TAREA 4
CIRCUITO LCR

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Respuesta de VL, VC Y VR ante un circuito RLC con un vi de entrada, señal de entrada, rampa y escalón unitario.

Componente	Tiempo	Frecuencia
Resistencia	$V_R = I * R$	$V_R = I_{(S)} * R$
Capacitor	$V_C = \frac{1}{C}\int_0^T I_C \ dt$	$V_C = \frac{I_{(S)}}{C * S}$
Inductor	$V_L = L\,\frac{di}{dt}$	$V_L = L * S * I_{(S)}$

Aplicando ley de voltaje de Kirchhoff:

$$-V_{in}(t) + V_R(t) + V_C(t) + V_L(t) = 0$$

Aplicando Laplace

$$L\left(-V_{in}(t) + I * R + \frac{1}{C}\int_0^T I_C \ dt + L\,\frac{di}{dt} = 0\right)$$

$$-V_{in}(s) + I_{(S)} * R + \frac{I_{(S)}}{C * S} + \ L * S * I_{(S)} = 0$$

❖ Para cada uno de los elementos su función de transferencia

- para el Inductor

$$\frac{I_{(S)}}{V_{in}(s)} = \frac{1}{R + L * S + \frac{1}{CS}} = \frac{S}{R * S + L * S^2 + \frac{1}{C}}$$

$$\frac{I_{(S)} * L * S}{V_{in}(s)} = \frac{S * L * S}{R * S + L * S^2 + \frac{1}{C}}$$

$$\frac{V_L(s)}{V_{in}(s)} = \frac{L * S^2}{R * S + L * S^2 + \frac{1}{C}}$$

- Para la Resistencia:

$$\frac{I_{(S)}}{V_{in}(s)} = \frac{1}{R + L * S + \frac{1}{CS}} = \frac{S}{R * S + L * S^2 + \frac{1}{C}}$$

$$\frac{I_{(S)} * R}{V_{in}(s)} = \frac{S * R}{R * S + L * S^2 + \frac{1}{C}}$$

$$\frac{V_R(s)}{V_{in}(s)} = \frac{S * R}{R * S + L * S^2 + \frac{1}{C}}$$

- Para el Capacitor:

$$\frac{I_{(S)}}{V_{in}(s)} = \frac{1}{R + L * S + \frac{1}{CS}} = \frac{S}{R * S + L * S^2 + \frac{1}{C}}$$

$$\frac{\frac{I_{(S)}}{CS}}{V_{in}(s)} = \frac{\frac{S}{CS}}{R * S + L * S^2 + \frac{1}{C}} = \frac{S}{CS\left(R * S + L * S^2 + \frac{1}{C}\right)} = \frac{S}{CR * S^2 + CL * S^3 + S}$$

$$\frac{V_C(s)}{V_{in}(s)} = \frac{S}{CR * S^2 + CL * S^3 + S}$$

Respuesta ante impulso del inductor

WolframAlpha computational intelligence.

laplace inverse (1*10^-6*s^2)/(1*10^3s+1*10^-6*s^2+(1/1*10^-6))

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Assuming "s" is a variable | Use "s^2" as a unit instead

Input interpretation:

$$\mathcal{L}_s^{-1}\left[\frac{1\times 10^{-6}\,s^2}{1\times 10^3\,s+1\times 10^{-6}\,s^2+\frac{1}{1\times 10^{-6}}}\right](t)$$

Open code

$\mathcal{L}_s^{-1}[f(s)](t)$ is the inverse Laplace transform of $f(s)$ with real variable t

Result:

$$\begin{aligned}
&\frac{1}{1\,000\,000}\Bigg(1\,000\,000\,\delta(t)-\Bigg(500\,000\,000\,000\,e^{-\frac{1\,000\,000\,t}{500+\sqrt{249\,999}}}\\
&\quad\Bigg(499\,998\,500\,e^{\frac{1\,000\,000\,t}{500+\sqrt{249\,999}}+\left(-500\,000\,000-1\,000\,000\sqrt{249\,999}\right)t}+\\
&\quad\quad 999\,999\sqrt{249\,999}\,e^{\frac{1\,000\,000\,t}{500+\sqrt{249\,999}}+\left(-500\,000\,000-1\,000\,000\sqrt{249\,999}\right)t}-\\
&\quad\quad 500+\sqrt{249\,999}\Bigg)\Bigg)\Big/\left(249\,999+500\sqrt{249\,999}\right)\Bigg)
\end{aligned}$$

Respuesta a escalón del inductor

WolframAlpha computational intelligence.

laplace inverse (1*10^-6*s^2)/(1*10^3s+1*10^-6*s^2+(1/1*10^-6))(1/s)

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Assuming "s" is a variable | Use "s^2" as a unit instead

Input interpretation:

$$\mathcal{L}_s^{-1}\left[\frac{1\times 10^{-6}\, s^2}{1\times 10^3\, s + 1\times 10^{-6}\, s^2 + \frac{1}{1\times 10^{-6}}}\times\frac{1}{s}\right](t)$$

Open code

$\mathcal{L}_s^{-1}[f(s)](t)$ is the inverse Laplace transform of $f(s)$ with real variable t

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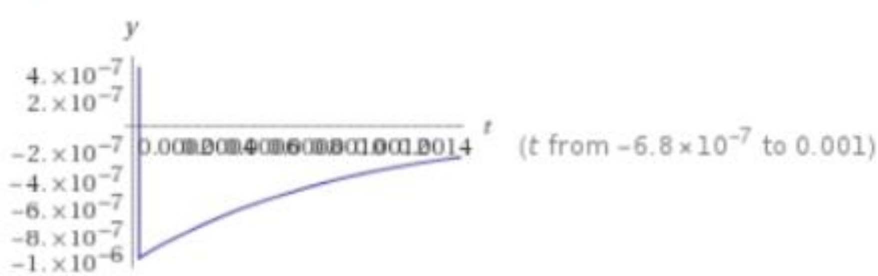
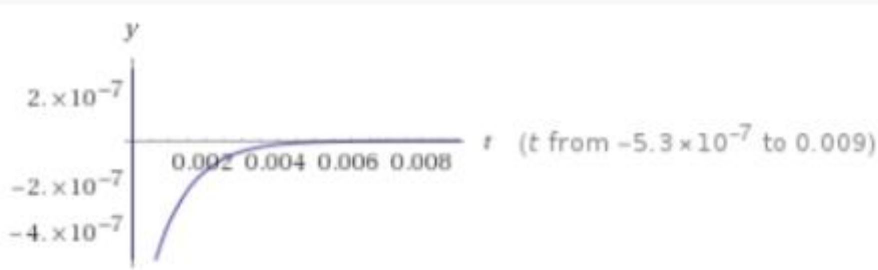
Result:

$$\left(e^{-\frac{1\,000\,000\, t}{500+\sqrt{249\,999}}}\left(499\,999\, e^{\frac{1\,000\,000\, t}{500+\sqrt{249\,999}}+\left(-500\,000\,000-1\,000\,000\sqrt{249\,999}\right)t} + 1000\sqrt{249\,999}\, e^{\frac{1\,000\,000\, t}{500+\sqrt{249\,999}}+\left(-500\,000\,000-1\,000\,000\sqrt{249\,999}\right)t} - 1\right)\right) \Big/ \left(2\left(249\,999+500\sqrt{249\,999}\right)\right)$$

Plots:





Respuesta ante impulso en la resistencia

WolframAlpha computational intelligence.

laplace inverse (1*10^3*s)/(1*10^3s+1*10^-6*s^2+(1/1*10^-6))

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Assuming "s" is a variable | Use as a unit instead

Input interpretation:

$$\mathcal{L}_s^{-1}\left[\frac{1\times 10^3\, s}{1\times 10^3\, s + 1\times 10^{-6}\, s^2 + \frac{1}{1\times 10^{-6}}}\right](t)$$

Open code

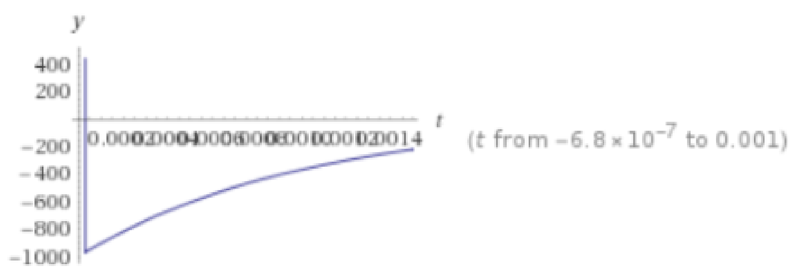
$\mathcal{L}_s^{-1}[f(s)](t)$ is the inverse Laplace transform of $f(s)$ with real variable t

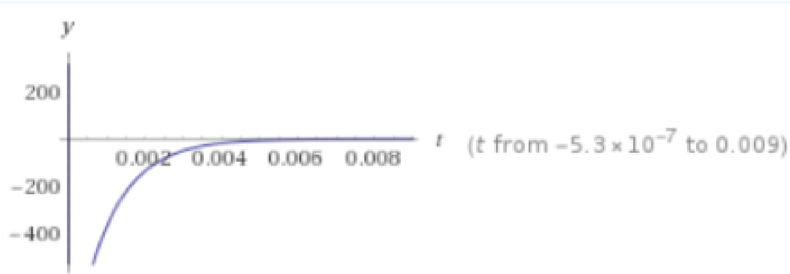
Enlarge | Data | Customize | Plaintext | Interactive

Result:

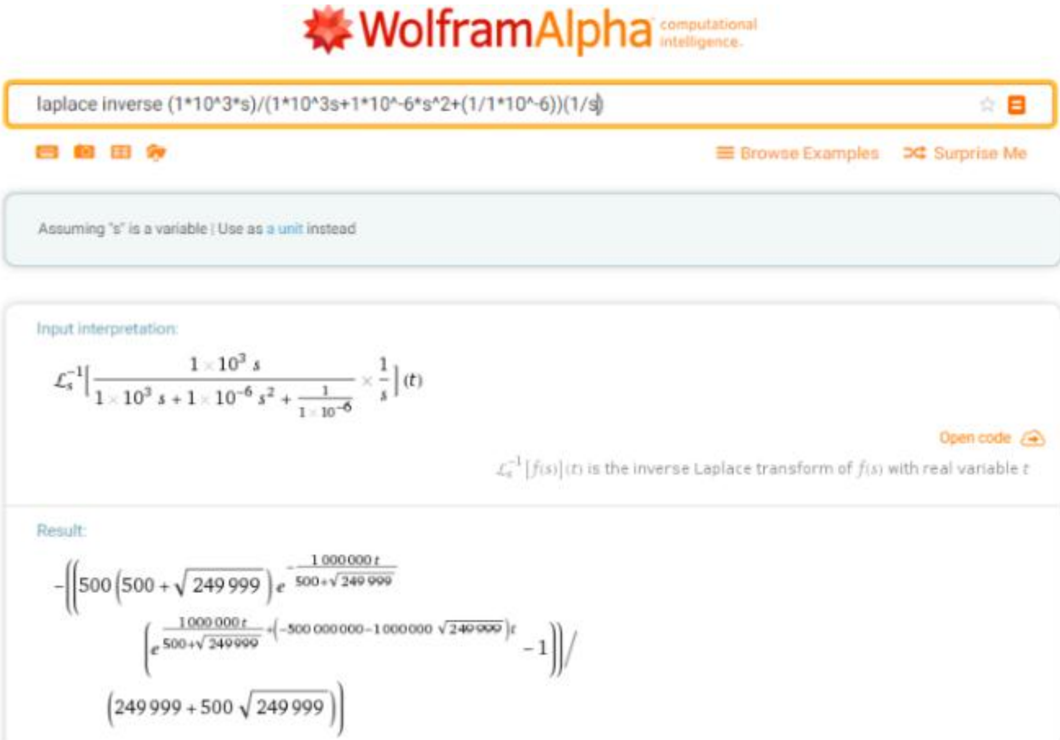
$$\left(500\,000\,000\, e^{-\frac{1\,000\,000\, t}{500+\sqrt{249\,999}}} \left(499\,999\, e^{\frac{1\,000\,000\, t}{500+\sqrt{249\,999}}+\left(-500\,000\,000-1\,000\,000\sqrt{249\,999}\right)t} + 1000\sqrt{249\,999}\, e^{\frac{1\,000\,000\, t}{500+\sqrt{249\,999}}+\left(-500\,000\,000-1\,000\,000\sqrt{249\,999}\right)t} - 1\right)\right) \Big/ \left(249\,999 + 500\sqrt{249\,999}\right)$$

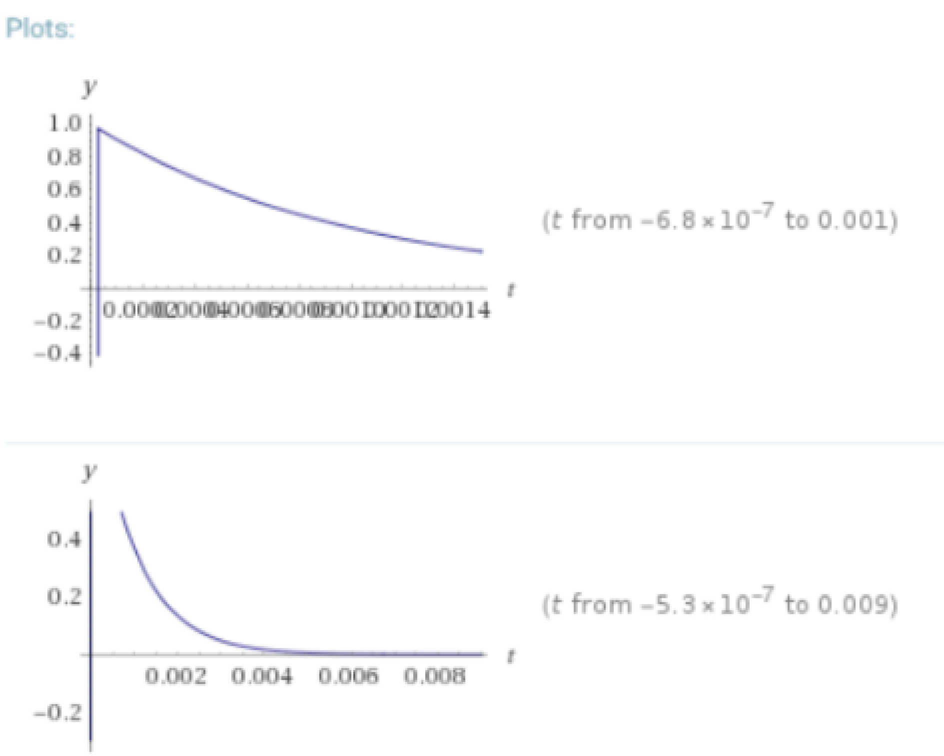
Plots:



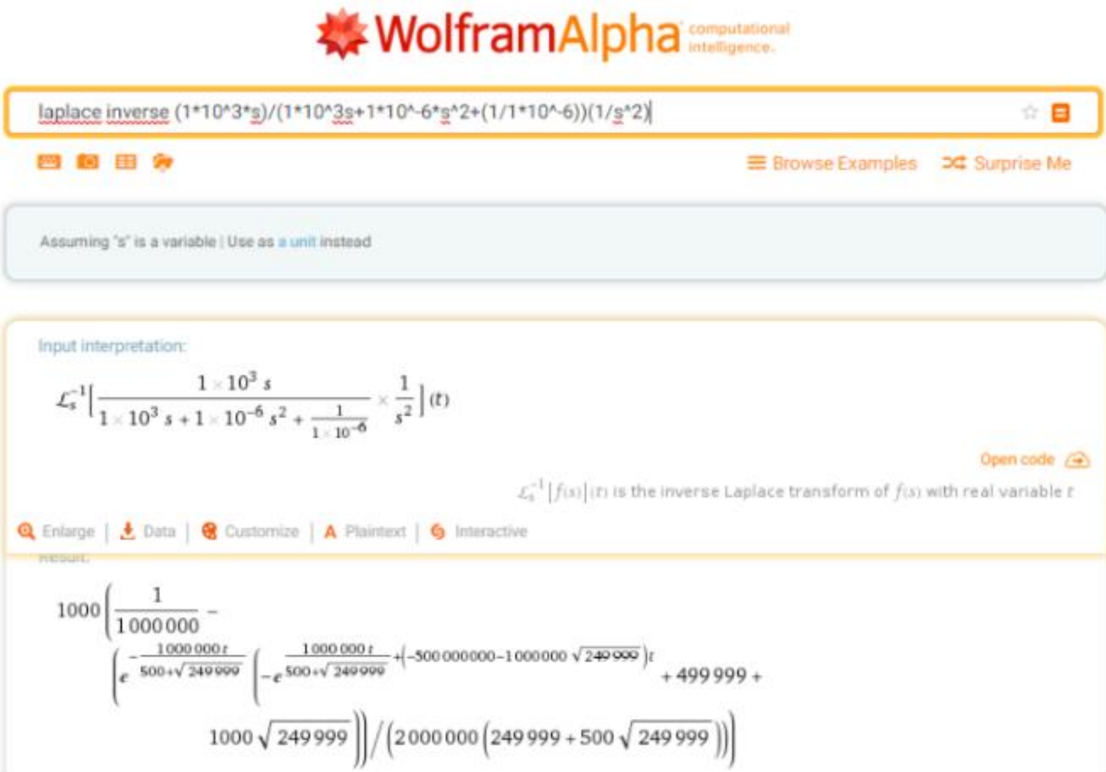


Respuesta a escalón en la resistencia

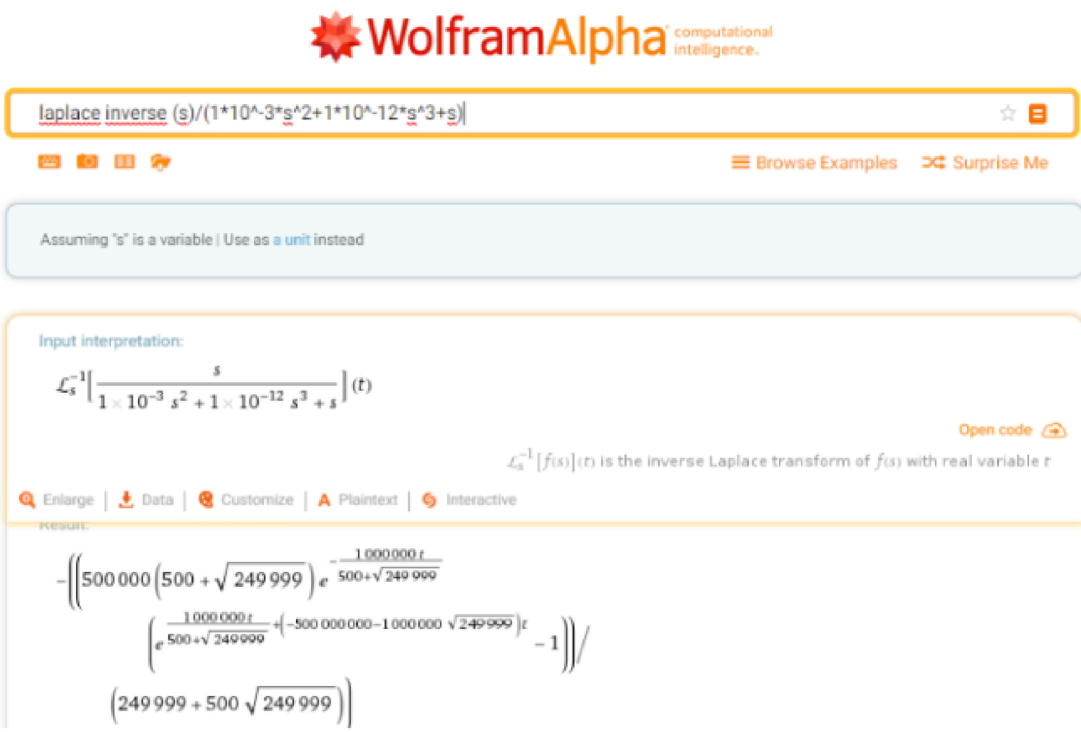




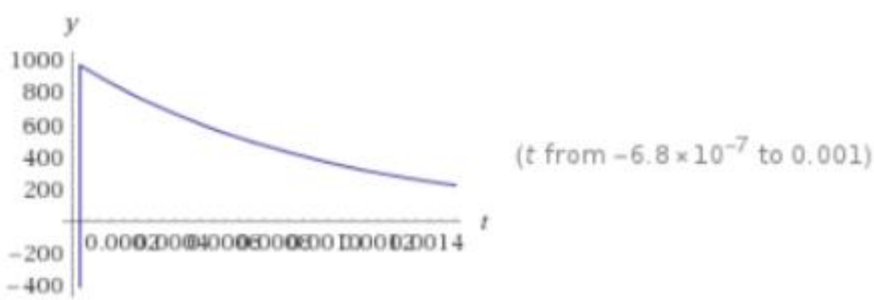
Respuesta ante rampa en la resistencia

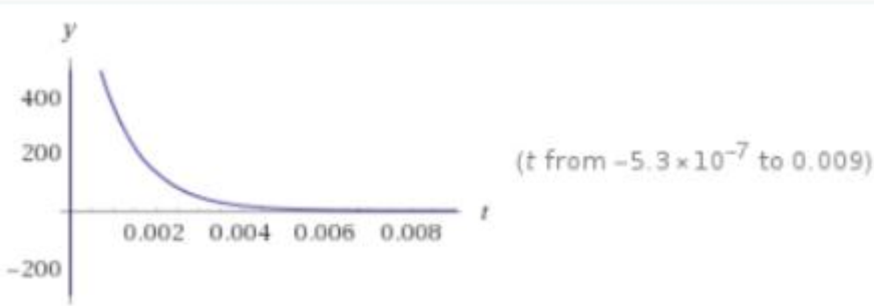


Respuesta ante impulso del capacitor

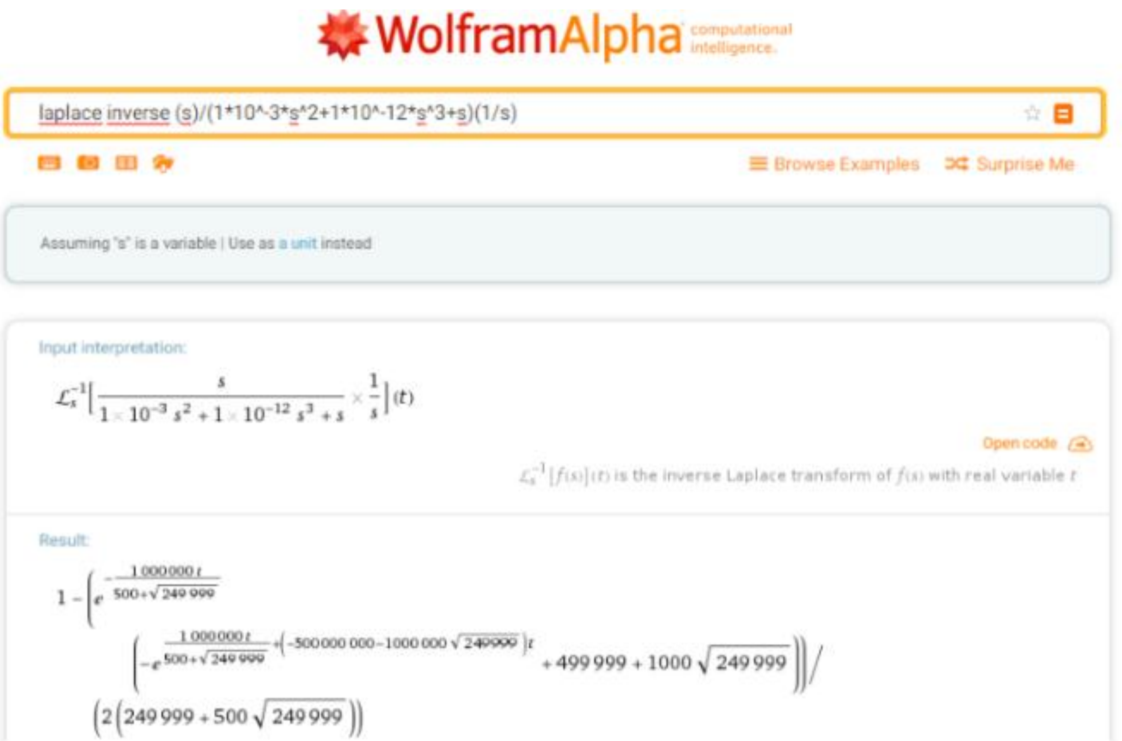


Plots:





Respuesta ante escalón del capacitor



Respuesta ante rampa del capacitor