> restart

EJEMPLO DE UNA ECUACION LINEAL HOMOGÉNEA

> $Ecuacion := diff(s(t), t\$2) + \frac{\left(\frac{957}{25}\right)}{\left(\frac{8}{4905}\right)} \cdot s(t) = 0$

$$Ecuacion := \frac{d^2}{dt^2} s(t) + \frac{938817}{40} s(t) = 0 \quad (1)$$

> $EcuacionCaracteristica := m \cdot \cdot 2 + \frac{938817}{40} = 0$

$$EcuacionCaracteristica := m^2 + \frac{938817}{40} = 0 \quad (2)$$

> $Raiz := solve(EcuacionCaracteristica)$

$$Raiz := \frac{3}{20} I\sqrt{1043130}, -\frac{3}{20} I\sqrt{1043130} \quad (3)$$

> $Sol_1 := s(t) = \exp(\mathrm{Re}(Raiz_1) \cdot t) \cdot \cos(\mathrm{Im}(Raiz_1) \cdot t); evalf(\%, 5)$

$$Sol_1 := s(t) = \cos\left(\frac{3}{20}\sqrt{1043130}\ t\right)$$

$$s(t) = \cos(153.20\ t) \quad (4)$$

> $Sol_2 := s(t) = \exp(\mathrm{Re}(Raiz_1) \cdot t) \cdot \sin(\mathrm{Im}(Raiz_1) \cdot t); evalf(\%, 5)$

$$Sol_2 := s(t) = \sin\left(\frac{3}{20}\sqrt{1043130}\ t\right)$$

$$s(t) = \sin(153.20\ t) \quad (5)$$

> $SolucionGeneral := s(t) = C_1 \cdot rhs(Sol_1) + C_2 \cdot rhs(Sol_2); evalf(\%, 5)$

$$SolucionGeneral := s(t) = C_1 \cos\left(\frac{3}{20}\sqrt{1043130}\ t\right) + C_2 \sin\left(\frac{3}{20}\sqrt{1043130}\ t\right)$$

$$s(t) = C_1 \cos(153.20\ t) + C_2 \sin(153.20\ t) \quad (6)$$

> $CondicionesIniciales := s(0) = -\frac{417}{1000}, \mathrm{D}(s)(0) = 0;$

$$CondicionesIniciales := s(0) = -\frac{417}{1000}, \mathrm{D}(s)(0) = 0 \quad (7)$$

> $Sistema := eval(subs(t = 0, rhs(SolucionGeneral) = rhs(CondicionesIniciales_1))),$
> $eval(subs(t = 0, rhs(diff(SolucionGeneral, t)) = rhs(CondicionesIniciales_2))) :$
> $Sistema_1; Sistema_2;$

$$C_1 = -\frac{417}{1000}$$

$$\frac{3}{20} C_2 \sqrt{1043130} = 0 \quad (8)$$

> $Parametro := solve(\{Sistema\}, \{C_1, C_2\})$

$$Parametro := \left\{C_1 = -\frac{417}{1000}, C_2 = 0\right\} \quad (9)$$

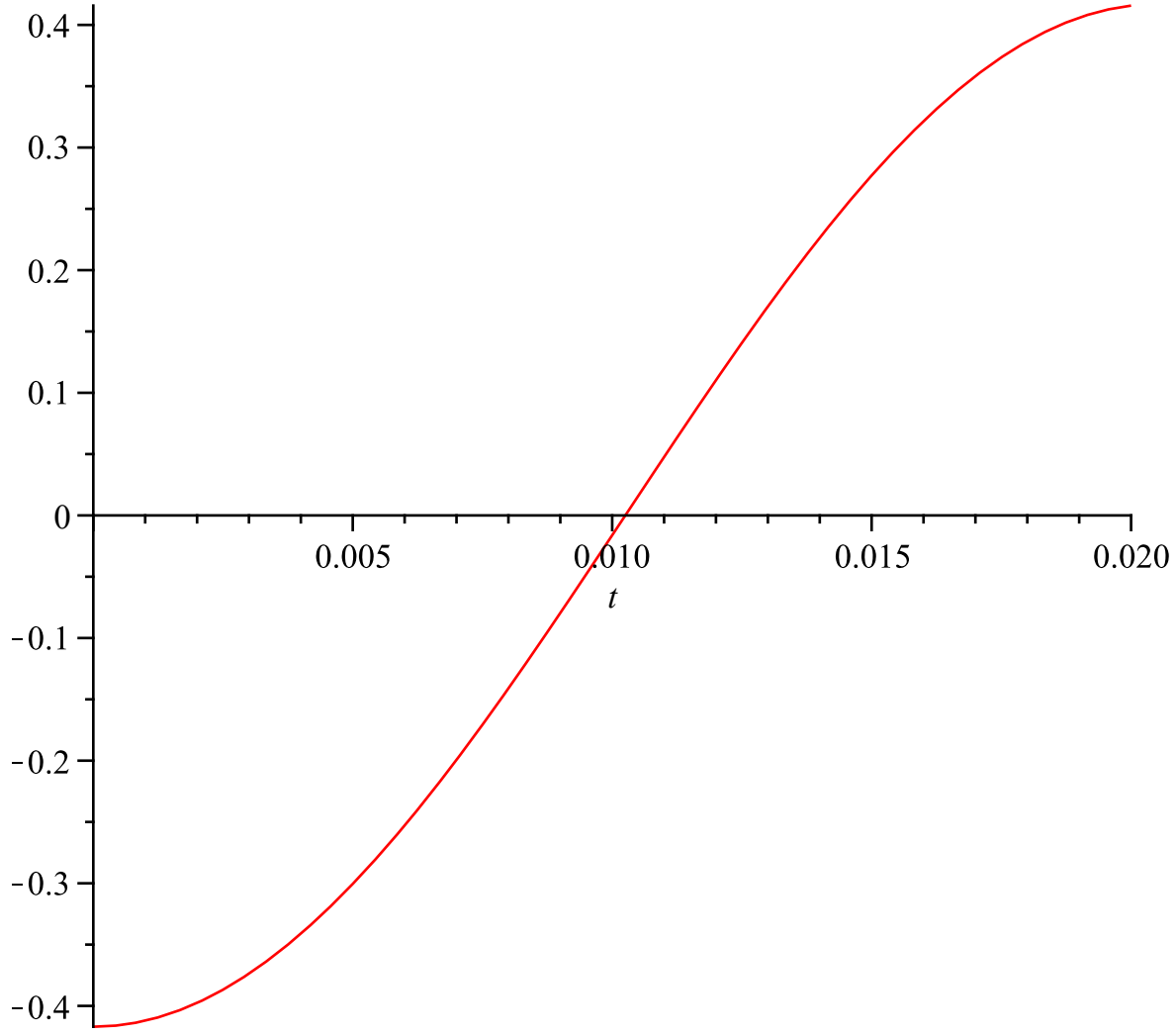
> $SolucionParticular := subs(C_1 = rhs(Parametro_1), C_2 = rhs(Parametro_2),$

$SolucionGeneral); evalf(\%, 5)$

$$SolucionParticular := s(t) = -\frac{417}{1000}\cos\left(\frac{3}{20}\sqrt{1043130}\ t\right)$$

$$s(t) = -0.41700\cos(153.20\ t) \quad \textbf{(10)}$$

> $plot(rhs(SolucionParticular), t = 0..0.02)$




> $TiempoImpulso := solve(rhs(SolucionParticular) = 0, t); evalf(\%, 5)$

$$TiempoImpulso := \frac{1}{312939}\pi\sqrt{1043130}$$

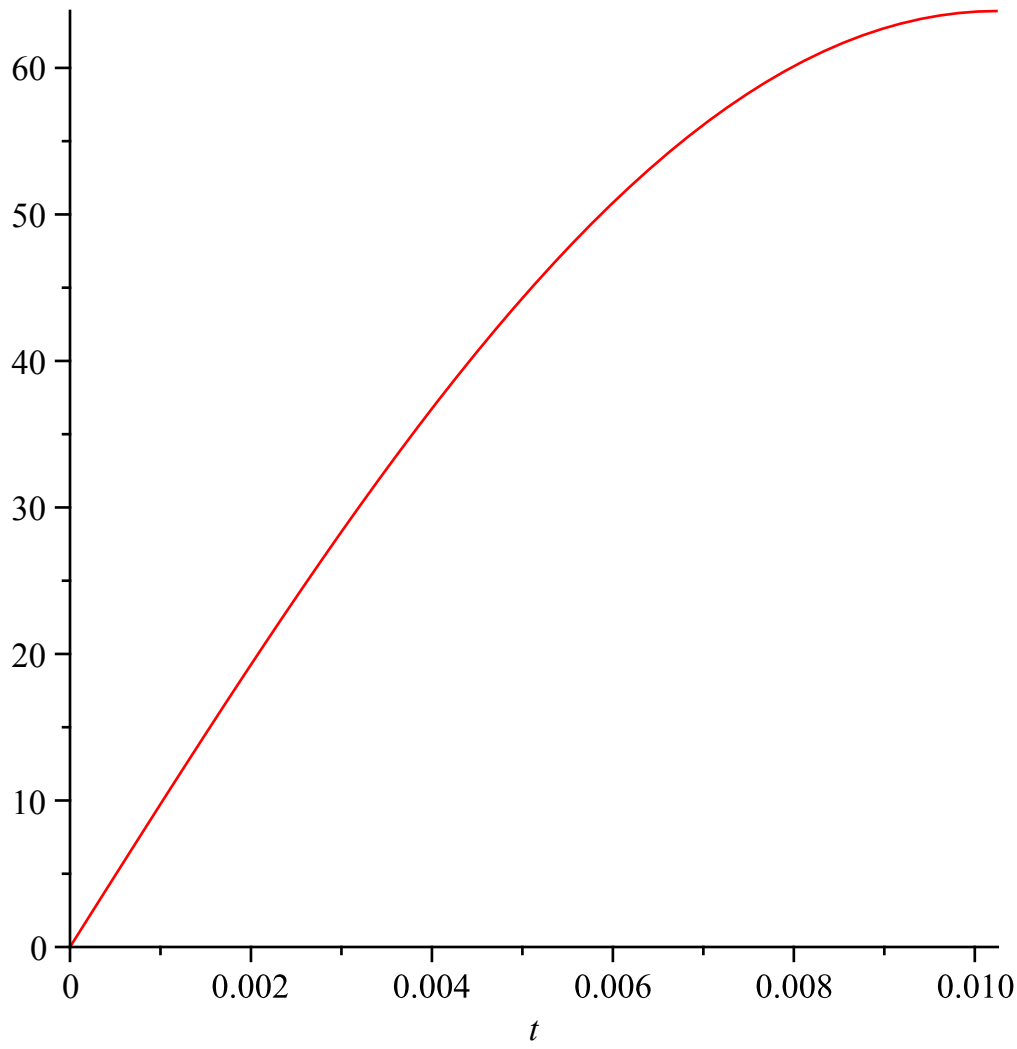
$$0.010253 \quad \textbf{(11)}$$

> $VelocidadImpulso := diff(SolucionParticular, t); evalf(\%, 5)$

$$VelocidadImpulso := \frac{d}{dt}s(t) = \frac{1251}{20000}\sin\left(\frac{3}{20}\sqrt{1043130}\ t\right)\sqrt{1043130}$$

$$\frac{d}{dt}s(t) = 63.882\sin(153.20\ t) \quad \textbf{(12)}$$

> $plot(rhs(diff(SolucionParticular, t)), t = 0..TiempoImpulso)$




> $VelocidadInicialTiroParabólico := eval(subs(t = TiempoImpulso, rhs(diff(SolucionParticular, t)))); evalf(\%, 5); \frac{evalf(\%\%, 5) \cdot 3600}{1000};$

$$VelocidadInicialTiroParabólico := \frac{1251}{20000}\sqrt{1043130}$$

$$63.882$$

$$229.9752000 \quad \textbf{(13)}$$

> *restart*

PROBLEMA DEL SISTEMA DE AMORTIGUACION DE UN VEHÍCULO

> $EcuacionOriginal := \frac{(1000)}{\left(\frac{981}{100}\right)} \cdot diff(s(t), t\$2) = -4 \cdot s(t) - 2 \cdot diff(s(t), t)$

$$EcuacionOriginal := \frac{100000}{981}\frac{d^2}{dt^2}s(t) = -4\,s(t) - 2\left(\frac{d}{dt}s(t)\right) \quad \textbf{(14)}$$

> $Ecuacion := diff(s(t), t\$2) + \frac{4}{\left(\frac{(1000)}{\left(\frac{981}{100}\right)}\right)} \cdot diff(s(t), t) + \frac{2}{\left(\frac{(1000)}{\left(\frac{981}{100}\right)}\right)} \cdot s(t) = 0$

$$Ecuacion := \frac{d^2}{dt^2} s(t) + \frac{981}{25000} \frac{d}{dt} s(t) + \frac{981}{50000} s(t) = 0 \quad (15)$$

> $EcuaCaract := m\cdot\cdot 2 + \frac{981}{50000}\cdot m + \frac{981}{50000} = 0$

$$EcuaCaract := m^2 + \frac{981}{50000} m + \frac{981}{50000} = 0 \quad (16)$$

> $Raiz := solve(EcuaCaract); evalf(\%, 5)$

$$Raiz := -\frac{981}{100000} + \frac{3}{100000} I\sqrt{21693071}, -\frac{981}{100000} - \frac{3}{100000} I\sqrt{21693071}$$

$$-0.0098100 + 0.13973\ I, -0.0098100 - 0.13973\ I \quad (17)$$

> $Sol_1 := s(t) = \exp(\mathrm{Re}(Raiz_1)\cdot t)\cdot\cos(\mathrm{Im}(Raiz_1)\cdot t) : Sol_2 := s(t) = \exp(\mathrm{Re}(Raiz_1)\cdot t)$
> $\cdot\sin(\mathrm{Im}(Raiz_1)\cdot t) : evalf(Sol_1, 5); evalf(Sol_2, 5)$

$$s(t) = e^{-0.0098100\, t}\cos(0.13973\ t)$$

$$s(t) = e^{-0.0098100\, t}\sin(0.13973\ t) \quad (18)$$

> $SolucionGeneral := s(t) = C_1\cdot rhs(Sol_1) + C_2\cdot rhs(Sol_2) : evalf(\%, 5)$

$$s(t) = C_1\, e^{-0.0098100\, t}\cos(0.13973\ t) + C_2\, e^{-0.0098100\, t}\sin(0.13973\ t) \quad (19)$$

> $Condiciones := s(0) = \frac{1}{10}, D(s)(0) = 0$

$$Condiciones := s(0) = \frac{1}{10}, D(s)(0) = 0 \quad (20)$$

> $Sistema := eval(subs(t = 0, rhs(SolucionGeneral) = rhs(Condiciones_1))), eval(subs(t = 0,$
> $rhs(diff(SolucionGeneral, t)) = rhs(Condiciones_2))) : Sistema_1; Sistema_2$

$$C_1 = \frac{1}{10}$$

$$-\frac{981}{100000} C_1 + \frac{3}{100000} C_2\sqrt{21693071} = 0 \quad (21)$$

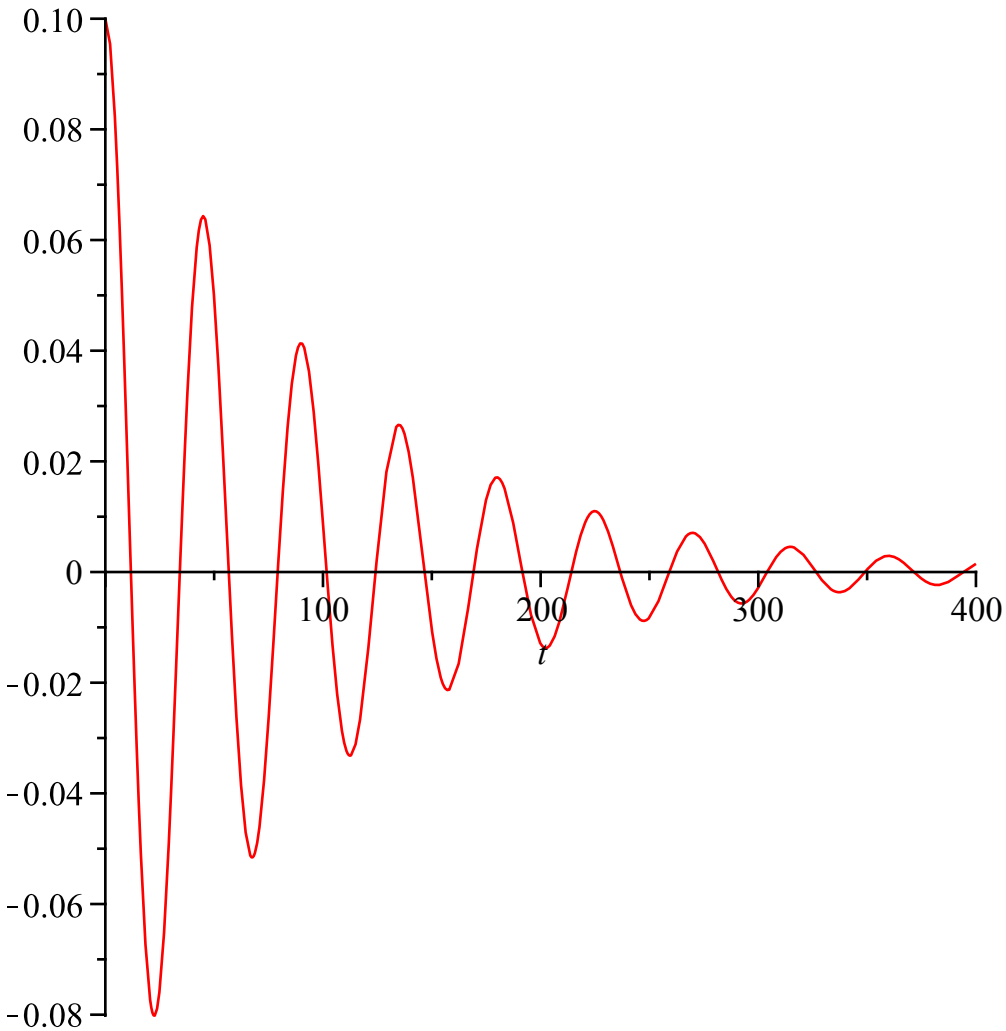
> $Parametro := solve(\{Sistema\}, \{C_1, C_2\})$

$$Parametro := \left\{C_1 = \frac{1}{10}, C_2 = \frac{3}{1990190}\sqrt{21693071}\right\} \quad (22)$$

> $SolucionParticular := simplify(subs(C_1 = rhs(Parametro_1), C_2 = rhs(Parametro_2),$
> $SolucionGeneral)) : evalf(\%, 3)$

$$s(t) = 5.02\ 10^{-7}\, e^{-0.00981\, t}\left(1.99\ 10^5\cos(0.140\ t) + 14000.\sin(0.140\ t)\right) \quad (23)$$

> $plot(rhs(SolucionParticular), t = 0..400)$


0.10
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
100
200
300
400
t