2\,e^{2t} \quad \textbf{(32)}$$

```
> DerSolPartOriginal := diff(SolPartOriginal, t)
```

$$DerSolPartOriginal := \frac{d}{dt}y(t) = 11\,e^t\sin(t) - e^t\cos(t) + 4\,e^{2t} \quad \textbf{(33)}$$

```
> SolucionParticular; diff(SolucionParticular, t)
```

$$y(t) = 2\,(e^t)^2 - 6\,e^t\cos(t) + 5\,e^t\sin(t)$$

(34)

$$\frac{d}{dt} y(t) = 4 \left(e^{t}\right)^{2} - e^{t} \cos(t) + 11\, e^{t} \sin(t) \tag{34}$$

> $Identidad := map(rcurry(eval, t = '0'), MatExp)$

$$Identidad := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{35}$$

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

$$DerMatExp := \begin{bmatrix} -2\, e^{t} \sin(t) & e^{t} \sin(t) + e^{t} \cos(t) \\ -2\, e^{t} \sin(t) - 2\, e^{t} \cos(t) & 2\, e^{t} \cos(t) \end{bmatrix} \tag{36}$$

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

$$AAA := \begin{bmatrix} 0 & 1 \\ -2 & 2 \end{bmatrix} \tag{37}$$

>