TABLE OF LAPLACE TRANSFORM FORMULAS

$$\mathcal{L}\left[t^n\right] = \frac{n!}{s^{n+1}} \qquad \mathcal{L}^{-1}\left[\frac{1}{s^n}\right] = \frac{1}{(n-1)!}\ t^{n-1}$$

$$\mathcal{L}\left[e^{at}\right] = \frac{1}{s-a} \qquad \mathcal{L}^{-1}\left[\frac{1}{s-a}\right] = e^{at}$$

$$\mathcal{L}\left[\sin at\right] = \frac{a}{s^2+a^2} \qquad \mathcal{L}^{-1}\left[\frac{1}{s^2+a^2}\right] = \frac{1}{a}\sin at$$

$$\mathcal{L}\left[\cos at\right] = \frac{s}{s^2+a^2} \qquad \mathcal{L}^{-1}\left[\frac{s}{s^2+a^2}\right] = \cos at$$

Differentiation and integration

$$\mathcal{L}\left[\frac{d}{dt}f(t)\right] = s\mathcal{L}[f(t)] - f(0)$$

$$\mathcal{L}\left[\frac{d^2}{dt^2}f(t)\right] = s^2\mathcal{L}[f(t)] - sf(0) - f'(0)$$

$$\mathcal{L}\left[\frac{d^n}{dt^n}f(t)\right] = s^n\mathcal{L}[f(t)] - s^{n-1}f(0) - s^{n-2}f'(0) - \cdots - f^{(n-1)}(0)$$

In the following formulas $F(s) = \mathcal{L}[f(t)]$, so $f(t) = \mathcal{L}^{-1}[F(s)]$.

$$\mathcal{L}\left[\int_0^t f(u)\ du\right] = \frac{1}{s}\mathcal{L}[f(t)] \qquad \mathcal{L}^{-1}\left[\frac{1}{s}F(s)\right] = \int_0^t f(u)\ du$$

$$\mathcal{L}\left[t^n f(t)\right] = (-1)^n\frac{d^n}{ds^n}\mathcal{L}[f(t)] \qquad \mathcal{L}^{-1}\left[\frac{d^nF(s)}{ds^n}\right] = (-1)^n t^n f(t)$$

Shift formulas

$$\mathcal{L}\left[e^{at}f(t)\right] = F(s-a) \qquad \mathcal{L}^{-1}[F(s)] = e^{at}\mathcal{L}^{-1}[F(s+a)]$$

$$\mathcal{L}\left[u_a(t)f(t)\right] = e^{-as}\mathcal{L}[f(t+a)] \qquad \mathcal{L}^{-1}\left[e^{-as}F(s)\right] = u_a(t)f(t-a)$$

Here $u_a(t) = \begin{cases} 0, & t < a, \\ 1, & t \geq a. \end{cases}$