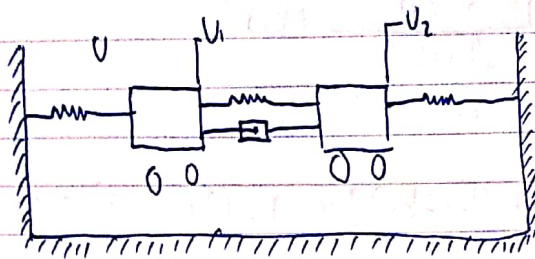


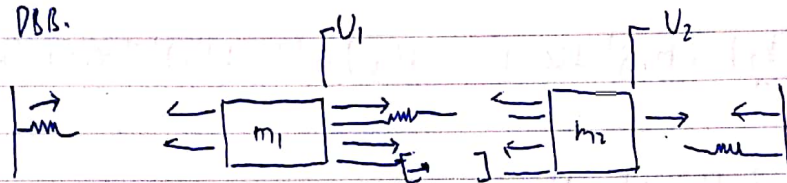
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: Sistem kendali



DBB.



$$\begin{aligned} \Rightarrow U &= m_1 \ddot{u}_1 + k_1 u_1 + k_2 (u_1 - u_2) + b (\dot{u}_1 - \dot{u}_2) \\ m_1 \ddot{u}_1 &= -k_1 u_1 - k_2 (u_1 - u_2) - b (\dot{u}_1 - \dot{u}_2) + U \\ m_1 \ddot{u}_1 &= -k_1 u_1 - k_2 u_1 + k_2 u_2 - b \dot{u}_1 + b \dot{u}_2 + U \\ m_1 \ddot{u}_1 + b \dot{u}_1 + (k_1 + k_2) u_1 &= k_2 u_2 + b \dot{u}_2 + U \end{aligned}$$

Menggunakan transformasi Laplace

$$\begin{aligned} m_1 s^2 x_1(s) + b s x_1(s) + (k_1 + k_2) x_1(s) &= k_2 x_2(s) + b s x_2(s) + U(s) \\ [m_1 s^2 + b s + (k_1 + k_2)] x_1(s) &= (k_2 + b s) x_2(s) + U(s) \dots (1) \end{aligned}$$

$$\begin{aligned} \Rightarrow m_2 \ddot{u}_2 + k_3 u_2 + k_2 (u_2 - u_1) + b (\dot{u}_2 - \dot{u}_1) &= 0 \\ m_2 \ddot{u}_2 &= -k_3 u_2 - k_2 (u_2 - u_1) - b (\dot{u}_2 - \dot{u}_1) \\ m_2 \ddot{u}_2 + (k_3 + k_2) u_2 + b \dot{u}_2 &= k_2 u_1 + b \dot{u}_1 \end{aligned}$$

Menggunakan transformasi Laplace

$$\begin{aligned} m_2 s^2 x_2(s) + (k_3 + k_2) x_2(s) + b s x_2(s) &= k_2 x_1(s) + b s x_1(s) \\ [m_2 s^2 + b s + (k_3 + k_2)] x_2(s) &= (k_2 + b s) x_1(s) \dots (2) \end{aligned}$$

Selesaikan persamaan 2 untuk  $x_2(s)$  dan substitusikan kedalam pers 1

$$\begin{aligned} [m_1 s^2 + b s + (k_1 + k_2)] x_1(s) &= (b s + k_2) x_2(s) + U(s) \dots (1) \\ [m_2 s^2 + b s + (k_2 + k_3)] x_2(s) &= (b s + k_2) x_1(s) \dots (2) \end{aligned}$$

$$\Rightarrow x_2(s) = \frac{(b s + k_2) x_1(s)}{[m_2 s^2 + b s + (k_2 + k_3)]}$$



$$\Rightarrow [m_1 s^2 + b s + (k_1 + k_2)] x_1(s) = \frac{(b s + k_2)(b s + k_2)}{m_2 s^2 + b s + (k_2 + k_3)} x_1(s) + U(s)$$

$$\frac{[m_1 s^2 + b s + (k_1 + k_2)] x_1(s)}{m_2 s^2 + b s + (k_2 + k_3)} = \frac{(b s + k_2)^2 x_1(s)}{m_2 s^2 + b s + (k_2 + k_3)} + U(s)$$

$$\Rightarrow [m_1 s^2 + b s + (k_1 + k_2) (m_2 s^2 + b s + (k_2 + k_3)) - (b s + k_2)^2] x_1(s) = (m_2 s^2 + b s + (k_2 + k_3)) U(s)$$

$$\Rightarrow [m_1 s^2 + b s + (k_1 + k_2) (m_2 s^2 + b s + (k_2 + k_3)) - (b s + k_2)^2] x_1(s) = (m_2 s^2 + b s + (k_2 + k_3)) U(s)$$

$$\frac{x_1(s)}{U(s)} = \frac{m_2 s^2 + b s + k_2 + k_3}{(m_1 s^2 + b s + k_1 + k_2) (m_2 s^2 + b s + k_2 + k_3) - (b s + k_2)^2}$$

Untuk persamaan  $\frac{x_1(s)}{U(s)}$  digunakan persamaan 1 dan 2 diatas dengan metode substitusi, maka didapatkan.

$$\frac{x_2(s)}{U(s)} = \frac{b s + k_2}{(m_1 s^2 + b s + k_1 + k_2) (m_2 s^2 + b s + k_2 + k_3) - (b s + k_2)^2}$$