Ex.4 Convolution (Response of electric circuits)
R=3 Ω, L=1 H, C=0.5 F

$R:=3 \qquad L:=1 \qquad C:=0.5 \qquad Z(s):=R+s\cdot L+\dfrac{1}{s\cdot C}$

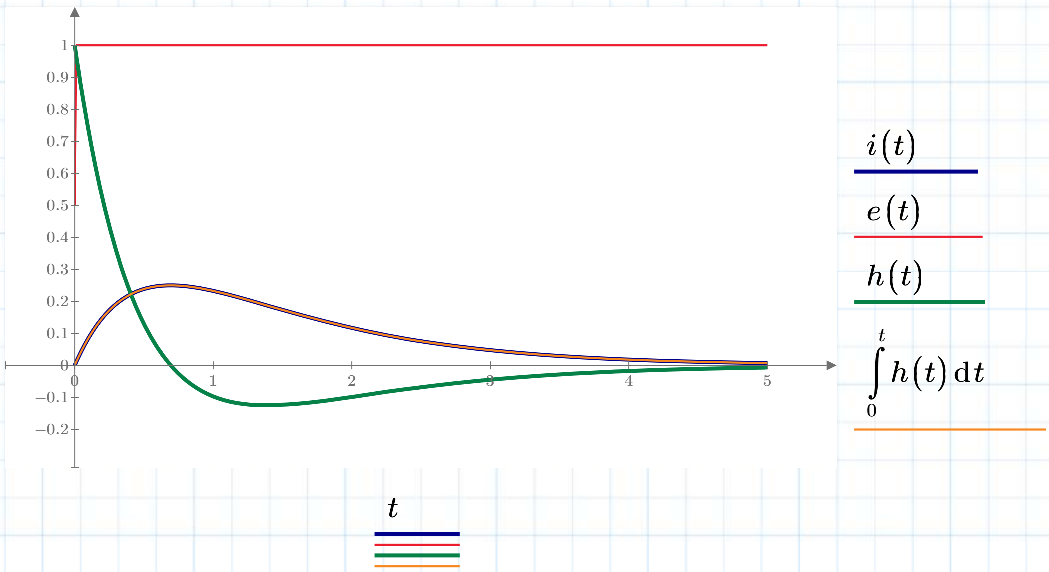
$\dfrac{1}{Z(s)} \xrightarrow{invlaplace} 2\cdot e^{-2\cdot t}-e^{-t} \qquad h(t):=2\cdot e^{-2\cdot t}-e^{-t}$ impulse response

$e(t):=\Phi(t) \xrightarrow{laplace} \dfrac{1}{s} \qquad E(s):=\dfrac{1}{s} \qquad e(t):=\Phi(t)$ *input*

$I(s):=\dfrac{E(s)}{Z(s)} \rightarrow \dfrac{1}{s\cdot\left(s+\dfrac{2.0}{s}+3\right)} \xrightarrow{invlaplace} e^{-t}-e^{-(2\cdot t)}$ *output*

output

$i(t):=e^{-t}-e^{-(2\cdot t)}$



$h(t):=2\cdot e^{-2\cdot t}-e^{-t}$ impulse response

$h_i(t):=\int_0^t h(t)\,dt \rightarrow e^{-t}-e^{-(2\cdot t)}$ indicial response (unit step response)

推定値

$R:=3 \qquad L:=1 \qquad C:=0.5$

制約条件

$\dfrac{1}{C}\cdot q(t)+R\cdot\dfrac{d}{dt}q(t)+L\cdot\dfrac{d^2}{dt^2}q(t)=\Phi(t) \qquad q(0)=0 \qquad q'(0)=0$

ソルバー

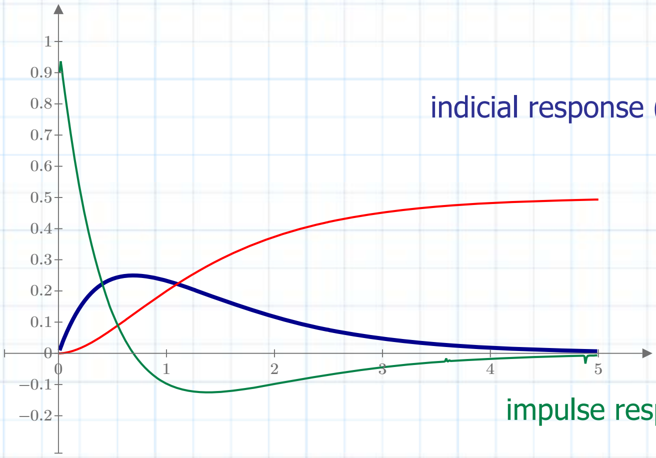
$q:=\text{odesolve}(q(t),5)$

[redacted]

RLC Circuit (series connection)

$$Y(s) := \frac{1}{s + \frac{2.0}{s} + 3}$$

$$i(t) := \frac{d}{dt} q(t) \qquad t := 0, 0.01 .. 5$$



indicial response (unit step response)

$i(t)$

$q(t)$

$\frac{d}{dt} i(t)$

impulse response

t

clear(t)

input

output

impulse response

$$\frac{d}{dt}\Phi(t) \xrightarrow{laplace} 1 \qquad 2 \cdot e^{-2 \cdot t} - e^{-t} \qquad \frac{1}{s + \frac{2.0}{s} + 3} \xrightarrow{invlaplace} 2 \cdot e^{-2 \cdot t} - e^{-t}$$

indicial response
(unit step response)

$$\Phi(t) \xrightarrow{laplace} \frac{1}{s} \qquad e^{-t} - e^{-(2 \cdot t)} \qquad \frac{\frac{1}{s}}{s + \frac{2.0}{s} + 3} \xrightarrow{invlaplace} e^{-t} - e^{-(2 \cdot t)}$$

ramp response

$$\int_0^t \Phi(t)\, dt \xrightarrow{laplace} \frac{1}{s^2} \qquad \frac{\left(e^{-t} - 1\right)^2}{2} \qquad \frac{\frac{1}{s^2}}{s + \frac{2.0}{s} + 3} \xrightarrow{invlaplace} \frac{\left(e^{-t} - 1\right)^2}{2}$$

exponential response

$$e^{-2 \cdot t} \xrightarrow{laplace} \frac{1}{s+2} \qquad e^{-2 \cdot t} - e^{-t} + 2 \cdot t \cdot e^{-2 \cdot t}$$

$$\frac{\frac{1}{s+2}}{s + \frac{2.0}{s} + 3} \xrightarrow{invlaplace} e^{-2 \cdot t} - e^{-t} + 2 \cdot t \cdot e^{-2 \cdot t}$$