Texas A&M University


# Laplace transforms

| $f(t)$ | $\mathcal{L}\left\{f\right\}(s)$ |
|---|---|
| $1$ | $\frac{1}{s}$ |
| $e^{at}$ | $\frac{1}{s-a}$ |
| $t^n \quad n=1,2,\cdots$ | $\frac{n!}{s^{n+1}}$ |
| $\sin bt$ | $\frac{b}{s^2+b^2}$ |
| $\cos bt$ | $\frac{s}{s^2+b^2}$ |
| $e^{at}\,t^n \quad n=1,2,\cdots$ | $\frac{n!}{(s-a)^{n+1}}$ |
| $e^{at}\sin bt$ | $\frac{b}{(s-a)^2+b^2}$ |
| $e^{at}\cos bt$ | $\frac{s-a}{(s-a)^2+b^2}$ |
| $\delta(t-c)$ | $e^{-sc}$ |

$$\mathcal{L}\left\{e^{at}\,f(t)\right\} = \mathcal{L}\left\{f(t)\right\}(s-a)$$

$$\mathcal{L}\left\{f'\right\}(s) = s\mathcal{L}\left\{f\right\}(s) - f(0).$$

$$\mathcal{L}\left\{f''\right\}(s) = s^2\mathcal{L}\left\{f\right\}(s) - f'(0) - sf(0).$$

$$\mathcal{L}\left\{f^{(n)}\right\}(s) = s^n\mathcal{L}\left\{f\right\}(s) - s^{n-1}f(0) - s^{n-2}f'(0) - \cdots - f^{(n-1)}(0).$$

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

$$\mathcal{L}\left\{u_c(t)f(t-c)\right\} = e^{-cs}\,\mathcal{L}\left\{f(t)\right\}(s)$$

$$(f*g)(t) = \int_0^t f(t-v)g(v)dv = \int_0^t f(v)g(t-v)dv$$

$$\mathcal{L}\left\{f*g\right\}(s) = \mathcal{L}\left\{f\right\}(s)\mathcal{L}\left\{g\right\}(s)$$

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