Laplace Transform Pairs

$$F(s) = \int_{0-}^{\infty} f(t)e^{-st}dt \quad , \quad s \in C$$

Number	$f(t)$	$F(s)$	Poles
1	$\delta(t)$	1	none
2	1	$\frac{1}{s}$	simple
3	e^{-at}	$\frac{1}{s+a}$	simple
4	te^{-at}	$\frac{1}{(s+a)^2}$	multiple
5	$t^n e^{-at}$	$\frac{n!}{(s+a)^{n+1}}$	multiple
6	$\cos(\omega t)$	$\frac{s}{s^2+\omega^2}$	imaginary
7	$\sin(\omega t)$	$\frac{\omega}{s^2+\omega^2}$	imaginary
8	$e^{-at}\cos(\omega t)$	$\frac{s+a}{(s+a)^2+\omega^2}$	complex
9	$e^{-at}\sin(\omega t)$	$\frac{\omega}{(s+a)^2+\omega^2}$	complex

Laplace Transform Properties

Property			Name
$\mathrm{L}\{af(t)+bg(t)\}$	$=$	$aF(s)+bG(s)$	linearity
$\mathrm{L}\{e^{-at}f(t)\}$	$=$	$F(s+a)$	frequency shift
$\mathrm{L}\{f(t-T)u_s(t-T)\}$	$=$	$e^{-sT}F(s)$	time shift
$\mathrm{L}\{f(at)\}$	$=$	$\frac{1}{a}F\left(\frac{s}{a}\right)$	scaling
$\mathrm{L}\{\dot{f}(t)\}$	$=$	$sF(s)-f(0^-)$	first derivative
$\mathrm{L}\{\ddot{f}(t)\}$	$=$	$s^2F(s)-sf(0^-)-\dot{f}(0-)$	second derivative
$\mathrm{L}\{f^{(n)}(t)\}$	$=$	$s^nF(s)-\sum_{k=1}^{n}s^{n-k}f^{(k-1)}(0^-)$	general derivative
$\mathrm{L}\left\{\int_0^t f(\tau)d\tau\right\}$	$=$	$\frac{F(s)}{s}$	integral
$f(0^+)$	$=$	$\lim_{s\to\infty}\{sF(s)\}$	initial value
$f(\infty)$	$=$	$\lim_{s\to 0}\{sF(s)\}$	final value, $sF(s)$ stable