

Possibly Useful Equations

$\bar{f} = m\bar{a}$	$\dot{\mathbf{x}} = A\mathbf{x} + B\mathbf{u}$
$I_0\bar{\alpha} = \sum \bar{M}_0$	$\mathbf{y} = C\mathbf{x} + D\mathbf{u}$
$\sin(a \pm b) = \sin(a)\cos(b) \pm \cos(a)\sin(b)$	$\mathbf{x} = \Phi(t)\mathbf{x}(0) + \int_0^t \Phi(t-\tau)\mathbf{B}\mathbf{u}(\tau)d\tau$
$\cos(a \pm b) = \cos(a)\cos(b) \mp \sin(a)\sin(b)$	$\mathbf{X}(s) = [s\mathbf{I} - \mathbf{A}]^{-1}\mathbf{x}(0) + [s\mathbf{I} - \mathbf{A}]^{-1}\mathbf{B}\mathbf{U}(s)$
$e^{\pm i\omega t} = \cos(\omega t) \pm i \sin(\omega t)$	$S_\alpha^T = S_G^T S_\alpha^G$
$x(t) = ae^{i\omega_n t} + be^{-i\omega_n t}$	$T_s = \frac{4}{\zeta\omega_n}$
$x(t) = a \cos \omega_n t + b \sin \omega_n t$	$T_r \approx \frac{2.16\zeta + 0.60}{\omega_n}, \quad 0.3 \leq \zeta \leq 0.8$
$x(t) = e^{-\zeta\omega_n t} [a \cos(\omega_d t) + b \sin(\omega_d t)]$	$T_p = \frac{\pi}{\omega_n \sqrt{1 - \zeta^2}}$
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	$M_{P_t} = 1 + e^{-\zeta\pi/\sqrt{1-\zeta^2}}$
$\int u \ dv = uv - \int v \ du$	$\% \text{Overshoot} = 100e^{-\zeta\pi/\sqrt{1-\zeta^2}}$
$\delta_{oc}V = \forall \sum$	$V(\omega, \zeta) = e^{-\zeta\omega t_n} \sqrt{[C(\omega, \zeta)]^2 + [S(\omega, \zeta)]^2}$

Table 1: Laplace Transform Pairs

$f(t)$	$F(s)$
$u(t) = A, \forall t > 0$	$\frac{A}{s}$
$u(t) = At, \forall t > 0$	$\frac{A}{s^2}$
$\delta(t)$	1
e^{-at}	$\frac{1}{s+a}$
$\sin \omega t$	$\frac{\omega}{s+\omega^2}$
$\cos \omega t$	$\frac{s}{s+\omega^2}$
$e^{-at} \sin \omega t$	$\frac{\omega}{(s+a)^2 + \omega^2}$
$e^{-at} \cos \omega t$	$\frac{s+a}{(s+a)^2 + \omega^2}$
$\frac{\omega_n}{\sqrt{1-\zeta^2}} e^{-\zeta\omega_n t} \sin(\omega_n \sqrt{1-\zeta^2}), \zeta < 1$	$\frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$
$1 - \frac{1}{\sqrt{1-\zeta^2}} e^{-\zeta\omega_n t} \sin(\omega_n \sqrt{1-\zeta^2} + \phi), \phi = \cos^{-1} \zeta, \zeta < 1$	$\frac{\omega_n^2}{s(s^2 + 2\zeta\omega_n s + \omega_n^2)}$