

Exam 1 Formula Sheet

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Laplace Transforms:

$f(t)$	$F(s)$
1	$\frac{1}{s}$
t^n	$\frac{n!}{s^{n+1}}$
e^{at}	$\frac{1}{s-a}$
$\sin(at)$	$\frac{a}{s^2+a^2}$
$\cos(at)$	$\frac{s}{s^2+a^2}$
$e^{at}\sin(bt)$	$\frac{b}{(s-a)^2+b^2}$
$e^{at}\cos(bt)$	$\frac{s-a}{(s-a)^2+b^2}$
$f'(t)$	$sF(s) - f(0)$
$f''(t)$	$s^2F(s) - sf(0) - f'(0)$
$f^n(t)$	$s^nF(s) - s^{n-1}f(0) - s^{n-2}f'(0) - \dots - f^{n-1}(0)$
$e^{at}f(t)$	$F(s-a)$
$f(ct)$	$\frac{1}{c}F\left(\frac{s}{c}\right)$
$\delta(t-c)$	e^{-cs}
$\int_0^t f(t)dt$	$\frac{F(s)}{s}$
$\lim_{s \rightarrow 0} sU(s)$	$\lim_{t \rightarrow \infty} u(t)$
$\lim_{s \rightarrow \infty} sU(s)$	$u(0^+)$

First Order Differential Equation:

$$y' + p(t)y = q(t)$$

$$I(t) = e^{\int p(t)dt}$$

$$y = \frac{1}{I(t)} \left[\int I(t)q(t)dt + C \right]$$

Roots of Characteristic Equation:

$$s^2 + 2\zeta\omega_n + \omega_n^2 = 0$$

$$s = \eta \pm j\omega$$

$$\eta = -\zeta\omega_n$$

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

$$\text{Underdamped: } \zeta < 1$$

$$\text{Undamped: } \zeta = 0$$

$$\text{Critically Damped: } \zeta = 1$$

$$\text{Overdamped: } \zeta > 1$$

$$\text{Unstable: } \zeta < 0$$

Linear Algebra Concepts:

$$\text{Null}(A) \rightarrow \text{rref}(A) \begin{bmatrix} x_1 \\ \dots \\ x_n \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\text{adjoint}(A) = C(A)^T$$

$$C(A) \rightarrow D(A_{\text{row}}) * A_{i,j} * (-1)^{(i+j)\%2}$$

$$\text{Rank}(A) \rightarrow \text{rref}(A) \text{ number of non-zero rows}$$