Laplace Transform Table

Time Signal	Laplace Transform
$u(t)$	$1/s$
$u(t)-u(t-c), \quad c>0$	$(1-e^{-cs})/s, \quad c>0$
$t^N u(t), \quad N=1,2,3,\dots$	$\dfrac{N!}{s^{N+1}}, \quad N=1,2,3,\dots$
$\delta(t)$	1
$\delta(t-c), \quad c$ real	$e^{-cs}, \quad c$ real
$e^{-bt}u(t), \quad b$ real or complex	$\dfrac{1}{s+b}, \quad b$ real or complex
$t^N e^{-bt}u(t), \quad N=1,2,3,\dots$	$\dfrac{N!}{(s+b)^{N+1}}, \quad N=1,2,3,\dots$
$\cos(\omega_o t)u(t)$	$\dfrac{s}{s^2+\omega_o^2}$
$\sin(\omega_o t)u(t)$	$\dfrac{\omega_o}{s^2+\omega_o^2}$
$\cos^2(\omega_o t)u(t)$	$\dfrac{s^2+2\omega_o^2}{s(s^2+4\omega_o^2)}$
$\sin^2(\omega_o t)u(t)$	$\dfrac{2\omega_o^2}{s(s^2+4\omega_o^2)}$
$e^{-bt}\cos(\omega_o t)u(t)$	$\dfrac{s+b}{(s+b)^2+\omega_o^2}$
$e^{-bt}\sin(\omega_o t)u(t)$	$\dfrac{\omega_o}{(s+b)^2+\omega_o^2}$
$t\cos(\omega_o t)u(t)$	$\dfrac{s^2-\omega_o^2}{(s^2+\omega_o^2)^2}$
$t\sin(\omega_o t)u(t)$	$\dfrac{2\omega_o s}{(s^2+\omega_o^2)^2}$
$Ae^{-\zeta\omega_n t}\sin\left[\left(\omega_n\sqrt{1-\zeta^2}\right)t\right]u(t)$ where: $A=\dfrac{\alpha}{\omega_n\sqrt{1-\zeta^2}}$	$\dfrac{\alpha}{s^2+2\zeta\omega_n s+\omega_n^2}$
$Ae^{-\zeta\omega_n t}\sin\left[\left(\omega_n\sqrt{1-\zeta^2}\right)t+\phi\right]u(t)$ $A=\beta\sqrt{\dfrac{(\alpha-\zeta\omega_n)^2}{\omega_n^2(1-\zeta^2)}+1} \quad \phi=\tan^{-1}\left(\dfrac{\omega_n\sqrt{1-\zeta^2}}{\alpha-\zeta\omega_n}\right)$	$\beta\dfrac{s+\alpha}{s^2+2\zeta\omega_n s+\omega_n^2}$
$te^{-bt}\cos(\omega_o t)u(t)$	$\dfrac{(s+b)^2-\omega_o^2}{((s+b)^2+\omega_o^2)^2}$
$te^{-bt}\sin(\omega_o t)u(t)$	$\dfrac{2\omega_o(s+b)}{((s+b)^2+\omega_o^2)^2}$

Laplace Transform Properties

Property Name	Property	
Linearity	$ax(t)+bv(t)$	$aX(s)+bV(s)$
Right Time Shift (**Causal** Signal)	$x(t-c), \quad c>0$	$e^{-cs}X(s)$
Time Scaling	$x(at), \quad a>0$	$\frac{1}{a}X(s/a), \quad a>0$
Multiply by t^n	$t^n x(t), \quad n=1,2,3,\ldots$	$(-1)^n \dfrac{d^n}{ds^n}X(s), \quad n=1,2,3,\ldots$
Multiply by Exponential	$e^{at}x(t), \quad a$ real or complex	$X(s-a), \quad a$ real or complex
Multiply by Sine	$\sin(\omega_o t)x(t)$	$\dfrac{j}{2}\left[X(s+j\omega_o)-X(s-j\omega_o)\right]$
Multiply by Cosine	$\cos(\omega_o t)x(t)$	$\dfrac{1}{2}\left[X(s+j\omega_o)+X(s-j\omega_o)\right]$
Time Differentiation 2nd Derivative n^{th} Derivative	$\dot{x}(t)$ $\ddot{x}(t)$ $x^{(N)}(t)$	$sX(s)-x(0)$ $s^2X(s)-sx(0)-\dot{x}(0)$ $s^N X(s)-s^{N-1}x(0)-s^{N-2}\dot{x}(0)-$ $\cdots-sx^{(N-2)}(0)-x^{(N-1)}(0)$
Time Integration	$\int_{-\infty}^{t} x(\lambda)d\lambda$	$\dfrac{1}{s}X(s)$
Convolution in Time	$x(t)*h(t)$	$X(s)H(s)$
Initial-Value Theorem	$x(0)=\lim_{s\to\infty}\left[sX(s)\right]$ $\dot{x}(0)=\lim_{s\to\infty}\left[s^2X(s)-sx(0)\right]$ $x^{(N)}(0)=\lim_{s\to\infty}\left[s^{N+1}X(s)-s^N x(0)-s^{N-1}\dot{x}(0)-\cdots-sx^{(N-1)}(0)\right]$	
Final-Value Theorem	If $\lim_{t\to\infty}x(t)$ exists, then $\lim_{t\to\infty}x(t)=\lim_{s\to 0}sX(s)$	