Table of Laplace Transforms

	$f(t)$	$F(s)$		$f(t)$	$F(s)$
1.	1	$\frac{1}{s}$	**9.**	$t^n e^{at}$	$\frac{n!}{(s-a)^{n+1}}$
2.	t	$\frac{1}{s^2}$	**10.**	$1-\cos at$	$\frac{a^2}{s\left(s^2+a^2\right)}$
3.	t^n	$\frac{n!}{s^{n+1}}$	**11.**	$at-\sin at$	$\frac{a^3}{s^2\left(s^2+a^2\right)}$
4.	e^{at}	$\frac{1}{s-a}$	**12.**	$\sin at - at\cos at$	$\frac{2a^3}{\left(s^2+a^2\right)^2}$
5.	$\sin at$	$\frac{a}{s^2+a^2}$	**13.**	$t\sin at$	$\frac{2as}{\left(s^2+a^2\right)^2}$
6.	$\cos at$	$\frac{s}{s^2+a^2}$	**14.**	$\sin at + at\cos at$	$\frac{2as^2}{\left(s^2+a^2\right)^2}$
7.	$e^{at}\sin bt$	$\frac{b}{(s-a)^2+b^2}$	**15.**	$t\cos at$	$\frac{s^2-a^2}{\left(s^2+a^2\right)^2}$
8.	$e^{at}\cos bt$	$\frac{s-a}{(s-a)^2+b^2}$			

Laplace Transforms of Derivatives:

$\mathcal{L}\{y'\} = sY(s) - y(0)$, $\quad \mathcal{L}\{y''\} = s^2 Y(s) - sy(0) - y'(0)$ where $Y(s) = \mathcal{L}\{y\}$

Integrating Factors: $y' = P(x)y = Q(x)$ has solution y where $ye^{\int P(x)dx} = \int Q(x)e^{\int P(x)dx}dx + C$

Taylor Series: $f(x) = f(c) + f'(c)(x-c) + \frac{f''(c)}{2!}(x-c)^2 + \frac{f'''(c)}{3!}(x-c)^3 + \ldots = \sum_{n=0}^{\infty} \frac{f^{(n)}(c)}{n!}(x-c)^n$

Maclaurin Series: $f(x) = f(0) + f'(0)x + \frac{f''(0)}{2!}x^2 + \frac{f'''(0)}{3!}x^3 + \ldots = \sum_{n=0}^{\infty} \frac{f^{(n)}(0)}{n!}x^n$

Examples:

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots \text{ (for all } x\text{)} \qquad \sin x = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{(2n+1)!} = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots$$

$$\ln(x+1) = \sum_{n=1}^{\infty} \frac{(-1)^{n-1}x^n}{n} = x - \frac{x^2}{1} + \frac{x^3}{3} - \ldots \qquad \cos x = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{(2n)!} = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \ldots$$

Fourier Series:

$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left(a_n \cos\frac{n\pi x}{p} + b_n \sin\frac{n\pi x}{p}\right)$ for a function defined on the interval $(-p, p)$

where $a_0 = \frac{1}{p}\int_{-p}^{p} f(x)dx \qquad a_n = \frac{1}{p}\int_{-p}^{p} f(x)\cos\frac{n\pi x}{p}dx \qquad b_n = \frac{1}{p}\int_{-p}^{p} f(x)\sin\frac{n\pi x}{p}dx$

For any constant function defined by $f(x) = k$:

$$a_0 = \frac{k}{p}(b-a) \qquad a_n = \frac{k}{n\pi}\left(\sin\frac{bn\pi}{p} - \sin\frac{an\pi}{p}\right) \qquad b_n = \frac{k}{n\pi}\left(\cos\frac{an\pi}{p} - \cos\frac{bn\pi}{p}\right)$$

Moments: $\quad M_y = \rho\int_a^b x\left[f(x) - g(x)\right]dx \qquad M_x = \rho\int_a^b \frac{1}{2}\left(\left[f(x)\right]^2 - \left[g(x)\right]^2\right)dx$

Centroids: $\quad \bar{x} = \frac{M_y}{m} \qquad \bar{y} = \frac{M_x}{m}$