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

**Power Functions**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $1$ | $\frac{1}{s}$ |
| $t$ | $\frac{1}{s^2}$ |
| $t^n$ | $\frac{n!}{s^{n+1}}$, where $n$ is a positive integer |
| General: $t^n f(t)$ | $(-1)^n \frac{d^n}{ds^n} F(s)$ |
| $t^{-1/2}$ | $\sqrt{\frac{\pi}{s}}$ |
| $t^{1/2}$ | $\frac{\sqrt{\pi}}{2s^{3/2}}$ |
| $t^\alpha$ | $\frac{\Gamma(\alpha+1)}{s^{\alpha+1}}$, Where $\alpha > -1$ |

**Exponential function**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $e^{at}$ | $\frac{1}{s-a}$ |
| General: $e^{at} f(t)$ | $F(s-a)$ |
| $\frac{e^{at}-e^{bt}}{a-b}$ | $\frac{1}{(s-a)(s-b)}$ |
| $\frac{ae^{at}-be^{bt}}{a-b}$ | $\frac{s}{(s-a)(s-b)}$ |

**Trigonometric Functions**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $\sin kt$ | $\frac{k}{s^2+k^2}$ |
| $\cos kt$ | $\frac{s}{s^2+k^2}$ |
| $\sin^2 kt$ | $\frac{2k^2}{s(s^2+4k^2)}$ |
| $\cos^2 kt$ | $\frac{s^2+2k^2}{s(s^2+4k^2)}$ |
| $\sin kt + kt\cos kt$ | $\frac{2ks^2}{(s^2+k^2)^2}$ |
| $\sin kt - kt\cos kt$ | $\frac{2k^3}{(s^2+k^2)^2}$ |
| $\frac{a\sin bt - b\sin at}{ab(a^2-b^2)}$ | $\frac{1}{(s^2+a^2)(s^2+b^2)}$ |
| $\frac{\cos bt - \cos at}{a^2-b^2}$ | $\frac{s}{(s^2+a^2)(s^2+b^2)}$ |

**Hyperbolic Functions**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $\sinh kt$ | $\frac{k}{s^2-k^2}$ |
| $\cosh kt$ | $\frac{s}{s^2-k^2}$ |
| $\sinh^2 kt$ | $\frac{2k^2}{s(s^2-4k^2)}$ |
| $\cosh^2 kt$ | $\frac{s^2-2k^2}{s(s^2-4k^2)}$ |

**Power and Exponential**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $te^{at}$ | $\dfrac{1}{(s-a)^2}$ |
| $t^n e^{at}$ | $\dfrac{n!}{(s-a)^{n+1}}$ , where $n$ is a positive integer. |
| $\dfrac{e^{bt}-e^{at}}{t}$ | $\ln\dfrac{s-a}{s-b}$ |

**Power and Trigonometric**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $t\sin kt$ | $\dfrac{2ks}{\left(s^2+k^2\right)^2}$ |
| $t\cos kt$ | $\dfrac{s^2-k^2}{\left(s^2+k^2\right)^2}$ |
| $1-\cos kt$ | $\dfrac{k^2}{s\left(s^2+k^2\right)}$ |
| $kt-\sin kt$ | $\dfrac{k^3}{s^2\left(s^2+k^2\right)}$ |
| $\dfrac{2(1-\cos kt)}{t}$ | $\ln\dfrac{s^2+k^2}{s^2}$ |
| $\dfrac{\sin at}{t}$ | $\arctan\left(\dfrac{a}{s}\right)$ |
| $\dfrac{\sin at\cos at}{t}$ | $\dfrac{1}{2}\arctan\dfrac{a+b}{s}+\dfrac{1}{2}\arctan\dfrac{a-b}{s}$ |

**Power and Hyperbolic**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $t\sinh kt$ | $\dfrac{2ks}{\left(s^2-k^2\right)^2}$ |
| $t\cosh kt$ | $\dfrac{s^2+k^2}{\left(s^2-k^2\right)^2}$ |
| $\dfrac{2(1-\cosh kt)}{t}$ | $\ln\dfrac{s^2-k^2}{s^2}$ |

**Exponential and trigonometric**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $e^{at}\sin kt$ | $\dfrac{k}{(s-a)^2+k^2}$ |
| $e^{at}\cos kt$ | $\dfrac{s-a}{(s-a)^2+k^2}$ |

**Trigonometric and Hyperbolic**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $\sin kt\sinh kt$ | $\dfrac{2k^2s}{s^4+4k^4}$ |
| $\sin kt\cosh kt$ | $\dfrac{k\left(s^2+2k^2\right)}{s^4+4k^4}$ |
| $\cos kt\sinh kt$ | $\dfrac{k\left(s^2-2k^2\right)}{s^4+4k^4}$ |
| $\cos kt\cosh kt$ | $\dfrac{s^3}{s^4+4k^4}$ |

**Exponential and hyperbolic**

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $e^{at}\sinh kt$ | $\dfrac{k}{(s-a)^2-k^2}$ |
| $e^{at}\cosh kt$ | $\dfrac{s-a}{(s-a)^2-k^2}$ |

## Special Functions

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| Bessel : $J_0(kt)$ | $\frac{1}{\sqrt{s^2+k^2}}$ |
| Dirac delta (unit impulse): $\delta(t)$ | $1$ |
| $\delta(t-t_0)$ | $e^{-st_0}$ |
| Heaviside step (unit step): $u(t-a)$ | $\frac{e^{-as}}{s}$ |
| General: $f(t-a)u(t-a)$ | $e^{-as}F(s)$ |
| Nth Derivative: $f^{(n)}(t)$ | $s^nF(s)-s^{n-1}f(0)-\ldots-f^{(n-1)}(0)$ |
| Convolution: $\int_0^t f(\tau)g(t-\tau)\,d\tau$ | $F(s)G(s)$ |

## Error Functions

| $f(t)$ | $\mathcal{L}\{f(t)\}$ |
|---|---|
| $\operatorname{erfc}\left(\frac{a}{2\sqrt{t}}\right)$ | $\frac{e^{-a\sqrt{s}}}{s}$ |
| $\frac{1}{\sqrt{\pi t}}e^{-a^2/4t}$ | $\frac{e^{-a\sqrt{s}}}{\sqrt{s}}$ |
| $\frac{a}{2\sqrt{\pi t^3}}e^{-a^2/4t}$ | $e^{-a\sqrt{s}}$ |
| $2\sqrt{\frac{t}{\pi}}e^{-a^2/4t}-a\ \operatorname{erfc}\left(\frac{a}{2\sqrt{t}}\right)$ | $\frac{e^{-a\sqrt{s}}}{s\sqrt{s}}$ |
| $e^{ab}e^{b^2t}\ \operatorname{erfc}\left(b\sqrt{t}+\frac{a}{2\sqrt{t}}\right)$ | $\frac{e^{-a\sqrt{s}}}{\sqrt{s}\left(\sqrt{s}+b\right)}$ |
| $-e^{ab}e^{b^2t}\ \operatorname{erfc}\left(b\sqrt{t}+\frac{a}{2\sqrt{t}}\right)+\operatorname{erfc}\left(\frac{a}{2\sqrt{t}}\right)$ | $\frac{be^{-a\sqrt{s}}}{s\left(\sqrt{s}+b\right)}$ |