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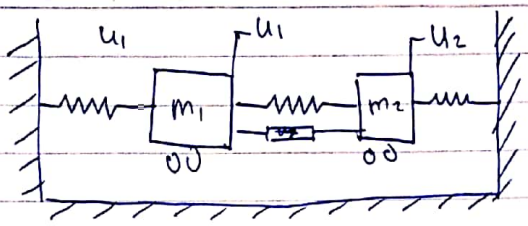
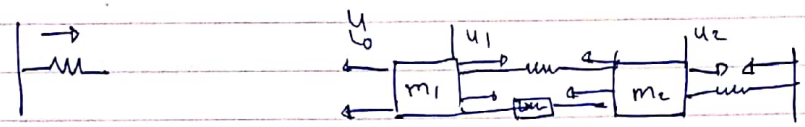
Sistem Kendali

A




gambar 3-4

DBB = 0




$$\Rightarrow u = m_1\ddot{u}_1 + k_1u_1 + k_2(u_1 - u_2) + b(\dot{u}_1 - \dot{u}_2)$$

$$m_1\ddot{u}_1 = -k_1u_1 - k_2(u_1 - u_2) - b(\dot{u}_1 - u_2) + u$$

$$m_1\ddot{u}_1 = -k_1u_1 - k_2u_1 - k_2u_2 - b\dot{u}_1 - b\dot{u}_2 + u$$

$$m_1\ddot{u}_1 + k_1u_1 + k_2u_1 + b\dot{u}_1 = k_2u_2 + b\dot{u}_2 + u$$

$$m_1\ddot{u}_1 + b\dot{u}_1 + (k_1 + k_2)u_1 = k_2u_2 + b\dot{u}_2 + u$$

Menggunakan transformasi laplace.

$$m_1s^2\, X_1(s) + bs\, X_1(s) + (k_1 + k_2)\, X_1(s) = k_2\, X_2(s) + bs\, X_2(s) + U(s)$$

$$([m_1s^2 + bs + (k_1 + k_2)]\, X_1(s) = (k_2 + bs).\, X_2(s) + U(s) \quad \ldots (1)$$

$$\Rightarrow m_2\ddot{u}_2 + k_3u_2 + k_2(u_2 - u_1) + b(\dot{u}_2 - \dot{u}_1) = 0$$

$$m_2\ddot{u}_2 = -k_3u_2 - k_2(u_2 - u_1) - b(\dot{u}_2 - \dot{u}_1)$$

$$m_2\ddot{u}_2 + k_3u_2 + k_2u_2 + b\dot{u}_2 = k_2u_1 + b\dot{u}_1$$

$$m_2\ddot{u}_2 + (k_3 + k_2)u_2 + b\dot{u}_2 = k_2u_1 + b\dot{u}_1$$

menggunakan transformasi Laplace

$$m_2s^2\, X_2(s) + (k_3 + k_2)\, X_2(s) + bs\, X_2(s) = k_2\, X_1(s) + bs\, X_1(s)$$

$$[m_2s^2 + bs + (k_3 + k_2)]\, X_2(s) = (k_2 + bs)\, X_1(s) \quad \ldots (2)$$

Selesaikan persamaan 2 untuk $X_2(s)$ dan substitusikan kedalam pers 1.

$$[m_1s^2 + bs + (k_1 + k_2)]\, X_1(s) = (bs + k_2)\, X_2(s) + U(s) \quad \ldots (1)$$

$$[m_1s^2 + bs + (k_2 + k_3)]\, X_2(s) = (bs + k_2)\, X_1(s) \quad \ldots (2)$$

$$\Rightarrow X_2(s) = \frac{(bs + k_2)\, X_1(s)}{[m_2s^2 + bs + (k_2 + k_3)}$$

$$\Rightarrow [m_1s^2 + bs + (k_1 + k_2)]\, X_1(s) = \frac{(bs + k_2)(bs + k_2)}{m_2s^2 + bs + (k_2 + k_3)}\, X_1(s) + U(s)$$

$$[m_1s^2 + bs + (k_1 + k_2)]\, X_1(s) = \frac{(bs + k_2)^2\, X_1(s)}{m_2s^2 + bs + (k_2 + k_3)} + U(s)$$

$$\cancel{\times}\, m_2s^2 + bs + (k_2 + k_3)$$

$$\Rightarrow \left[ (m_1 s^2 + bs + (k_1 + k_2)(m_2 s^2 + bs + (k_2 + k_3)) \right] X_1(s) = (bs + k_2)^2 X_1(s) + U(s)$$
$$(m_2 s^2 + bs + (k_2 + k_3)]$$

$$\Rightarrow \left[ (m_1 s^2 + bs + (k_1 + k_2)(m_2 s^2 + bs + (k_2 + k_3) - (bs + k_2)^2 \right] X_1(s) = (m_2 s^2 + bs$$
$$+ (k_2 + k_3) U(s)]$$

$$\frac{X_1(s)}{U(s)} = \frac{m_2 s^2 + bs + k_2 + k_3}{(m_1 s^2 + bs + k_1 + k_2)(m_2 s^2 + bs + k_2 + k_3) - (bs + k_2)^2}$$

untuk persamaan $\frac{X_2(s)}{U(s)}$ digunakan persamaan 1 & 2 diatas dengan metode

Subtitusi, maka didapatkan.

$$\frac{X_2(s)}{U(s)} = \frac{bs + k_2}{(m_1 s^2 + bs + k_1 + k_2)(m_2 s^2 + bs + k_2 + k_3) - (bs + k_2)^2}$$