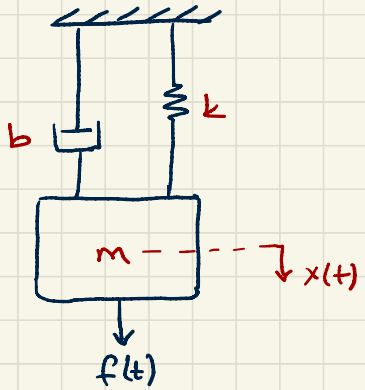
(GMI3181)
OTOMATİK KONTROL

6. HAFTA

10.11.2023

MEKANİK SİSTEMLERİN BLOK DİYAGRAMLAR İLE İFADESİ



$$T(s) = \frac{X(s)}{F(s)} = ?$$ Çıkış ✓ Giriş ✓

Transfer fonksiyonunu sistemin blok diyagramını oluşturarak bulalım. Başlangıç koşulları sıfır ve sistem dengededir.

$$\Sigma f(t) = m.a$$

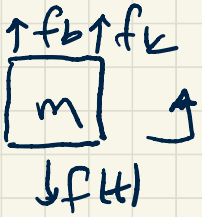
$$f(t) = m.\ddot{x}(t)$$

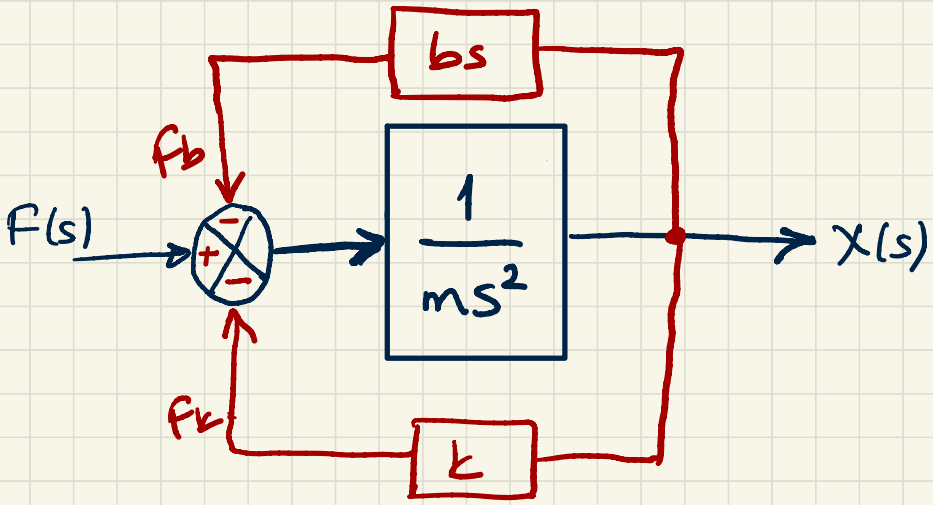
$$F(s) = ms^2X(s)$$

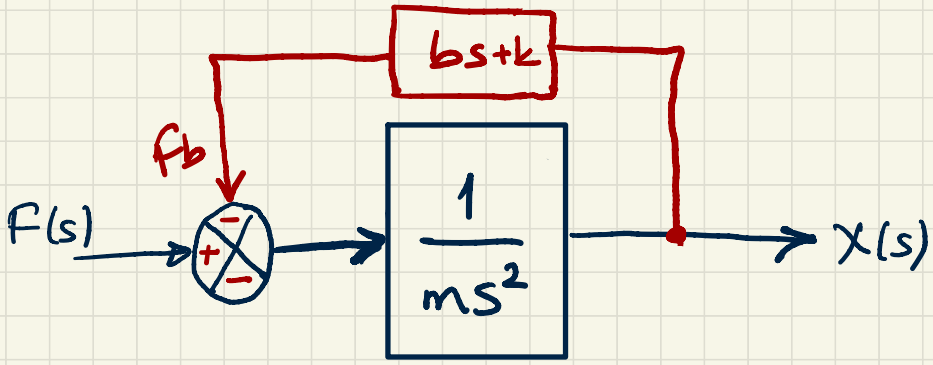
$$\boxed{X(s) = \frac{F(s)}{ms^2}}$$

$$f_b = b\dot{x}(t) \qquad f_k = k.x(t)$$

$$F_b(s) = bsX(s) \qquad F_k(s) = kX(s)$$

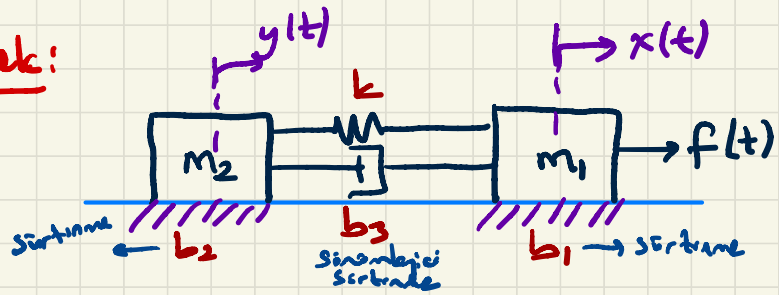






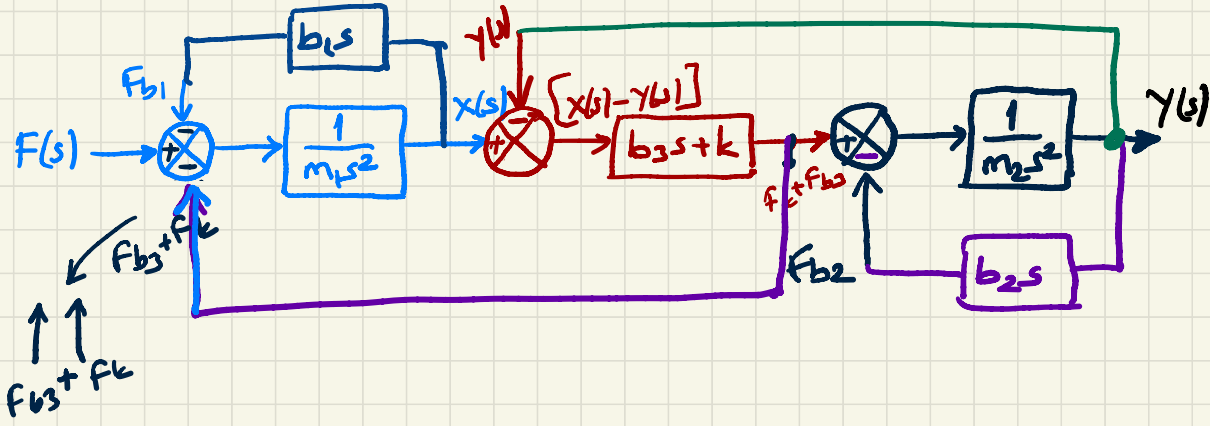
$$\frac{X(s)}{F(s)} = \frac{1/ms^2}{1+\frac{(bs+k)}{ms^2}} = \frac{1}{ms^2} \cdot \frac{ms^2}{(ms^2+bs+k)} = \frac{1}{ms^2+bs+k}$$

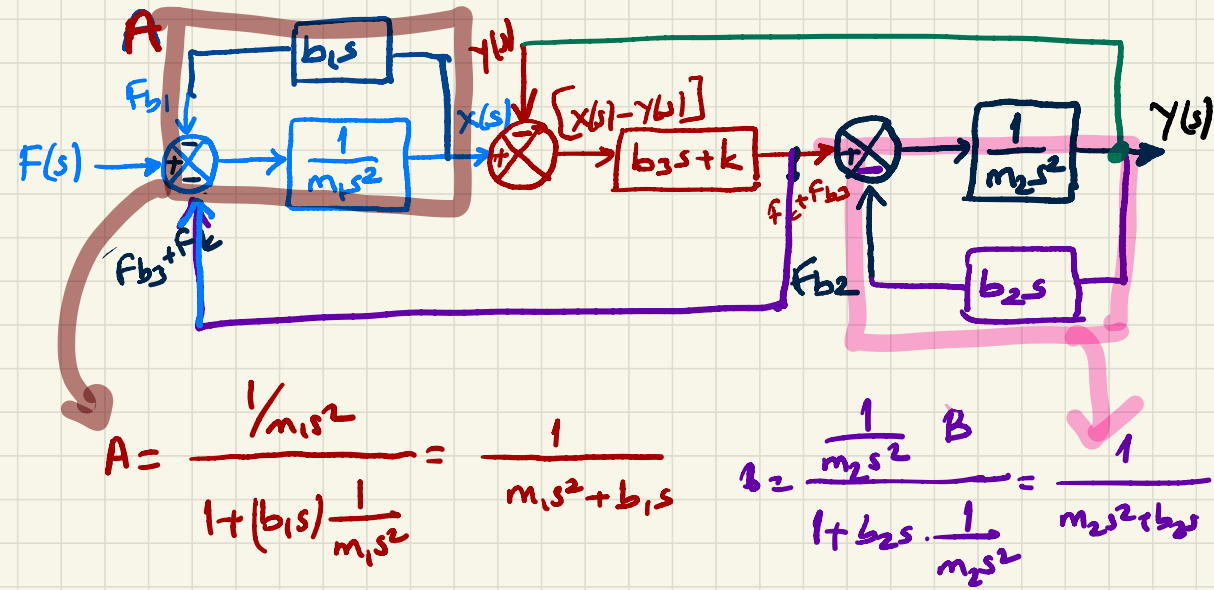
Örnek:



$T(s) = \frac{Y(s)}{F(s)} = ?$

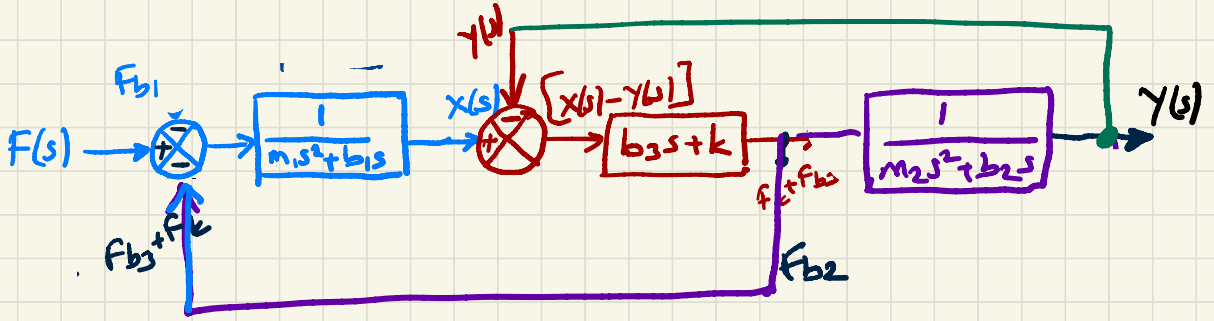
$f_{b_1} = b_1\dot{x}(t)$, $f_{b_3} = b_3(\dot{x}(t) - \dot{y}(t))$, $f_k = k(x(t) - y(t))$, $f_{b_2} = b_2\dot{y}(t)$

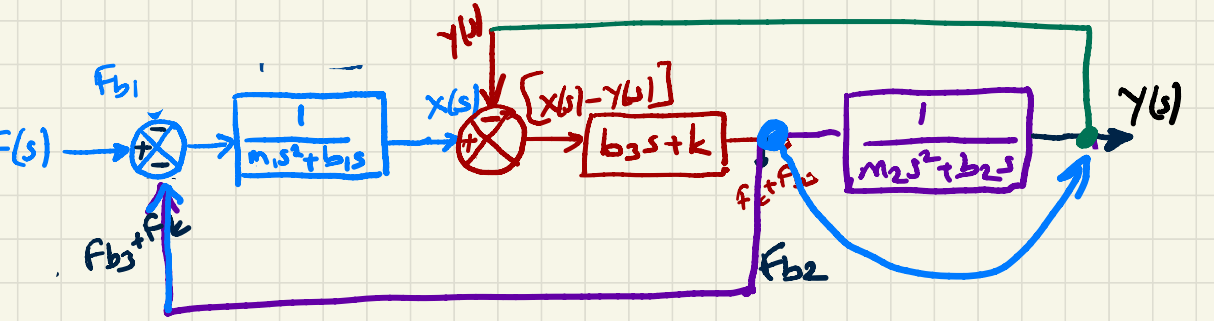


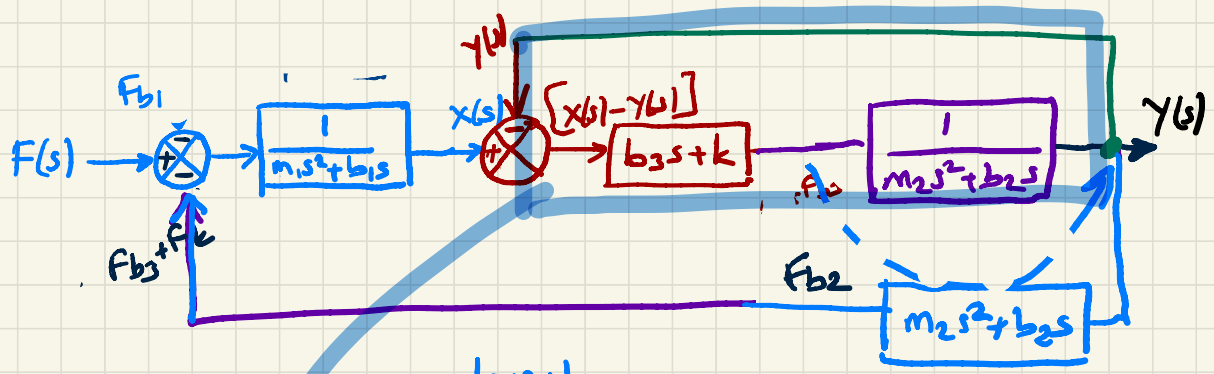


$$A = \frac{1/m_1 s^2}{1 + (b_1 s)\frac{1}{m_1 s^2}} = \frac{1}{m_1 s^2 + b_1 s}$$

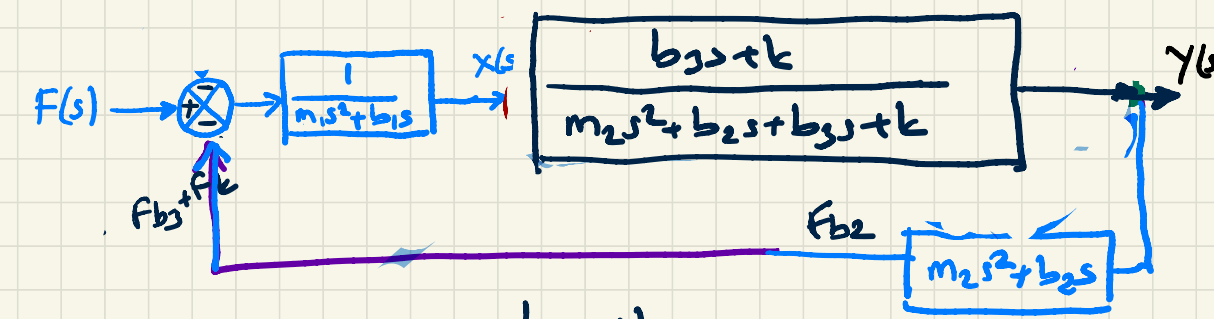
$$B = \frac{\frac{1}{m_2 s^2}}{1 + b_2 s \cdot \frac{1}{m_2 s^2}} = \frac{1}{m_2 s^2 + b_2 s}$$







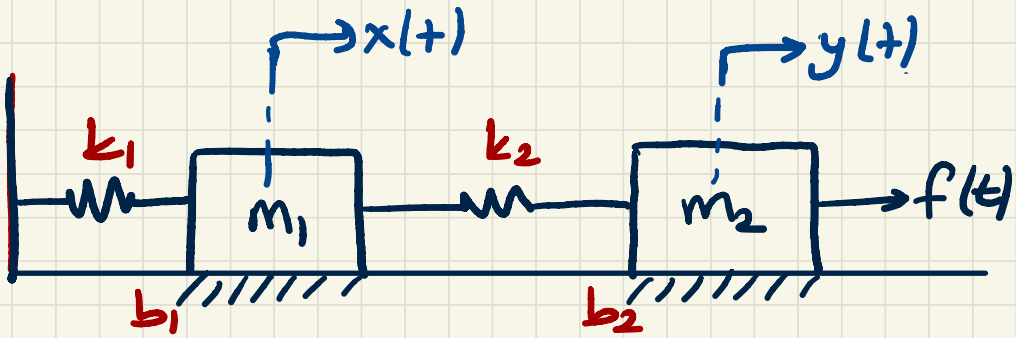
$$C = \frac{\frac{b_3 s + k}{m_2 s^2 + b_2 s}}{1 + (1)\left(\frac{b_3 s + k}{m_2 s^2 + b_2 s}\right)} = \frac{b_3 s + k}{m_2 s^2 + b_2 s + b_3 s + k}$$



$$\frac{Y(s)}{F(s)} = \frac{\frac{1}{m_1 s^2 + b_1 s}\,\frac{b_3 s + k}{m_2 s^2 + b_2 s + b_3 s + k}}{1 + (m_2 s^2 + b_2 s)\left(\frac{1}{m_1 s^2 + b_1 s}\,\frac{b_3 s + k}{m_2 s^2 + b_2 s + b_3 s + k}\right)}$$

$$\frac{Y(s)}{F(s)} = \frac{b_3 s + k}{(m_1 s^2 + b_1 s)(m_2 s^2 + b_2 s + b_3 s + k) + (b_3 s + k)(m_2 s^2 + b_2 s)}$$

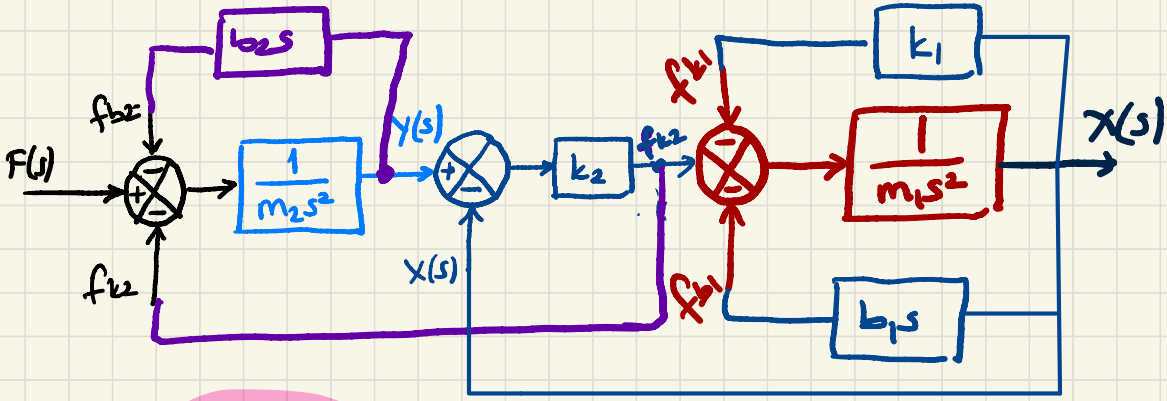
Örnek:

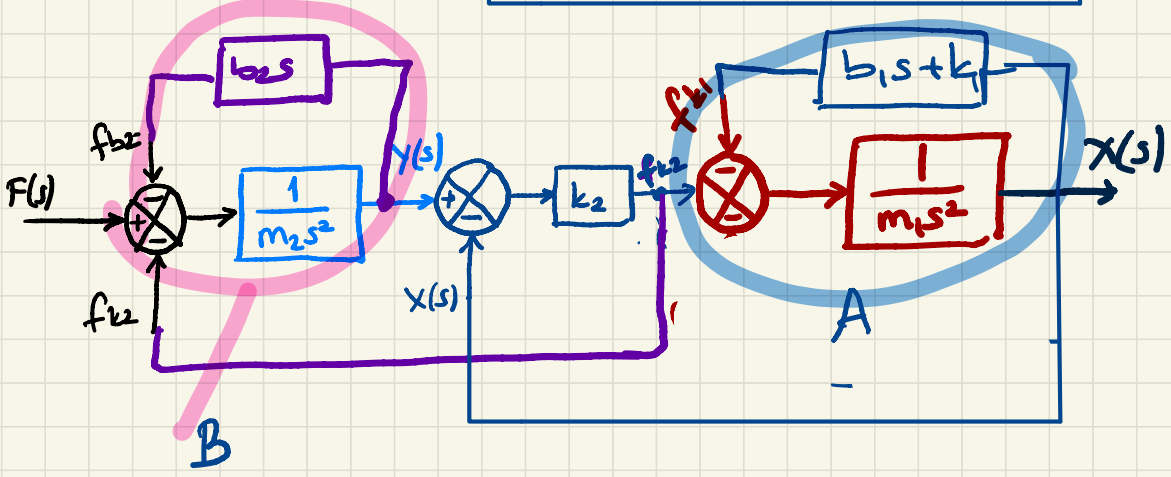


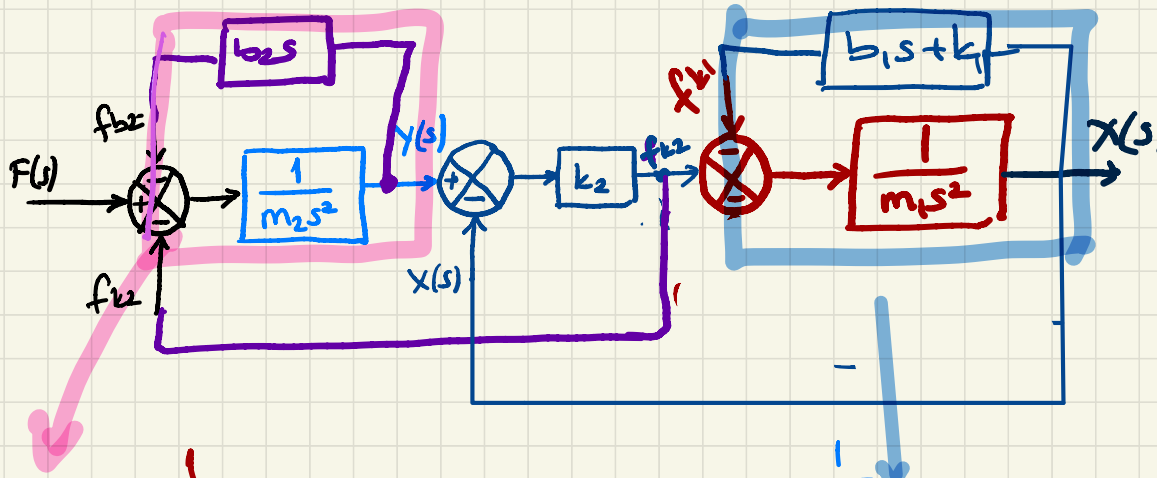
$$T(s) = \frac{X(s)}{F(s)} = ?$$

$$f_{b_2} = b_2 \dot{y}(t), \quad f_{b_1} = b_1 \dot{x}(t)$$

$$f_{k_2} = k_2(y - x), \quad f_{k_1} = k_1 x$$

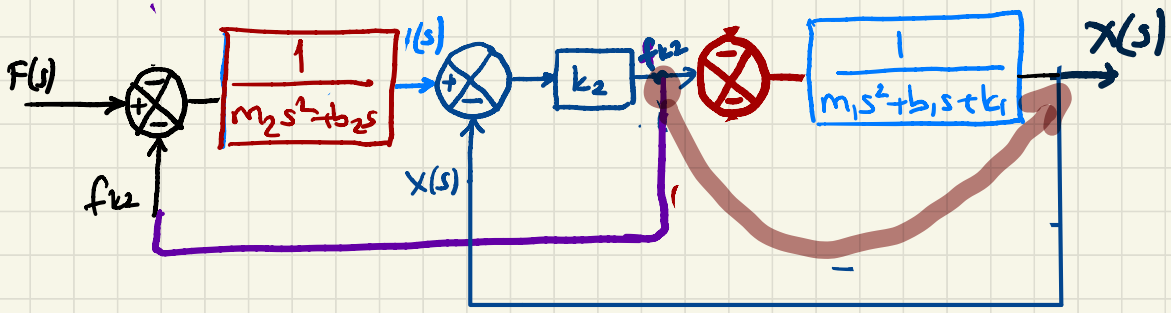


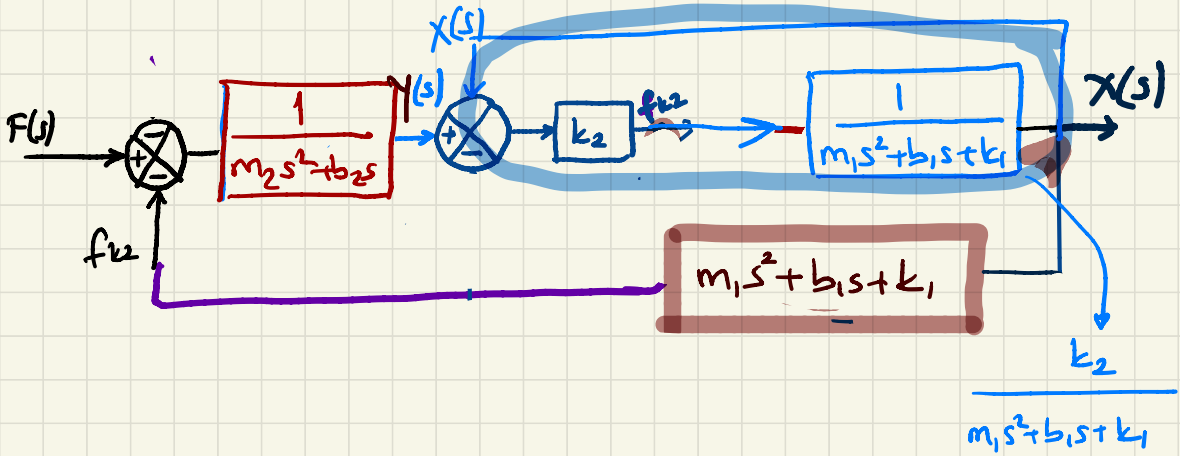




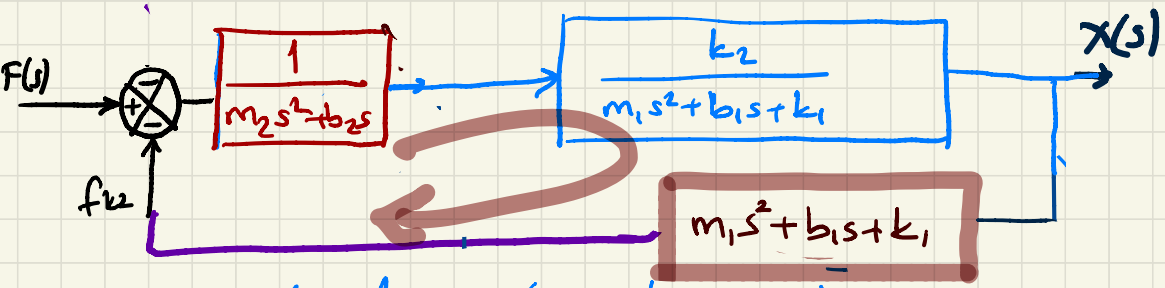
$$B = \frac{\frac{1}{m_2 s^2}}{1 + \frac{b_2 s}{m_2 s^2}} = \frac{1}{m_2 s^2 + b_2 s}$$

$$A = \frac{\frac{1}{m_1 s^2}}{1 + \frac{b_1 s + k_1}{m_1 s^2}} = \frac{1}{m_1 s^2 + b_1 s + k_1}$$





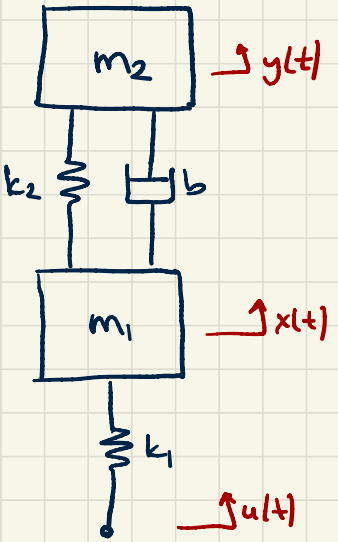
$$\frac{k_2}{m_1 s^2 + b_1 s + k_1}$$



$$\frac{X(s)}{F(s)} = \frac{\left(\frac{1}{m_2s^2+b_2s}\right)\left(\frac{k_2}{m_1s^2+b_1s+k_1}\right)}{1+\left(\frac{1}{m_2s^2+b_2s}\right)\left(\frac{k_2}{m_1s^2+b_1s+k_1}\right)\left(m_1s^2+b_1s+k_1\right)}$$

$$\frac{X(s)}{F(s)} = \frac{k_2}{\left(m_2s^2+b_2s\right)\left(m_1s^2+b_1s+k_1+k_2\right)+k_2\left(m_1s^2+b_1s+k_1\right)}$$

Örn:

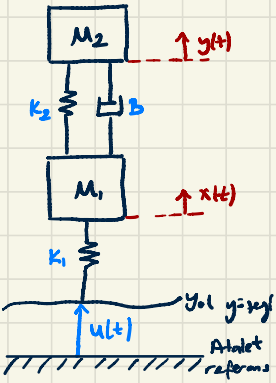


$$T(s) = \frac{Y(s)}{U(s)} = ?$$

$$f_{k_1} = k_1 (u - x)$$

$$f_{k_2} = k_2 (x - y)$$

$$f_b = b (\dot{x} - \dot{y})$$



(3. Hafta FBD)