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Let $f(t)$ and $g(t)$ be two functions whose Laplace transforms – denoted by $F(s)$ and $G(s)$ as usual – exist. Then $F(s)G(s) = \mathcal{L}\{h(t)\}$ where:

This is very similar to "multiplication" and has many similar properties:

(1)

(2)

(3)

(4)

(5)

There are is also one thing that we don't have. Indeed, it is not true that:

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Find the inverse Laplace transform of:

$$\frac{1}{s^2(s^2+1)}.$$

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Solve the IVP:

$$x'' + 4x = g(t), \qquad x(0) = 3, \qquad x'(0) = -1$$

Thus, using Laplace transforms allows us to split the solution into a piece that describes how the system behaves when there is no external force plus the system's response to an external force.

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Solve the IVP

$$x'' + 2x' + 2x = \sin at, \qquad x(0) = x'(0) = 0.$$

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Solve the IVP

$$x'' + x' + \frac{5}{4}x = 1 - u_\pi(t), \qquad x(0) = 1, \qquad x'(0) = -1.$$

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