> $restart$

> $Ecua := diff(x(t), t) = 1 - t - int(x(v), v = 0..t)$

$$Ecua := \frac{d}{dt}\,x(t) = 1 - t - \left(\int_0^t x(v)\,dv\right) \quad \textbf{(1)}$$

> $CondIni := x(0) = 0$

$$CondIni := x(0) = 0 \quad \textbf{(2)}$$

> $with(inttrans):$

> $EcuaTL := subs(CondIni, laplace(Ecua, t, s))$

$$EcuaTL := s\,\mathcal{L}(x(t), t, s) = \frac{s-1}{s^2} - \frac{\mathcal{L}(x(t), t, s)}{s} \quad \textbf{(3)}$$

> $SolPartTL := isolate(EcuaTL, laplace(x(t), t, s))$

$$SolPartTL := \mathcal{L}(x(t), t, s) = \frac{s-1}{s^2\left(s + \frac{1}{s}\right)} \quad \textbf{(4)}$$

> $SolPart := invlaplace(SolPartTL, s, t)$

$$SolPart := x(t) = -1 + \cos(t) + \sin(t) \quad \textbf{(5)}$$

> $restart$

> $Ecua := diff(y(t), t) = \cos(t) + int(y(\mathrm{tau}) \cdot \cos(t - \mathrm{tau}), \mathrm{tau} = 0..t)$

$$Ecua := \frac{d}{dt}\,y(t) = \cos(t) + \int_0^t y(\tau)\,\cos(t-\tau)\,d\tau \quad \textbf{(6)}$$

> $CondIni := y(0) = 1$

$$CondIni := y(0) = 1 \quad \textbf{(7)}$$

> $with(inttrans):$

> $EcuaTL := subs(CondIni, laplace(Ecua, t, s))$

$$EcuaTL := s\,\mathcal{L}(y(t), t, s) - 1 = \frac{s}{s^2+1} + \frac{\mathcal{L}(y(t), t, s)\,s}{s^2+1} \quad \textbf{(8)}$$

> $SolPartTL := isolate(EcuaTL, laplace(y(t), t, s))$

$$SolPartTL := \mathcal{L}(y(t), t, s) = \frac{1 + \frac{s}{s^2+1}}{s - \frac{s}{s^2+1}} \quad \textbf{(9)}$$

> $SolPart := invlaplace(SolPartTL, s, t)$

$$SolPart := y(t) = t + \frac{1}{2}\,t^2 + 1 \quad \textbf{(10)}$$

> $Comprobar := eval(subs(y(t) = rhs(SolPart), Ecua))$

$$Comprobar := 1 + t = \cos(t) + \int_0^t y(\tau)\,\cos(t-\tau)\,d\tau \quad \textbf{(11)}$$

> $int\left(\left(\mathrm{tau} + \frac{\tau^2}{2} + 1\right)\cos(t - \mathrm{tau}), \mathrm{tau} = 0..t\right)$

(12)

$$1 + t - \cos(t) \tag{12}$$

> *restart*

> $Sistema := diff(x(t), t\$2) + diff(y(t), t\$2) = \exp(2 \cdot t), 2 \cdot diff(x(t), t) + diff(y(t), t\$2) = -\exp(2\,t) : Sistema[1]; Sistema[2]$

$$\frac{d^2}{dt^2}\,x(t) + \frac{d^2}{dt^2}\,y(t) = e^{2\,t}$$

$$2\,\frac{d}{dt}\,x(t) + \frac{d^2}{dt^2}\,y(t) = -e^{2\,t} \tag{13}$$

> $CondIni := x(0) = 0, y(0) = 0, D(x)(0) = 0, D(y)(0) = 0$

$$CondIni := x(0) = 0, y(0) = 0, D(x)(0) = 0, D(y)(0) = 0 \tag{14}$$

>

RESPUESTA

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

$$AA := \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -2 & 0 & 0 \end{bmatrix} \tag{15}$$

> $Xcero := array([0, 0, 0, 0])$

$$Xcero := \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} \tag{16}$$

> $BB := array([0, 2 \cdot \exp(2\,t), 0, -\exp(2\,t)])$

$$BB := \begin{bmatrix} 0 & 2\,e^{2\,t} & 0 & -e^{2\,t} \end{bmatrix} \tag{17}$$

> $with(linalg):$

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

$$MatExp := \begin{bmatrix} 1 & \frac{e^{2\,t}}{2} - \frac{1}{2} & 0 & 0 \\ 0 & e^{2\,t} & 0 & 0 \\ 0 & -\frac{e^{2\,t}}{2} + \frac{1}{2} + t & 1 & t \\ 0 & -e^{2\,t} + 1 & 0 & 1 \end{bmatrix} \tag{18}$$

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

$$MatExpTau := \begin{bmatrix} 1 & \frac{e^{2\,t - 2\,\tau}}{2} - \frac{1}{2} & 0 & 0 \\ 0 & e^{2\,t - 2\,\tau} & 0 & 0 \\ 0 & -\frac{e^{2\,t - 2\,\tau}}{2} + \frac{1}{2} + t - \tau & 1 & t - \tau \\ 0 & -e^{2\,t - 2\,\tau} + 1 & 0 & 1 \end{bmatrix} \tag{19}$$

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

$$BBtau := \begin{bmatrix} 0 & 2\,e^{2\,\tau} & 0 & -e^{2\,\tau} \end{bmatrix} \quad \textbf{(20)}$$

> $ProdTau := evalm(MatExpTau \,\&*\, BBtau) : ProdTau[1]; ProdTau[2]; ProdTau[3]; ProdTau[4]$

$$2\left(\frac{e^{2\,t-2\,\tau}}{2} - \frac{1}{2}\right) e^{2\,\tau}$$

$$2\,e^{2\,t-2\,\tau}\,e^{2\,\tau}$$

$$2\left(-\frac{e^{2\,t-2\,\tau}}{2} + \frac{1}{2} + t - \tau\right) e^{2\,\tau} - (t-\tau)\,e^{2\,\tau}$$

$$2\left(-e^{2\,t-2\,\tau} + 1\right) e^{2\,\tau} - e^{2\,\tau} \quad \textbf{(21)}$$

> $SolPart := map(int, ProdTau, \mathrm{tau} = 0..t) : x[1](t) = SolPart[1]; x[2](t) = SolPart[2]; y[1](t) = SolPart[3]; y[2](t) = SolPart[4];$

$$x_1(t) = \frac{1}{2} + e^{2\,t}\,t - \frac{e^{2\,t}}{2}$$

$$x_2(t) = 2\,e^{2\,t}\,t$$

$$y_1(t) = -\frac{3}{4} - \frac{t}{2} + \frac{3\,e^{2\,t}}{4} - e^{2\,t}\,t$$

$$y_2(t) = -\frac{1}{2} + \frac{e^{2\,t}}{2} - 2\,e^{2\,t}\,t \quad \textbf{(22)}$$

> $Sistema[1]; Sistema[2]$

$$\frac{d^2}{dt^2}\,x(t) + \frac{d^2}{dt^2}\,y(t) = e^{2\,t}$$

$$2\,\frac{d}{dt}\,x(t) + \frac{d^2}{dt^2}\,y(t) = -e^{2\,t} \quad \textbf{(23)}$$

> $Solucion := dsolve(\{CondIni, Sistema\}) : Solucion[1]$

$$x(t) = \left(t - \frac{1}{2}\right) e^{2\,t} + \frac{1}{2} \quad \textbf{(24)}$$

> $x[1](t) = SolPart[1]$

$$x_1(t) = \frac{1}{2} + e^{2\,t}\,t - \frac{e^{2\,t}}{2} \quad \textbf{(25)}$$

> $Solucion[2]$

$$y(t) = -\frac{3}{4} - \frac{t}{2} + \frac{3\,e^{2\,t}}{4} - e^{2\,t}\,t \quad \textbf{(26)}$$

> $y[1](t) = SolPart[3]$

$$y_1(t) = -\frac{3}{4} - \frac{t}{2} + \frac{3\,e^{2\,t}}{4} - e^{2\,t}\,t \quad \textbf{(27)}$$

> $restart$

> $Ecua := diff(y(t), t\$2) - 4\cdot diff(y(t), t) + 13\cdot y(t) = \mathrm{Dirac}(t-4)$

$$Ecua := \frac{d^2}{dt^2}\, y(t) - 4\, \frac{d}{dt}\, y(t) + 13\, y(t) = \mathrm{Dirac}(t-4) \tag{28}$$

> $CondIni := y(0) = 1, \mathrm{D}(y)(0) = -1$

$$CondIni := y(0) = 1, \mathrm{D}(y)(0) = -1 \tag{29}$$

> $with(inttrans):$

> $EcuaTL := subs(CondIni, laplace(Ecua, t, s))$

$$EcuaTL := s^2\, \mathcal{L}(y(t), t, s) + 5 - s - 4\, s\, \mathcal{L}(y(t), t, s) + 13\, \mathcal{L}(y(t), t, s) = e^{-4\, s} \tag{30}$$

> $SolPartTL := isolate(EcuaTL, laplace(y(t), t, s))$

$$SolPartTL := \mathcal{L}(y(t), t, s) = \frac{e^{-4\, s} + s - 5}{s^2 - 4\, s + 13} \tag{31}$$

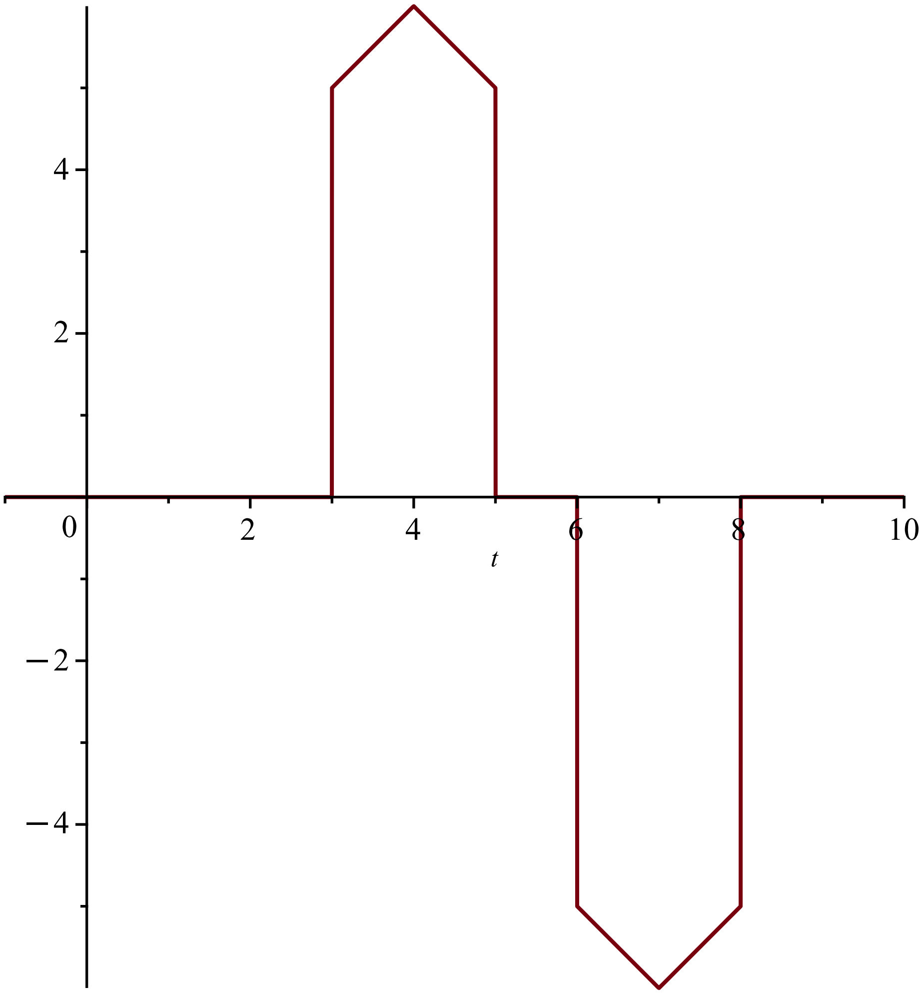
> $SolPart := invlaplace(SolPartTL, s, t)$

$$SolPart := y(t) = \frac{(1 - \mathrm{Heaviside}(4-t))\, \sin(3\, t - 12)\, e^{2\, t - 8}}{3} + e^{2\, t}\, (\cos(3\, t) - \sin(3\, t)) \tag{32}$$

> $restart$

> $Castillo := 5 \cdot \mathrm{Heaviside}(t-3) + (t-3) \cdot \mathrm{Heaviside}(t-3) - 2 \cdot (t-4) \cdot \mathrm{Heaviside}(t-4) + (t-5) \cdot \mathrm{Heaviside}(t-5) - 5 \cdot \mathrm{Heaviside}(t-5) - 5 \cdot \mathrm{Heaviside}(t-6) - (t-6) \cdot \mathrm{Heaviside}(t-6) + 2 \cdot (t-7) \cdot \mathrm{Heaviside}(t-7) - (t-8) \cdot \mathrm{Heaviside}(t-8) + 5 \cdot \mathrm{Heaviside}(t-8); plot(Castillo, t = -1 ..10, scaling = CONSTRAINED)$

$$Castillo := 5\, \mathrm{Heaviside}(t-3) + (t-3)\, \mathrm{Heaviside}(t-3) - 2\, (t-4)\, \mathrm{Heaviside}(t-4) + (t-5)\, \mathrm{Heaviside}(t-5) - 5\, \mathrm{Heaviside}(t-5) - 5\, \mathrm{Heaviside}(t-6) - (t-6)\, \mathrm{Heaviside}(t-6) + 2\, (t-7)\, \mathrm{Heaviside}(t-7) - (t-8)\, \mathrm{Heaviside}(t-8) + 5\, \mathrm{Heaviside}(t-8)$$



> $with(inttrans):$

> $CastilloTL := laplace(Castillo, t, s)$

$$CastilloTL := \frac{e^{-3\,s} - e^{-8\,s} + 2\,e^{-7\,s} - e^{-6\,s} + e^{-5\,s} - 2\,e^{-4\,s}}{s^2} + \frac{5\left(e^{-3\,s} + e^{-8\,s} - e^{-6\,s} - e^{-5\,s}\right)}{s} \tag{33}$$

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