

Assume

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

$\rightarrow \dim(\text{numerator}) = n$   
 $\rightarrow \dim(\text{denominator}) = n$

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

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

$$Y(s) = b_0 U(s) + \frac{b_1 s^{n-1} + b_2 s^{n-2} + \dots + b_{n-1} s + b_n}{s^n a_1 s^{n-1} + a_2 s^{n-2} + \dots + a_{n-1} s + a_n} U(s) = b_0 U(s) + X_1(s) + X_2(s) + \dots + X_n(s)$$

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

