ELEN90055 Semester 2 Exam Formula Sheet (2 Pages)

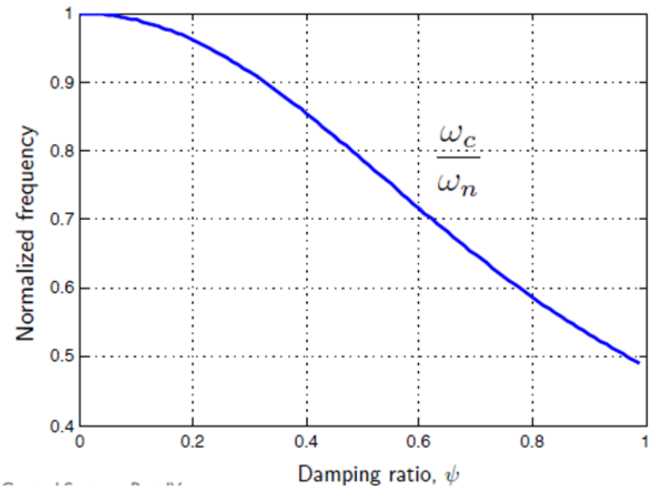
NO HAND-WRITING OR ADDITIONS ALLOWED TO PRE-PRINTED SHEET

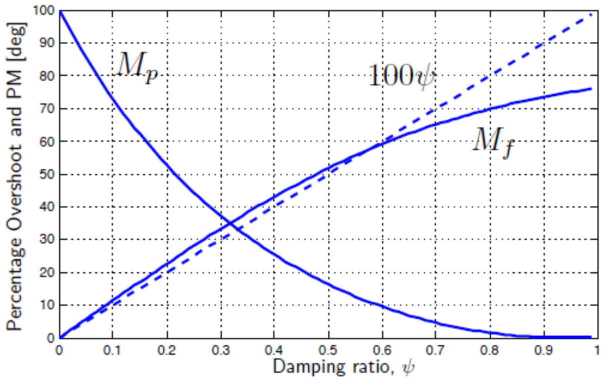
$$
\begin{aligned}
&\ell_{\text{lin}}(y_n, \ldots, y_1, y_0, u_n, \ldots, u_1, u_0) \\
&\quad \doteq \ell(0, \ldots, 0, \bar{y}, 0, \ldots, 0, \bar{u}) + \frac{\partial \ell}{\partial y_n}\Big|_{(0,\ldots,0,\bar{y},0,\ldots,0,\bar{u})}(y_n - 0) + \ldots + \frac{\partial \ell}{\partial y_0}\Big|_{(0,\ldots,0,\bar{y},0,\ldots,0,\bar{u})}(y_0 - \bar{y}) \\
&\quad + \frac{\partial \ell}{\partial u_n}\Big|_{(0,\ldots,0,\bar{y},0,\ldots,0,\bar{u})}(u_n - 0) + \ldots + \frac{\partial \ell}{\partial u_0}\Big|_{(0,\ldots,0,\bar{y},0,\ldots,0,\bar{u})}(u_0 - \bar{u})
\end{aligned}
$$

0

$f(t) \qquad (t \geq 0)$	$\mathcal{L}[f(t)]$	Region of Convergence
1	$\frac{1}{s}$	$\sigma > 0$
$\delta_D(t)$	1	$\lvert\sigma\rvert < \infty$
t	$\frac{1}{s^2}$	$\sigma > 0$
$t^n \qquad n \in \mathbb{Z}^+$	$\frac{n!}{s^{n+1}}$	$\sigma > 0$
$e^{\alpha t} \qquad \alpha \in \mathbb{C}$	$\frac{1}{s-\alpha}$	$\sigma > \Re\{\alpha\}$
$te^{\alpha t} \qquad \alpha \in \mathbb{C}$	$\frac{1}{(s-\alpha)^2}$	$\sigma > \Re\{\alpha\}$
$\cos(\omega_o t)$	$\frac{s}{s^2+\omega_o^2}$	$\sigma > 0$
$\sin(\omega_o t)$	$\frac{\omega_o}{s^2+\omega_o^2}$	$\sigma > 0$

$f(t)$	$\mathcal{L}[f(t)]$	Names
$\sum_{i=1}^{l} a_i f_i(t)$	$\sum_{i=1}^{l} a_i F_i(s)$	Linear combination
$\frac{dy(t)}{dt}$	$sY(s) - y(0^-)$	Derivative Law
$\frac{d^k y(t)}{dt^k}$	$s^k Y(s) - \sum_{i=1}^{k} s^{k-i} \frac{d^{i-1}y(t)}{dt^{i-1}}\Big\rvert_{t=0^-}$	High order derivative
$\int_{0^-}^{t} y(\tau)d\tau$	$\frac{1}{s}Y(s)$	Integral Law
$y(t-\tau)\mu(t-\tau)$	$e^{-s\tau}Y(s)$	Delay
$ty(t)$	$-\frac{dY(s)}{ds}$	
$t^k y(t)$	$(-1)^k \frac{d^k Y(s)}{ds^k}$	
$\int_{0^-}^{t} f_1(\tau) f_2(t-\tau)d\tau$	$F_1(s)F_2(s)$	Convolution
$\lim_{t\to\infty} y(t)$	$\lim_{s\to 0} sY(s)$	Final Value Theorem
$\lim_{t\to 0^+} y(t)$	$\lim_{s\to\infty} sY(s)$	Initial Value Theorem





note M_f (deg) $\approx 100\psi$
for $0 < \psi < 0.6$

$(\psi = \zeta)$

To achieve 1% settling time, $\sigma \geq \frac{4.6}{t_s}$ where $\sigma = \zeta\omega_n$.

To achieve 10%-90% rise time, $\omega_n \geq \frac{1.8}{t_r}$

$$\omega_d = \omega_n\sqrt{1-\zeta^2}$$

Routh-Hurwitz array:

$$\gamma_{k,j} := -\frac{1}{\gamma_{k-1,1}}\begin{vmatrix}\gamma_{k-2,1} & \gamma_{k-2,j+1}\\ \gamma_{k-1,1} & \gamma_{k-1,j+1}\end{vmatrix}$$

$$\begin{array}{c|cccc}
s^n & \gamma_{0,1} := a_n & \gamma_{0,2} := a_{n-2} & \gamma_{0,3} := a_{n-4} & \cdots \\
s^{n-1} & \gamma_{1,1} := a_{n-1} & \gamma_{1,2} := a_{n-3} & \gamma_{1,3} := a_{n-5} & \cdots \\
s^{n-2} & \gamma_{2,1} & \gamma_{2,2} & \gamma_{2,3} & \cdots \\
\vdots & \vdots & \vdots & \vdots & \vdots \\
s^1 & \gamma_{n-1,1} & \gamma_{n-1,2} & \gamma_{n-1,3} & \cdots \\
s^0 & \gamma_{n,1} & \gamma_{n,2} & \gamma_{n,3} & \cdots
\end{array}$$