Exam 2 Formula Sheet

Friday, September 20, 2024 10:29 AM

Laplace Transforms:

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

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:

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

$$s = \eta \pm j\omega_d$$

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

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

$$M_p = e^{\frac{-\pi\zeta}{\sqrt{1-\zeta^2}}}$$

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

$$\mathrm{t_s} = \frac{4.6}{\eta}$$

Linear Algebra Concepts:

$$Null(A) \to rref(A)\begin{bmatrix} x_1 \\ \cdots \\ x_n \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$adjoint(A) = C(A)^T$$

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

$$Rank(A) \to rref(A)\ number\ of\ non-zero\ rows$$

Block Diagrams:

$$\text{Series} \to \frac{Y}{U} = G(s)H(s)$$

$$\text{Parallel} \to \frac{Y}{U} = G(s) + H(s)$$

$$\text{Feedback} \to \frac{Y}{U} = \frac{G(s)}{1+G(s)H(s)}$$

Zero Locations:

$$G(s) = (s+z)G_0(s)U(s) \to y(t) = \frac{d(y_0(t))}{dt} + zy_0(t)$$

$$G(s) = \left(\frac{s}{z}+1\right)G_0(s)U(s) \to y(t) = \frac{1}{z}\frac{d(y_0(t))}{dt} + y_0(t)$$