

Formulas for Laplace Transforms  
Math 255 Summer 2012

**General:**

1.  $\mathcal{L}\{f(t)\} = \int_0^{\infty} e^{-st} f(t) dt$
2.  $\mathcal{L}\{f^{(n)}(t)\} = s^n F(s) - s^{n-1} f(0) - s^{n-2} f'(0) - \dots - f^{(n-1)}(0)$
3.  $\mathcal{L}\{e^{at} f(t)\} = F(s - a)$
4.  $\mathcal{L}\{f(t - a)\mathcal{U}(t - a)\} = e^{-as} F(s)$
5.  $\mathcal{L}\{g(t)\mathcal{U}(t - a)\} = e^{-as} \mathcal{L}\{g(t + a)\}$
6.  $\mathcal{L}\{t^n f(t)\} = (-1)^n \frac{d^n}{ds^n} [F(s)]$
7.  $f * g = \int_0^t f(\tau) g(t - \tau) d\tau$
8.  $\mathcal{L}\{f * g\} = F(s)G(s)$
9.  $\mathcal{L}\left\{\int_0^t f(\tau) d\tau\right\} = \frac{F(s)}{s}$
10.  $\mathcal{L}\{f(t)\} = \frac{1}{1 - e^{-sT}} \int_0^T e^{-st} f(t) dt$  (f is periodic)

**Specific Functions:**

1.  $\mathcal{L}\{1\} = \frac{1}{s}$
2.  $\mathcal{L}\{t^n\} = \frac{n!}{s^{n+1}}, n=1,2,3,\dots$
3.  $\mathcal{L}\{e^{at}\} = \frac{1}{s-a}$
4.  $\mathcal{L}\{\sin kt\} = \frac{k}{s^2+k^2}$
5.  $\mathcal{L}\{\cos kt\} = \frac{s}{s^2+k^2}$
6.  $\mathcal{L}\{\sinh kt\} = \frac{k}{s^2-k^2}$
7.  $\mathcal{L}\{\cosh kt\} = \frac{s}{s^2-k^2}$
8.  $\mathcal{L}\{\mathcal{U}(t - a)\} = \frac{e^{-as}}{s}$