

## función de transferencia Ejercicio 3

$$\Sigma f m_1 = -k_1(x-u) - b(\dot{x} - \dot{y}) - k_2(x-y) = m_1 \ddot{x}$$

$$\Sigma f m_2 = -b(\dot{y} - \dot{x}) - k_2(y-x) = m_2 \ddot{y}$$

1) aplicamos T. de Laplace

$$\Sigma f m_1 = -k_1(x-u) - b(sx - sy) - k_2(x-y) = m_1 s^2 x \quad (1)$$

$$\Sigma f m_2 = -b(sy - sx) - k_2(y-x) = m_2 s^2 y \quad (2)$$

2) despejamos y en (2)

$$-bsy + bsx - k_2y + k_2x = m_2 s^2 y$$

$$bsx + k_2x = m_2 s^2 y + bsy + k_2y$$

$$y = \frac{bsx + k_2x}{m_2 s^2 + k_2 + bs} \quad (3)$$

3) reemplazamos (3) en (1)

$$-k_1(x-u) - bsx + bsy - k_2x + k_2y = m_1 s^2 x$$

$$(bs + k_2)y = m_1 s^2 x + k_1(x-u) + bsx + k_2x$$

$$k_1 u + \left( \frac{bsx + k_2x}{m_2 s^2 + k_2 + bs} \right) (bs + k_2) = m_1 s^2 x + k_1 x + bsx + k_2x$$

$$k_1 u (m_2 s^2 + k_2 + bs) = (m_2 s^2 + k_2 + bs) [x(m_1 s^2 + k_1 + bs + k_2) + \dots \\ \dots (bs + k_2)(bs + k_2)]$$

$$u [k_1 (m_2 s^2 + k_2 + bs)] = x [(m_2 s^2 + k_2 + bs)(m_1 s^2 + k_1 + bs + k_2) + \dots \\ \dots (bs + k_2)(bs + k_2)]$$

$$\frac{x}{u} = \frac{k_1 (m_2 s^2 + k_2 + bs)}{(m_2 s^2 + k_2 + bs)(m_1 s^2 + k_1 + bs + k_2) - (bs + k_2)^2}$$



ahora, despejamos  $x$  en (2)

$$-bsy + bsx - k_2y + k_2x = m_2s^2y$$

$$x(bs + k_2) = m_2s^2y + bsy + k_2y$$

$$x = \frac{y(m_2s^2 + k_2 + bs)}{bs + k_2} \quad (4)$$

reemplazamos (4) en (1)

$$-k_1(x - u) - b(sx - sy) - k_2(x - y) = m_1s^2x$$

$$-k_1x + k_1u - bsx + bsy - k_2x + k_2y = m_1s^2x$$

$$k_1u + bsy + k_2y = m_1s^2x + k_1x + bsx + k_2x$$

$$k_1u + bsy + k_2y = x(m_1s^2 + k_1 + bs + k_2)$$

$$k_1u + bsy + k_2y = \frac{y(m_2s^2 + k_2 + bs)}{bs + k_2} \cdot (m_1s^2 + k_1 + bs + k_2)$$

$$k_1u = \frac{y(m_2s^2 + k_2 + bs)}{bs + k_2} \cdot (m_1s^2 + k_1 + bs + k_2) - y(bs + k_2)$$

$$(bs + k_2)k_1u = y(m_2s^2 + k_2 + bs)(m_1s^2 + k_1 + bs + k_2) - y(bs + k_2)^2$$

$$(bs + k_2)k_1u = y[(m_2s^2 + k_2 + bs)(m_1s^2 + k_1 + bs + k_2) - (bs + k_2)^2]$$

$$\frac{y}{u} = \frac{(bs + k_2)k_1}{(m_2s^2 + k_2 + bs)(m_1s^2 + k_1 + bs + k_2) - (bs + k_2)^2}$$