ENEL441 QUIZ Aid Sheet

Aid Sheet

One sided Laplace Transform $F(s)=\int_0^{\infty} f(t)e^{-st}dt$, $f(t)=\frac{1}{2\pi j}\int F(s)e^{st}ds$

$f(t)$	$F(s)$	$f(t)$	$F(s)$
1	$\delta(s)$	$\dot{f}$	$sF(s)-f(0^-)$
$\delta(t)$	1	$\ddot{f}$	$s^2F(s)-sf(0^-)-\dot{f}(0^-)$
$u(t)$	$1/s$	$\dddot{f}$	$s^3F(s)-s^2f(0^-)-s\dot{f}(0^-)-\ddot{f}(0^-)$
$t^m u(t)$	$m!/s^{m+1}$	$\int f(t)dt$	$F(s)/s$
$e^{-at}u(t)$	$1/(s+a)$	$\lim_{t\to\infty} f(t)$	$\lim_{s\to 0} sF(s)$
$\frac{1}{(m-1)!}t^{m-1}e^{-at}u(t)$	$1/(s+a)^m$	$\sin(at)u(t)$	$\frac{a}{s^2+a^2}$
$f(t-T)$	$F(s)e^{-sT}$	$\cos(at)u(t)$	$\frac{s}{s^2+a^2}$
$tf(t)$	$-\frac{d}{ds}F(s)$	$x(t)*y(t)$	$X(s)Y(s)$

$*$ implies convolution as $x(t)*y(t)=\int_{-\infty}^{\infty} x(\tau)y(t-\tau)d\tau$

Poles of second order system $s^2+2D\omega_n s+\omega_n{}^2=0$,

$s=-\sigma\pm j\omega_d \quad \sigma=D\omega_n \quad \omega_d=\omega_n\sqrt{1-D^2}$ rise time $\tau_r=\frac{2.2}{pole}$

State Space $\dot{x}=Ax+Br \quad y=Cx+Dr \quad H(s)=C(sI-A)^{-1}B+D$

Electric motor with parameters $\{R,K_T,K_b\}$, R internal resistance, current I flowing through motor gives torque $T=K_T I$, ω is rotation rate then induced back EMF voltage is $V_b=K_b\omega$

roots of quadratic $ax^2+bx+c=0 \quad x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$