

ESE 406 Final Exam Cheat Sheet

Function	Time domain $f(t) = \mathcal{L}^{-1}\{F(s)\}$	Laplace s-domain $F(s) = \mathcal{L}\{f(t)\}$
n th power (for integer n)	$\frac{t^n}{n!} \cdot u(t)$	$\frac{1}{s^{n+1}}$
q th power (for complex q)	$\frac{t^q}{\Gamma(q+1)} \cdot u(t)$	$\frac{1}{s^{q+1}}$
unit step	$u(t)$	$\frac{1}{s}$
delayed unit step	$u(t - \tau)$	$\frac{e^{-\tau s}}{s}$
ramp	$t \cdot u(t)$	$\frac{1}{s^2}$
n th power with frequency shift	$\frac{t^n}{n!} e^{-\alpha t} \cdot u(t)$	$\frac{1}{(s + \alpha)^{n+1}}$
exponential decay	$e^{-\alpha t} \cdot u(t)$	$\frac{1}{s + \alpha}$
exponential approach	$(1 - e^{-\alpha t}) \cdot u(t)$	$\frac{\alpha}{s(s + \alpha)}$
sine	$\sin(\omega t) \cdot u(t)$	$\frac{\omega}{s^2 + \omega^2}$
cosine	$\cos(\omega t) \cdot u(t)$	$\frac{s}{s^2 + \omega^2}$
hyperbolic sine	$\sinh(\alpha t) \cdot u(t)$	$\frac{\alpha}{s^2 - \alpha^2}$
hyperbolic cosine	$\cosh(\alpha t) \cdot u(t)$	$\frac{s}{s^2 - \alpha^2}$
Exponentially-decaying sine wave	$e^{-\alpha t} \sin(\omega t) \cdot u(t)$	$\frac{\omega}{(s + \alpha)^2 + \omega^2}$
Exponentially-decaying cosine wave	$e^{-\alpha t} \cos(\omega t) \cdot u(t)$	$\frac{s + \alpha}{(s + \alpha)^2 + \omega^2}$

$$F(s) = \mathcal{L}\{f(t)\} = \int_0^{\infty} e^{-st} f(t) dt.$$

$$X(z) = \mathcal{Z}\{x[n]\} = \sum_{n=0}^{\infty} x[n] z^{-n}.$$

Errors as a Function of System Type

Type Input	Step (position)	Ramp (velocity)	Parabola (acceleration)
Type 0	$\frac{1}{1 + K_p}$	∞	∞
Type 1	0	$\frac{1}{K_v}$	∞
Type 2	0	0	$\frac{1}{K_a}$

$$t_r = \frac{1.8}{\omega_n}$$

$$t_s = \frac{4.6}{\sigma}$$

