MATLAB FOR DYNAMIC SYSTEMS:

tf - DEFINES LAPLACE VARIABLE

s = tf('s')

USEFUL: [num, den] = tfdata(sysG, 'v')

z = roots(num)

p = roots(den)

p = pole(sysG) z = zero(sysG)

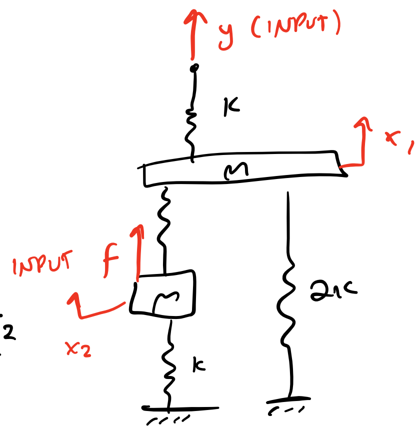
[wn, zeta] = damp(sysG)

TRANSFER FUNCTIONS

UNIT IMPULSE: $f(t) = \delta(t)$

UNIT STEP: $f(t) = 1(t)$

SINUSOIDAL: $f(t) = \sin(t)$



XFER FN'S:

$$\frac{X_1(s)}{F(s)} = \frac{K}{m^2 s^4 + 6mKs^2 + 7K^2}$$

$$\frac{X_2(s)}{F(s)} = \frac{ms^2 + 4K}{m^2 s^4 + 6mKs^2 + 7K^2}$$

→ TOSS THIS INTO MATLAB → SEE SLIDES

FINAL VALUE THEOREM

RECALL DERIV. THEOREM: $\mathcal{L}[\dot{x}(t)] = \int_0^\infty \dot{x}(t) e^{-st} dt = sX(s) - x(0)$

TAKE $\lim_{s \to 0}$ BOTH SIDES $\int_0^\infty \dot{x}(t)\,dt = \lim_{s \to 0} [sX(s)] - x(0)$

$$x(\infty) - \cancel{x(0)} = \lim_{s \to 0} (sX(s)) - \cancel{x(0)}$$

$$\therefore \quad x(\infty) = \lim_{s \to 0} [sX(s)]$$

VALID IF:
- DEGREE (num) $(X(s))$ < DEGREE (den)
- ROOTS OF $G(s)$ HAVE NEGATIVE REAL PARTS (SYS STABLE)

EX. $\underline{\ddot{x} + 5\dot{x} + 2x} = 6y + \dot{y}$

$y(t) = 2 \cdot 1(t)$

FVT $\quad x(\infty) = \lim_{s \to 0} [sX(s)] \qquad \mathcal{L}(y(t)) = Y(s) = \frac{2}{s}$

$$\boxed{T = \frac{X(s)}{F(s)}} \cdot F(s) = X(s)$$

FIND TRANSFER:

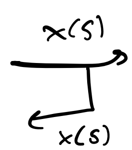
$$(s^2 + 5s + 2) X(s) = (s + 6) Y(s)$$

$$\frac{X(s)}{Y(s)} = \frac{s+6}{s^2 + 5s + 2}$$

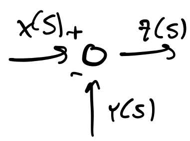
$$x(\infty) = \lim_{s \to 0} \left[\cancel{s} \cdot \frac{\cancel{s} + 6}{\cancel{s^2} + \cancel{5s} + 2} \cdot \frac{2}{\cancel{s}} \right] = 6$$

BLOCK DIAGRAM - GRAPH. REPRESENTATION OF DYNAMIC SYSTEM

SIGNAL: $\xrightarrow{X(s)}$



SUMMATION:



$Z(s) = X(s) - Y(s)$

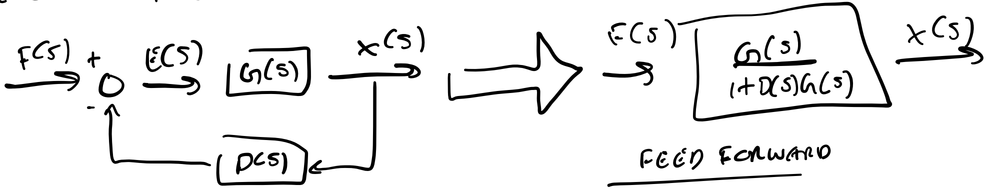
GAIN: $F(s) \rightarrow \boxed{K} \rightarrow X(s)$ $\Big\}$ $X(s) = K\,F(s)$

$F(s) \rightarrow \boxed{T(s)} \rightarrow X(s)$ $\Big\}$ $X(s) = T(s)\,F(s)$

INTEGRATOR: $F(s) \rightarrow \boxed{1/s} \rightarrow X(s)$ $\Big\}$ $x(t) = \int f(t)\,dt$

SERIES BLOCKS: $F(s) \rightarrow \boxed{T_1(s)} \xrightarrow{Y(s)} \boxed{T_2(s)} \rightarrow X(s) \;\Rightarrow\; F(s) \rightarrow \boxed{T_1(s)T_2(s)} \rightarrow X(s)$

BLOCKS IN NEGATIVE FEEDBACK:



$$\frac{\text{FEED FORWARD}}{1 + \text{TOTAL}}$$

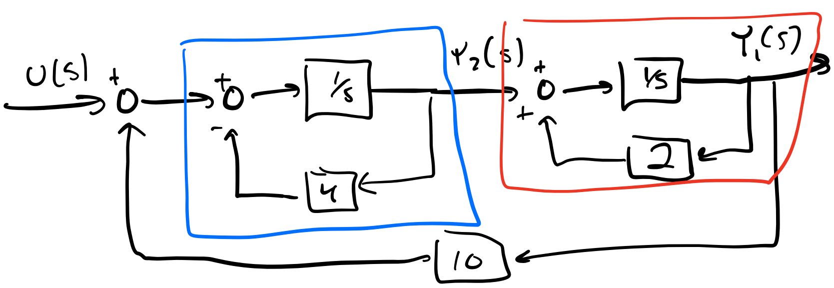
$X(s) = E(s)\,G(s)$

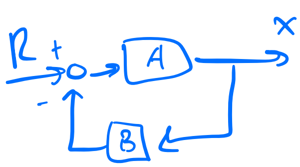
$E(s) = F(s) - X(s)\,D(s)$

$\rightarrow X(s) = \left[F(s) - X(s)\,D(s)\right] G(s)$

$\rightarrow \dfrac{X(s)}{F(s)} = \dfrac{G(s)}{1 + D(s)G(s)}$

EX. EVALUATE $\dfrac{Y_1(s)}{U(s)}$





$$\frac{X}{R} = \frac{A}{1 + AB}$$

$$\rightarrow \quad \frac{Y_2(s)}{X_1(s)} = \frac{\frac{1}{s}}{4 + \frac{1}{s}} = \frac{1}{s+4}$$

$$\frac{Y_1(s)}{Y_2(s)} = \frac{\frac{1}{s}}{1 - 2\frac{1}{s}} = \frac{1}{s-2}$$