

Transform from a function of t to a function of s

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November 20, 2022

1)

$$\begin{aligned}\mathcal{L}\{e^{3t}\} &= \int_0^\infty e^{-st} e^{3t} dt = \int_0^\infty e^{-t(s-3)} dt = \left[-\frac{e^{-t(s-3)}}{(s-3)} \right]_0^\infty \\ &= 0 + \frac{1}{s-3} = \frac{1}{s-3}\end{aligned}$$

Using theorem 7.1.1,

$$\mathcal{L}\{e^{3t}\} = \frac{1}{s-3}$$

2)

$$\mathcal{L}\{f(t)\} = \int_0^\infty e^{-st} f(t) dt = F(s)$$

3) Using theorem 7.1.1,

$$\mathcal{L}\{\sin(3t)\} = \frac{3}{s^2 + 3^2} = \frac{3}{s^2 + 9}$$

4) Using theorem 7.1.1,

$$\mathcal{L}\{\cos^2(2t)\} = \mathcal{L}\left\{\frac{1 + \cos(4t)}{2}\right\} = \frac{1}{2} \frac{1}{s} + \frac{1}{2} \frac{s}{s^2 + 4^2} = \frac{1}{2s} + \frac{s}{2s^2 + 32} = \frac{s^2 + 8}{s^3 + 16s}$$