(Pg 5)

Assume

$$T(s) = \frac{Y(s)}{U(s)} = \frac{b_0 s^n + b_1 s^{n-1} + \dots + b_{n-1}s + b_n}{s^n + a_1 s^{n-1} + \dots \dots + a_{n-1}s + a_n}$$

→ dim(numerator) = n

→ dim(denominator) = n

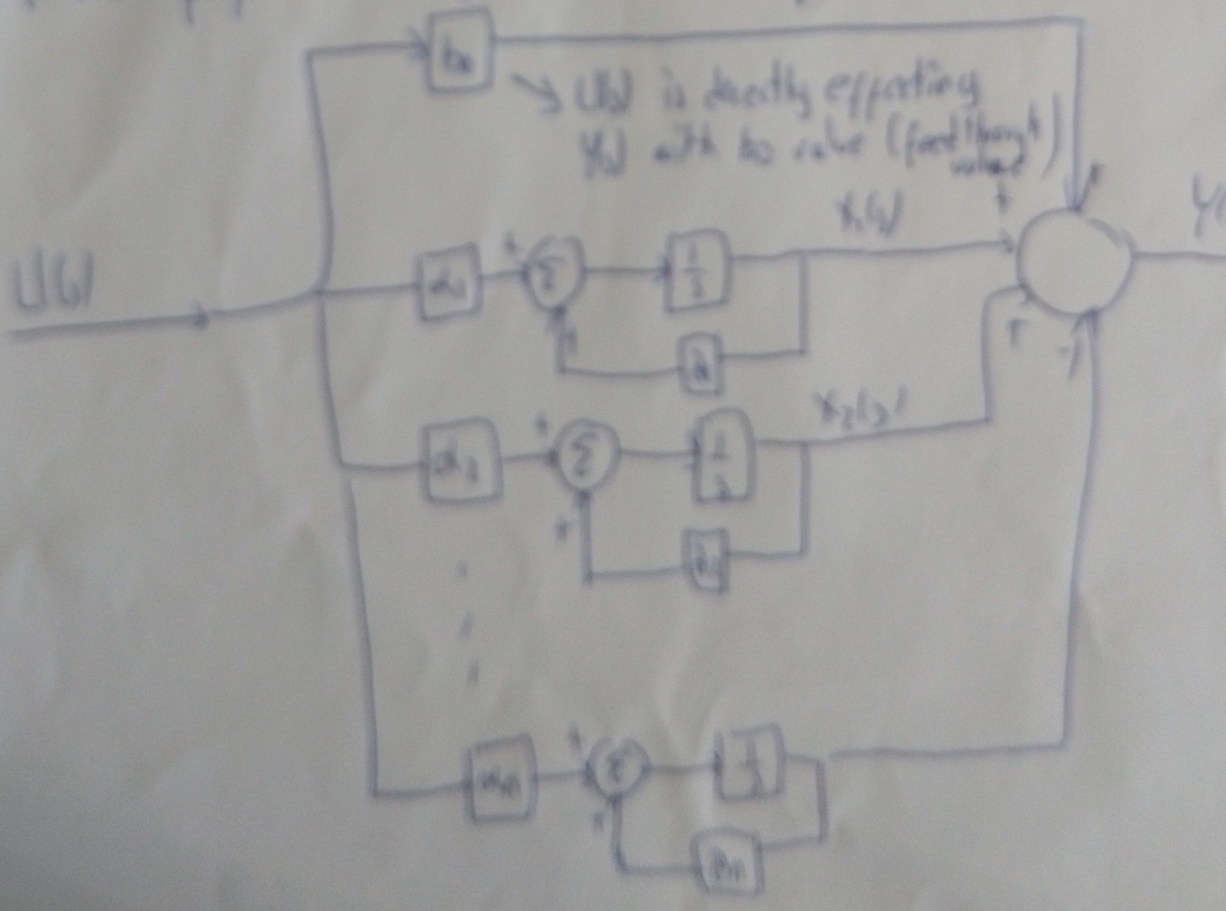
↓ after direct division of Y(s) to U(s) we will have a different configuration

$$\frac{Y(s)}{U(s)} = T(s) = b_0 + \frac{b_1 s^{n-1} + b_2 s^{n-2} + \dots + b_{n-1}s + b_n}{s^n + a_1 s^{n-1} + a_2 s^{n-2} + \dots + a_{n-1}s + a_n}$$

$$Y(s) = b_0 U(s) + \frac{b_1 s^{n-1} + b_2 s^{n-2} + \dots + b_{n-1}s + b_n}{s^n + a_1 s^{n-1} + a_2 s^{n-2} + \dots + a_{n-1}s + a_n}$$

$Y(s) = b_0 U(s) + X_1(s) + X_2(s) + \dots + X_n(s)$

if we perform diagonal canonical form (with integrators $\frac{1}{s}$)



In this case (when there is feedthrough value) the corresponding state space representation will be

$$\dot{x} = \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \vdots \\ \dot{x}_n \end{bmatrix} = \begin{bmatrix} \lambda_1 & 0 & 0 & \cdots & 0 \\ 0 & \lambda_2 & 0 & \cdots & 0 \\ & & \ddots & 0 & \vdots \\ & 0 & & \ddots & 0 \\ & & & & \lambda_n \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_n \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 1 & \cdots & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} + b_0 u(t)$$

↳ feed through value