Ex.8 Convolution (Response of Mass and Damper)
R=1 [N/(m/s)], L=1 [kg] (Series connection)

$mass := 1\ kg$ $x := 1\ m$ $v := 1\ \frac{m}{s}$ $f := 1\ N$ $t := 0$

$R_m := 1\ \frac{N}{\frac{m}{s}}$ $f_{Rm} := R_m \cdot v$ $\alpha := \frac{d}{dt} v$

$f := mass \cdot \alpha$

$f(t) := \Phi(t)$ $F(s) := \frac{1}{s}$ $force$ $input$

$f(t) = mass \cdot \frac{d}{dt} v(t) + R_m \cdot v(t)$

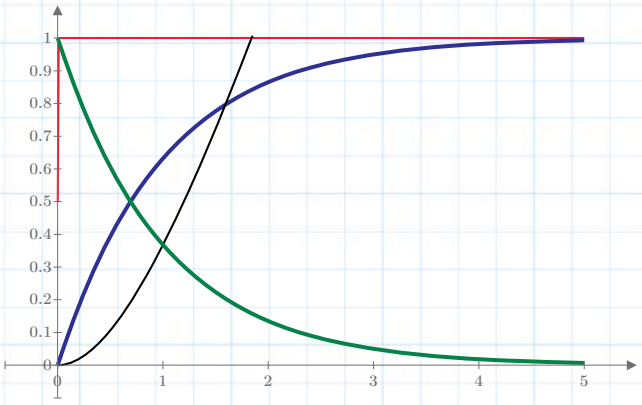
$e(t) = L \cdot \frac{d}{dt} i(t) + R \cdot i(t)$

$\frac{1}{s} = s \cdot L \cdot I(s) + R \cdot I(s) \xrightarrow{solve, I(s)} \frac{1}{s \cdot (R + L \cdot s)}$

$R := 1$ $L := 1$

$I(s) := \frac{1}{s \cdot (R + L \cdot s)} \xrightarrow{invlaplace} 1 - e^{-t}$ $t := 0, 0.01 .. 5$

$v(t) := 1 - e^{-t}$ $x(t) := \int_0^t v(t)\, dt \rightarrow t + e^{-t} - 1$ $\alpha(t) := \frac{d}{dt} v(t) \rightarrow e^{-t}$



t

$f(t)$ $input$

$v(t)$ $output$

$x(t)$

$\alpha(t)$ impulse response

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$\mathbf{clear}(I,t)$

$f(t) := e^{-2\cdot t} \xrightarrow{laplace} \frac{1}{s+2}$ $\quad F(s) := \frac{1}{s+2}$ $\quad force$

$f(t) = mass \cdot \frac{d}{dt} v(t) + R_m \cdot v(t)$ $\quad f(t) := e^{-2\cdot t}$ $\quad input$

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

$e(t) = L \cdot \frac{d}{dt} i(t) + R \cdot i(t)$

$\frac{1}{s+2} = s \cdot L \cdot I(s) + R \cdot I(s) \xrightarrow{solve, I(s)} \frac{1}{s^2+3\cdot s+2}$

$R := 1$ $\quad L := 1$

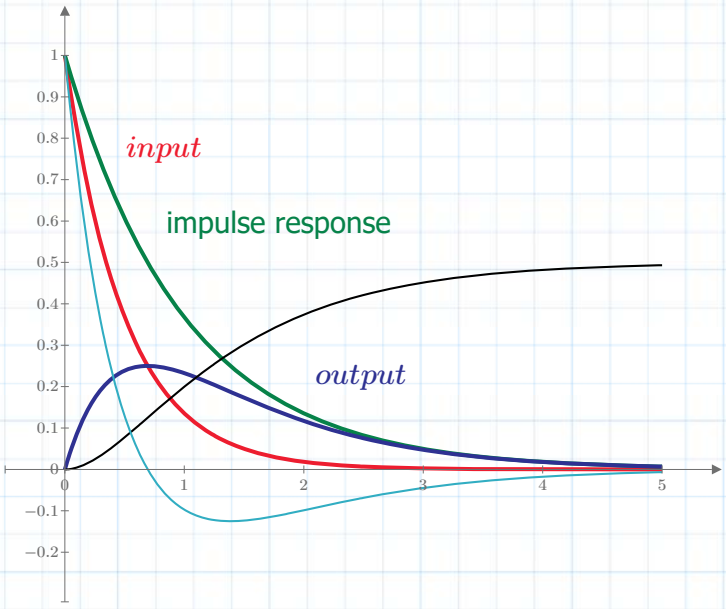
$I(s) := \frac{1}{s^2+3\cdot s+2} \xrightarrow[rewrite, \exp]{invlaplace} -2\cdot e^{-\frac{3\cdot t}{2}} \cdot \left(\frac{e^{-\frac{t}{2}}}{2} - \frac{e^{\frac{t}{2}}}{2} \right) \xrightarrow{simplify} e^{-2\cdot t} \cdot \left(e^t - 1\right)$

$v(t) := e^{-2\cdot t} \cdot \left(e^t - 1\right)$ $\quad output$

$x(t) := \int_0^t v(t)\, dt \rightarrow \frac{e^{-2\cdot t}}{2} - e^{-t} + \frac{1}{2}$

$\alpha(t) := \frac{d}{dt} v(t) \rightarrow e^{-t} - 2\cdot e^{-2\cdot t} \cdot \left(e^t - 1\right)$

$t := 0, 0.01 .. 5$



$f(t)$ $\quad input$

$h(t)$ $\quad$ impulse response

$v(t)$ $\quad output$

$x(t)$

$\alpha(t)$

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