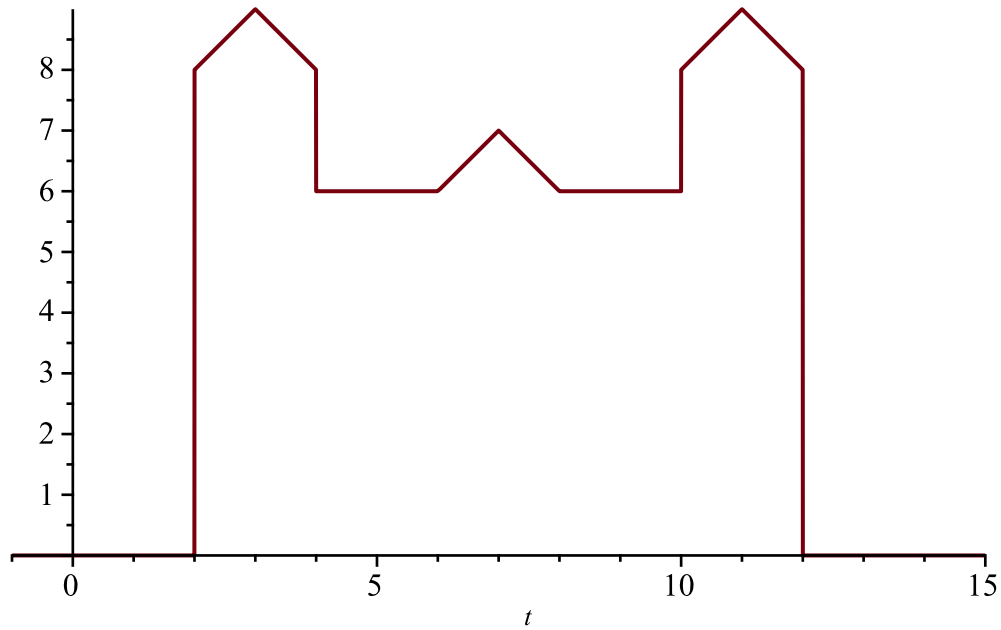


> restart

> CASTILLO := 8·Heaviside(t−2) + (t−2)·Heaviside(t−2) − 2·(t−3)·Heaviside(t−3)
+ (t−4)·Heaviside(t−4) − 2·Heaviside(t−4) + (t−6)·Heaviside(t−6) − 2·(t
− 7)·Heaviside(t−7) + (t−8)·Heaviside(t−8) + 2·Heaviside(t−10) + (t−10)
·Heaviside(t−10) − 2·(t−11)·Heaviside(t−11) + (t−12)·Heaviside(t−12) − 8
·Heaviside(t−12) : plot(CASTILLO, t=−1..15, scaling=CONSTRAINED)



> with(inttrans) :

> CastilloTL := simplify(laplace(CASTILLO, t, s))

$$\text{CastilloTL} := \frac{1}{s^2} \left((-2s+1)(e^{-2s})^2 + ((-8s+1)e^{-10s} + (2s+1)e^{-8s} + 8s - 2e^{-9s} \right. \\ \left. + e^{-6s} - 2e^{-5s} + e^{-4s} - 2e^{-s} + 1)e^{-2s} \right) \quad (1)$$

> restart

> Escalon := Heaviside(t−5)

$$\text{Escalon} := \text{Heaviside}(t-5) \quad (2)$$

> with(inttrans) :

> EscalonTL := laplace(Escalon, t, s)

$$\text{EscalonTL} := \frac{e^{-5s}}{s} \quad (3)$$

$$\begin{aligned} &> \text{Rampa} := (t - 5) \cdot \text{Heaviside}(t - 5) \\ &\quad \text{Rampa} := (t - 5) \text{ Heaviside}(t - 5) \end{aligned} \quad (4)$$

$$\begin{aligned} &> \text{RampaTL} := \text{laplace}(\text{Rampa}, t, s) \\ &\quad \text{RampaTL} := \frac{e^{-5s}}{s^2} \end{aligned} \quad (5)$$

$$\begin{aligned} &> \text{DerivadaRampaTL} := s \cdot \text{RampaTL} - (0) \\ &\quad \text{DerivadaRampaTL} := \frac{e^{-5s}}{s} \end{aligned} \quad (6)$$

$$\begin{aligned} &> \text{Compruebo} := \text{DerivadaRampaTL} - \text{EscalonTL} = 0 \\ &\quad \text{Compruebo} := 0 = 0 \end{aligned} \quad (7)$$

$$\begin{aligned} &> \text{DerivadaEscalonTL} := s \cdot \text{EscalonTL} - (0) \\ &\quad \text{DerivadaEscalonTL} := e^{-5s} \end{aligned} \quad (8)$$

$$\begin{aligned} &> \text{DeltaDiracTL} := \text{laplace}(\text{Dirac}(t - 5), t, s) \\ &\quad \text{DeltaDiracTL} := e^{-5s} \end{aligned} \quad (9)$$

$$\begin{aligned} &> \text{ComprueboDos} := \text{DerivadaEscalonTL} - \text{DeltaDiracTL} = 0 \\ &\quad \text{ComprueboDos} := 0 = 0 \end{aligned} \quad (10)$$

> restart

$$\begin{aligned} &> \text{Ecua} := L \cdot \text{diff}(q(t), t^2) + R \cdot \text{diff}(q(t), t) + \frac{q(t)}{C} = 0 \\ &\quad \text{Ecua} := L \left(\frac{d^2}{dt^2} q(t) \right) + R \left(\frac{d}{dt} q(t) \right) + \frac{q(t)}{C} = 0 \end{aligned} \quad (11)$$

$$\begin{aligned} &> \text{CondIni} := q(0) = \frac{5}{100}, D(q)(0) = 0 \\ &\quad \text{CondIni} := q(0) = \frac{1}{20}, D(q)(0) = 0 \end{aligned} \quad (12)$$

> with(inttrans) :

$$\begin{aligned} &> \text{EcuaTL} := \text{subs}(\text{CondIni}, \text{laplace}(\text{Ecua}, t, s)) \\ &\quad \text{EcuaTL} := L \mathcal{L}(q(t), t, s) s^2 - \frac{Ls}{20} + \mathcal{L}(q(t), t, s) Rs - \frac{R}{20} + \frac{\mathcal{L}(q(t), t, s)}{C} = 0 \end{aligned} \quad (13)$$

$$\begin{aligned} &> \text{Parametros} := L = \frac{1}{10}, R = 20, C = \frac{25}{1000000} \\ &\quad \text{Parametros} := L = \frac{1}{10}, R = 20, C = \frac{1}{40000} \end{aligned} \quad (14)$$

$$\begin{aligned} &> \text{EcuaTLdos} := \text{subs}(\text{Parametros}, \text{EcuaTL}) \\ &\quad \text{EcuaTLdos} := \frac{\mathcal{L}(q(t), t, s) s^2}{10} - \frac{s}{200} + 20 \mathcal{L}(q(t), t, s) s - 1 + 40000 \mathcal{L}(q(t), t, s) = 0 \end{aligned} \quad (15)$$

$$\begin{aligned} &> \text{SolTL} := \text{isolate}(\text{EcuaTLdos}, \text{laplace}(q(t), t, s)) \\ &\quad \end{aligned} \quad (16)$$

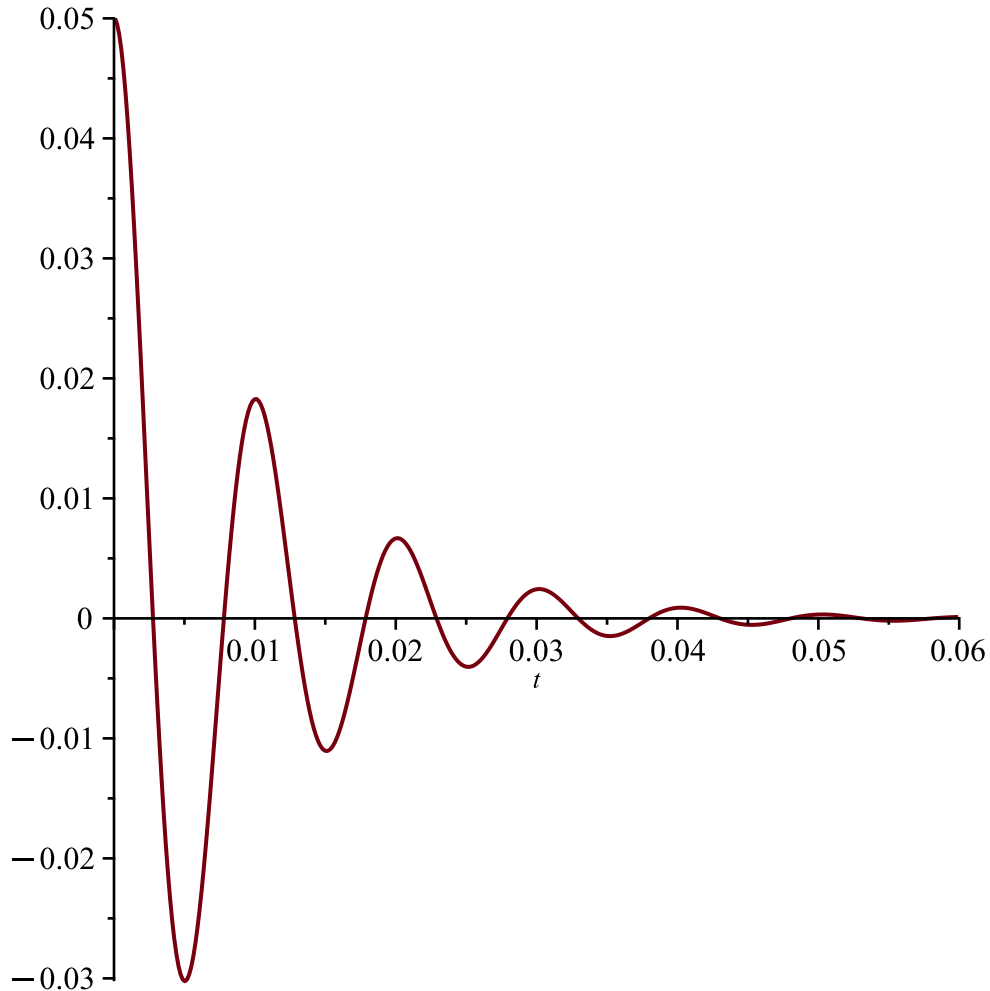
$$SolTL := \mathcal{L}(q(t), t, s) = \frac{\frac{s}{200} + 1}{\frac{1}{10} s^2 + 20 s + 40000} \quad (16)$$

> *SolPartCarga* := simplify(invlaplace(*SolTL*, *s*, *t*)); evalf(%, 2)

$$SolPartCarga := q(t) = \frac{e^{-100t} (39 \cos(100 \sqrt{39} t) + \sqrt{39} \sin(100 \sqrt{39} t))}{780}$$

$$q(t) = 0.0013 e^{-100 \cdot t} (39 \cdot \cos(620 \cdot t) + 6.2 \sin(620 \cdot t)) \quad (17)$$

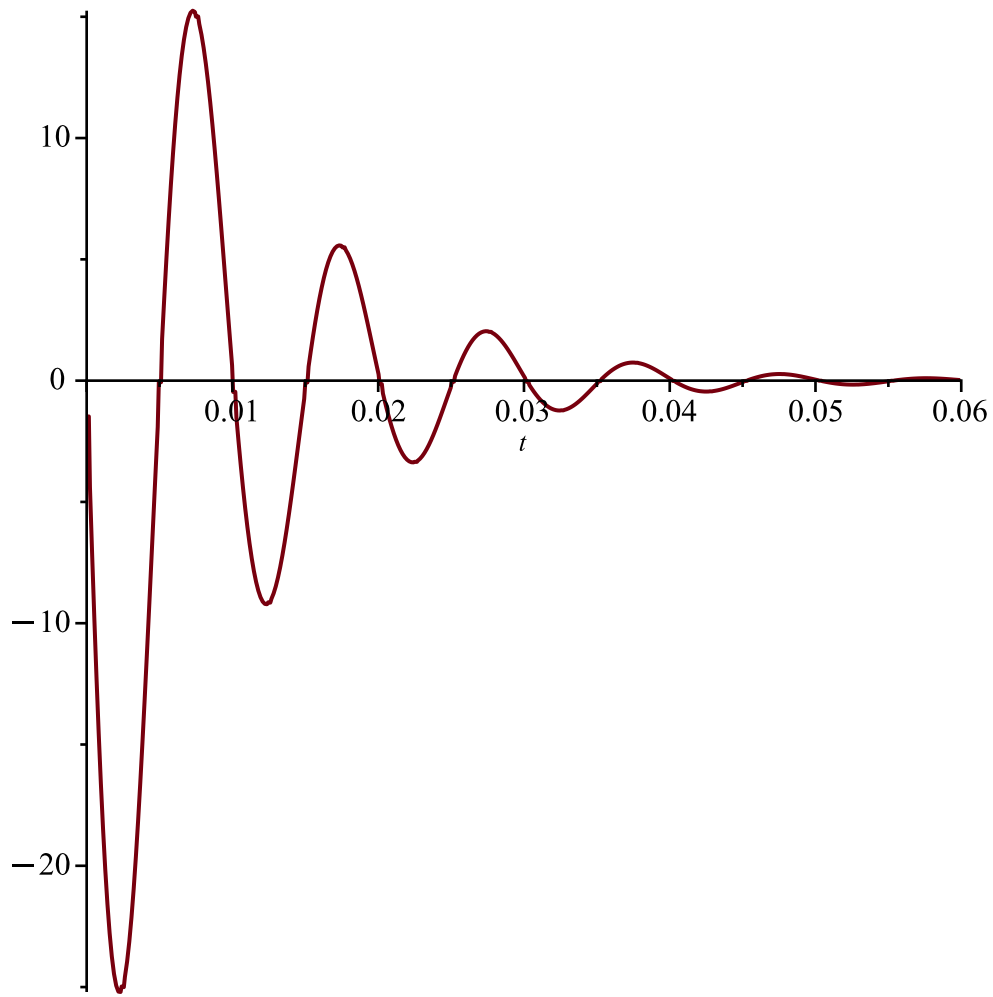
> plot(rhs(*SolPartCarga*), *t* = 0 .. 0.06)



> *SolPartCorriente* := diff(*SolPartCarga*, *t*): evalf(%, 2)

$$\frac{d}{dt} q(t) = -0.13 e^{-100 \cdot t} (39 \cdot \cos(620 \cdot t) + 6.2 \sin(620 \cdot t)) + 0.0013 e^{-100 \cdot t} (-24000 \cdot \sin(620 \cdot t) + 3900 \cdot \cos(620 \cdot t)) \quad (18)$$

> plot(rhs(*SolPartCorriente*), *t* = 0 .. 0.06)



```
> restart
```

```
> Ecua := L·diff(q(t), t$2) + R·diff(q(t), t) + q(t)/C = E(t)
```

$$Ecua := L \left(\frac{d^2}{dt^2} q(t) \right) + R \left(\frac{d}{dt} q(t) \right) + \frac{q(t)}{C} = E(t) \quad (19)$$

```
> CondIni := q(0) = 0, D(q)(0) = 0
```

$$CondIni := q(0) = 0, D(q)(0) = 0 \quad (20)$$

```
> Para := L = 5/100, R = 20, C = 100/1000000, E(t) = 100
```

$$Para := L = \frac{1}{20}, R = 20, C = \frac{1}{10000}, E(t) = 100 \quad (21)$$

```
> EcuaDos := subs(Para, Ecua)·20
```

$$EcuaDos := \frac{d^2}{dt^2} q(t) + 400 \frac{d}{dt} q(t) + 200000 q(t) = 2000 \quad (22)$$

```
> with(inttrans) :
```

```
> EcuaDosTL := subs(CondIni, laplace(EcuaDos, t, s))
```

$$EcuaDosTL := s^2 \mathcal{L}(q(t), t, s) + 400 s \mathcal{L}(q(t), t, s) + 200000 \mathcal{L}(q(t), t, s) = \frac{2000}{s} \quad (23)$$

> *SolTL* := isolate(*EcuaDosTL*, laplace(*q*(*t*), *t*, *s*))

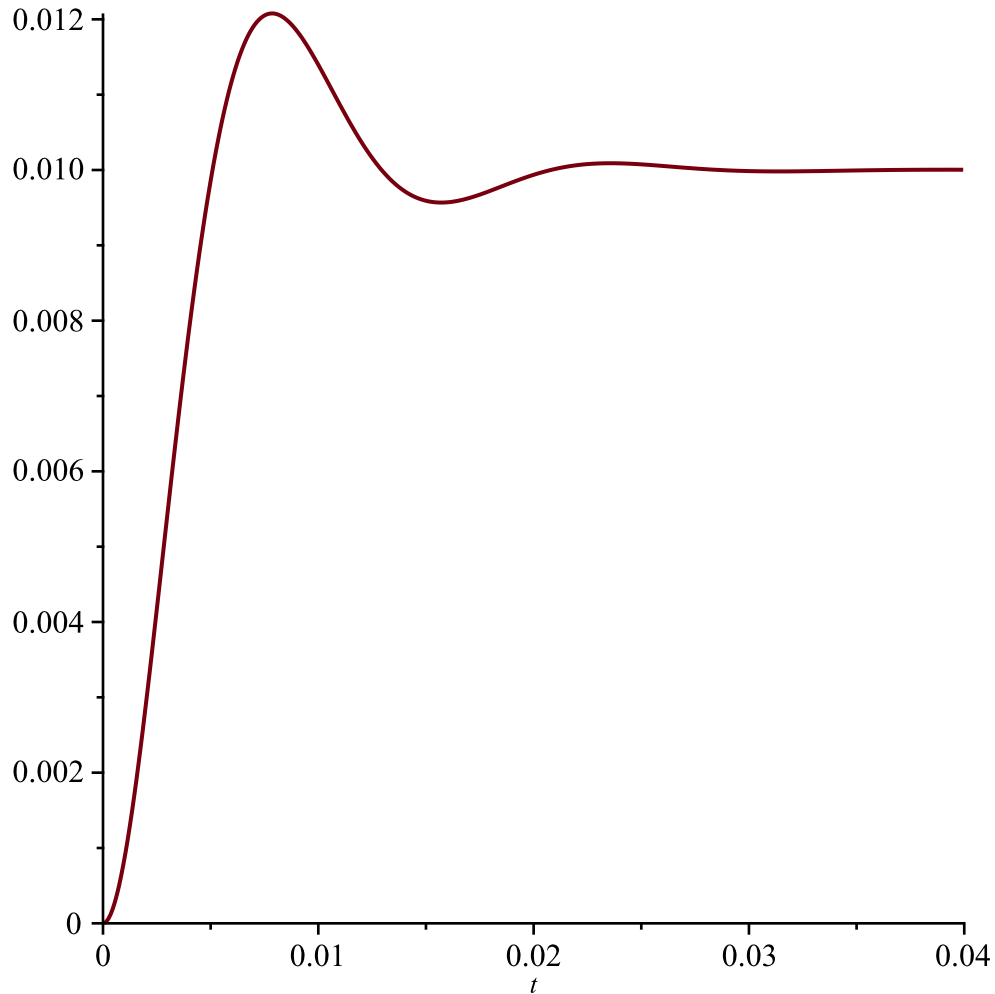
$$SolTL := \mathcal{L}(q(t), t, s) = \frac{2000}{s(s^2 + 400s + 200000)} \quad (24)$$

> *SolPartCarga* := simplify(invlaplace(*SolTL*, *s*, *t*)); evalf(%, 2)

$$SolPartCarga := q(t) = \frac{1}{100} + \frac{(-2 \cos(400t) - \sin(400t)) e^{-200t}}{200}$$

$$q(t) = 0.010 + 0.0050 (-2. \cos(400. t) - 1. \sin(400. t)) e^{-200. t} \quad (25)$$

> plot(rhs(*SolPartCarga*), t=0..0.04)

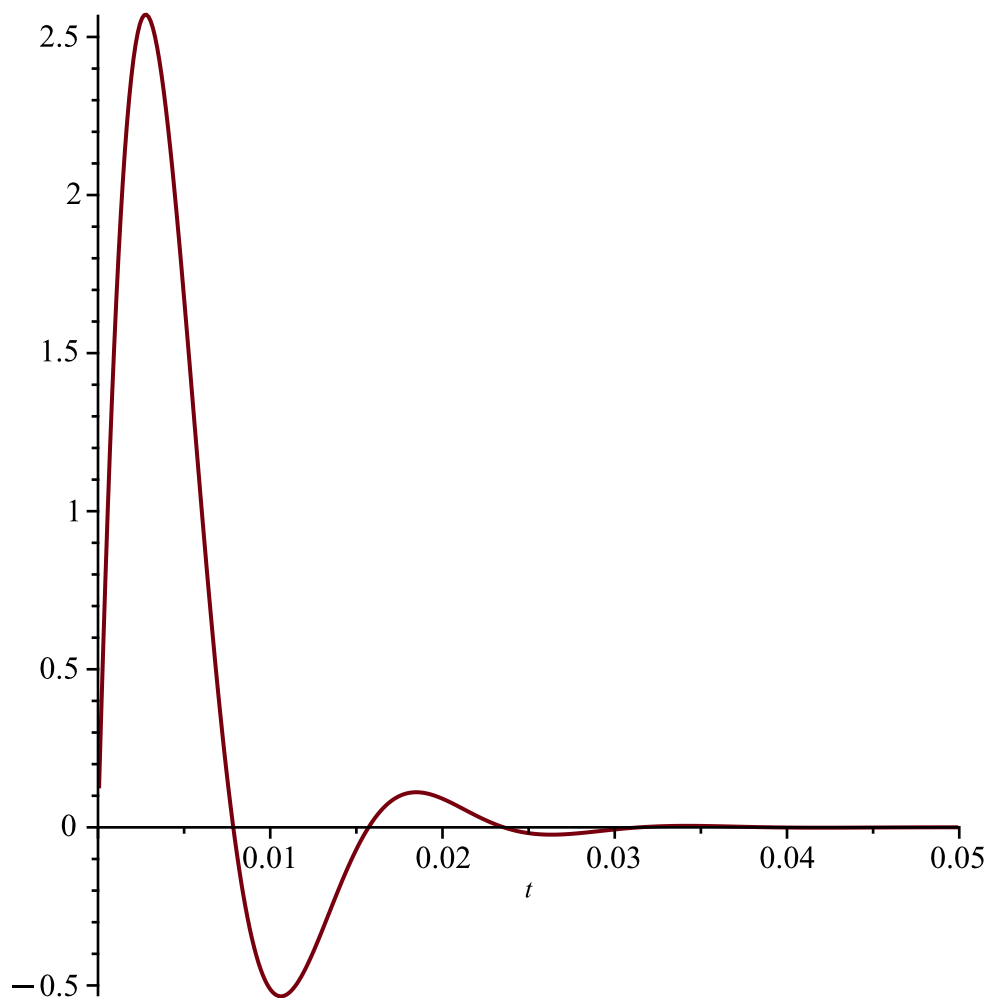


> *SolPartCorriente* := simplify(diff(*SolPartCarga*, *t*)); evalf(%, 2)

$$SolPartCorriente := \frac{d}{dt} q(t) = 5 e^{-200t} \sin(400t)$$

$$\frac{d}{dt} q(t) = 5. e^{-200. t} \sin(400. t) \quad (26)$$

> plot(rhs(*SolPartCorriente*), t=0..0.05)



```
> restart
```

```
> Ecua := L·diff(q(t), t$2) + R·diff(q(t), t) + q(t)/C = E(t)
```

$$Ecua := L \left(\frac{d^2}{dt^2} q(t) \right) + R \left(\frac{d}{dt} q(t) \right) + \frac{q(t)}{C} = E(t) \quad (27)$$

```
> CondIni := q(0) = 0, D(q)(0) = 0
```

$$CondIni := q(0) = 0, D(q)(0) = 0 \quad (28)$$

```
> Para := L = 5/100, R = 20, C = 100/1000000, E(t) = Heaviside(t - 0.02) · 100 · cos(200 · t)
```

$$Para := L = \frac{1}{20}, R = 20, C = \frac{1}{10000}, E(t) = 100 \text{ Heaviside}(t - 0.02) \cos(200 t) \quad (29)$$

```
> EcuaDos := subs(Para, Ecua) · 20
```

$$EcuaDos := \frac{d^2}{dt^2} q(t) + 400 \frac{d}{dt} q(t) + 200000 q(t) = 2000 \text{ Heaviside}(t - 0.02) \cos(200 t) \quad (30)$$

```
> with(inttrans) :
```

```
> EcuaDosTL := subs(CondIni, laplace(EcuaDos, t, s))
```

$$EcuaDosTL := s^2 \mathcal{L}(q(t), t, s) + 400 \cdot s \mathcal{L}(q(t), t, s) + 200000 \cdot \mathcal{L}(q(t), t, s) = \quad (31)$$

$$- \frac{2000. e^{-0.02000000000 s} (0.6536436209 s - 151.3604991)}{s^2 + 40000.}$$

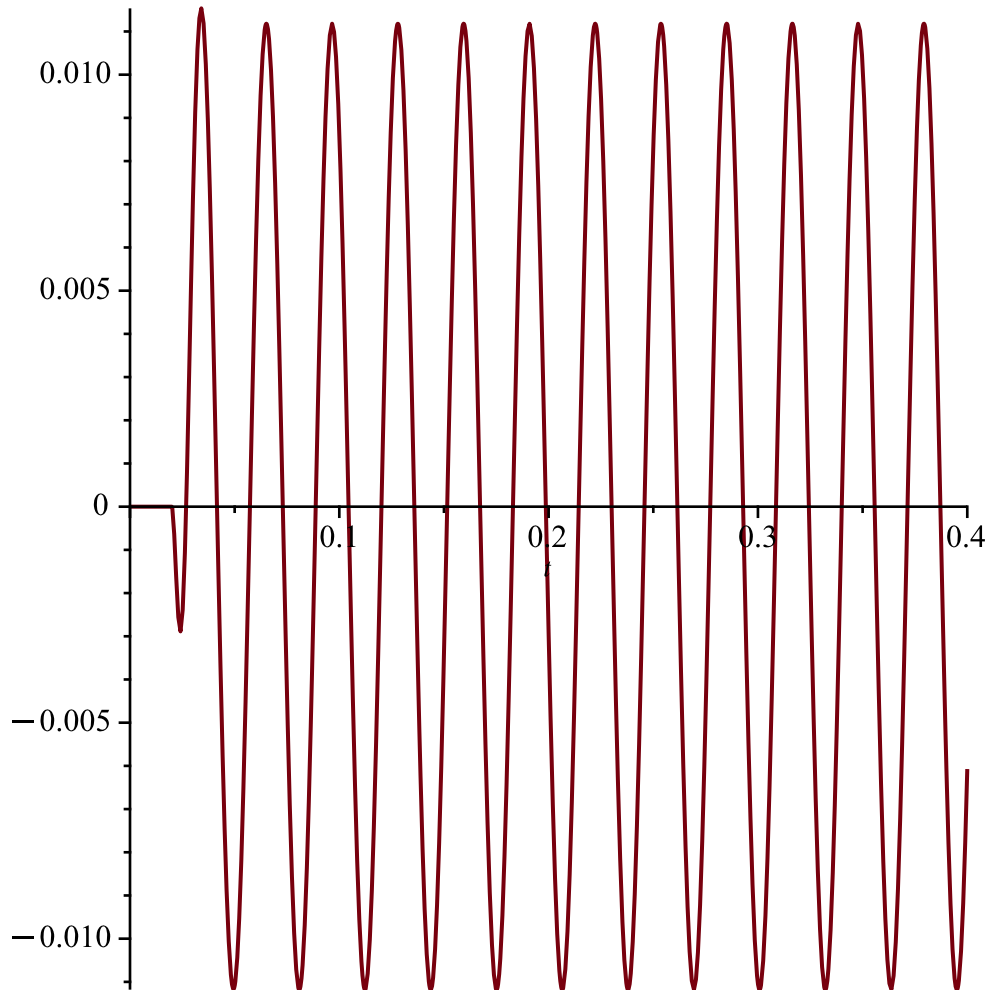
> SolPartTL := simplify(isolate(EcuaDosTL, laplace(q(t), t, s)))

$$SolPartTL := \mathcal{L}(q(t), t, s) = - \frac{1307.287242 e^{-0.02 s} (s - 231.5642565)}{(s^2 + 40000.) (s^2 + 400. s + 200000.)} \quad (32)$$

> SolPartCarga := invlaplace(SolPartTL, s, t)

$$SolPartCarga := q(t) = 4.085272631 \times 10^{-12} \text{Heaviside}(t - 0.02000000000) (-2.526257026 \times 10^9 \cos(200. t - 4.) + 1.052514052 \times 10^9 \sin(200. t - 4.) + e^{-200. t + 4.} (2.526257026 \times 10^9 \cos(400. t - 8.) + 7.36871487 \times 10^8 \sin(400. t - 8.))) \quad (33)$$

> plot(rhs(SolPartCarga), t=0..0.4)

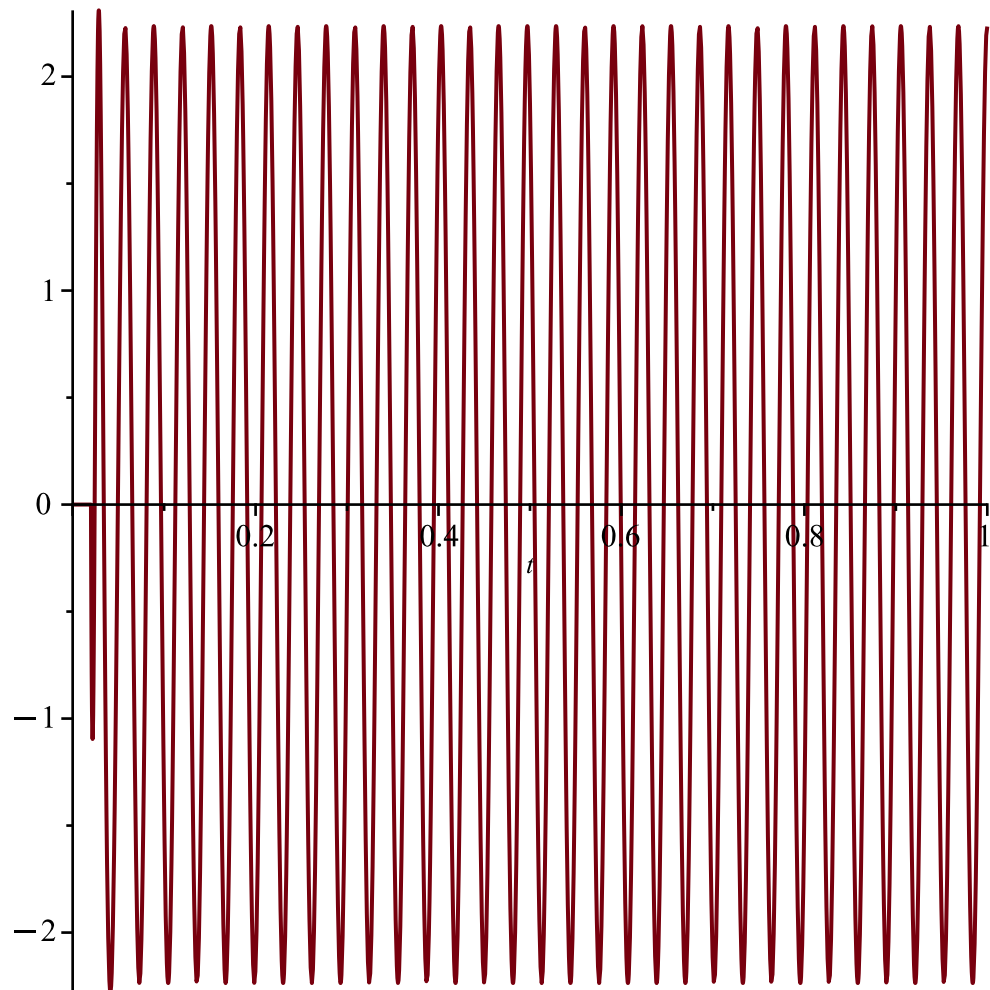


> SolPartCorriente := diff(SolPartCarga, t)

$$SolPartCorriente := \frac{d}{dt} q(t) = 4.085272631 \times 10^{-12} \text{Dirac}(t - 0.02000000000) (-2.526257026 \times 10^9 \cos(200. t - 4.) + 1.052514052 \times 10^9 \sin(200. t - 4.) + e^{-200. t + 4.} (2.526257026 \times 10^9 \cos(400. t - 8.) + 7.36871487 \times 10^8 \sin(400. t - 8.))) + 4.085272631 \times 10^{-12} \text{Heaviside}(t - 0.02000000000) (5.052514052 \times 10^{11} \sin(200. t$$

$$-4.) + 2.105028104 \times 10^{11} \cos(200.t - 4.) - 200. e^{-200.t+4.} (2.526257026 \\ \times 10^9 \cos(400.t - 8.) + 7.36871487 \times 10^8 \sin(400.t - 8.)) + e^{-200.t+4.} (-1.010502810 \\ \times 10^{12} \sin(400.t - 8.) + 2.947485948 \times 10^{11} \cos(400.t - 8.)))$$

```
> plot(rhs(SolPartCorriente), t=0..1)
```



```
> restart
```

```
>
```