Laplace transform theorems

1.	Definition	$L[f(t)] = F(s) = \int_{0-}^{\infty} f(t)e^{-st}\,dt$
2.	Linearity	$L[k_1 f(t_1) + k_2 f(t_2)] = k_1 F_1(s) + k_2 F_2(s)$
3.	Time shift	$L[f(t-t)] = e^{-ts}F(s)$
4.	Frequency Shift	$L[e^{-at} f(t)] = F(s+a)$
5.	Scaling Theorm	$L[f(at)] = \frac{1}{a}F\left(\frac{s}{a}\right)$
6.	Differenti ation Theorm	$L\left[\frac{df}{dt}\right] = sF(s) - f(0)$
7.	Differenti ation Theorm	$L\left[\frac{d^2 f}{dt^2}\right] = s^2F(s) - sf(0) - \dot{f}(0)$
8.	Differenti ation Theorm	$L\left[\frac{d^n f}{dt^n}\right] = s^nF(s) - \sum_{k=1}^{n} s^{n-k} f^{k-1}(0)$
9.	Integratio n Theorm	$L\left[\int f(t)dt\right] = \frac{F(s)}{s} + \frac{\int^{0+} f(t)dt}{s}$
10.	Final value theorem ℏ	$f(\infty) = \lim_{s\to 0} sF(s)$
11.	Initial value theorem ɜ	$f(0^+) = \lim_{s\to\infty} sF(s)$

ℏ Provided all poles of $F(s)$ have negative real parts with the exception of possibly one pole at the origin.

ɜ Provided $f(t)$ is continuous or has a step discontinu ity at $t = 0$.

Laplace transform of time funtions

1.	$d(t)$	1
2.	$u(t)$	$1/s$
3.	$tu(t)$	$1/s^2$
4.	$\frac{1}{2!}t^2u(t)$	$1/s^3$
5.	$\frac{1}{(m-1)!}t^{m-1}u(t)$	$1/(s^m)$
6.	$e^{-at}u(t)$	$1/(s+a)$
7.	$te^{-at}u(t)$	$1/(s+a)^2$
8.	$\frac{1}{(m-1)!}t^{m-1}e^{-at}u(t)$	$1/(s+a)^m$
9.	$(1-e^{-at})u(t)$	$a/[s(s+a)]$
10.	$\frac{1}{a}\ (at-1+e^{-at})u(t)$	$a/[s^2(s+a)]$
11.	$(1-at)e^{-at}u(t)$	$s/(s+a)^2$
12.	$\sin(wt)u(t)$	$w/(s^2+w^2)$
13.	$\cos(wt)u(t)$	$s/(s^2+w^2)$
14.	$e^{-at}\cos(wt)u(t)$	$(s+a)/[(s+a)^2+w^2]$
15.	$e^{-at}\sin(wt)u(t)$	$w/[(s+a)^2+w^2]$
16.	$\left\{1-\frac{1}{\sqrt{1-z^2}}e^{-zw_nt}\left[\sin(w_dt+q)\right]\right\}u(t)$	
	$w_\mathrm{d}=w_n\sqrt{1-z^2}\ ;\quad q=\cos^{-1}(z)$	
OR	$\left\{1-e^{-zw_nt}\left[\cos(w_dt)+\frac{z}{\sqrt{1-z^2}}\sin(w_dt)\right]\right\}$	$\frac{w_n^2}{s(s^2+2zw_ns+w_n^2)}$