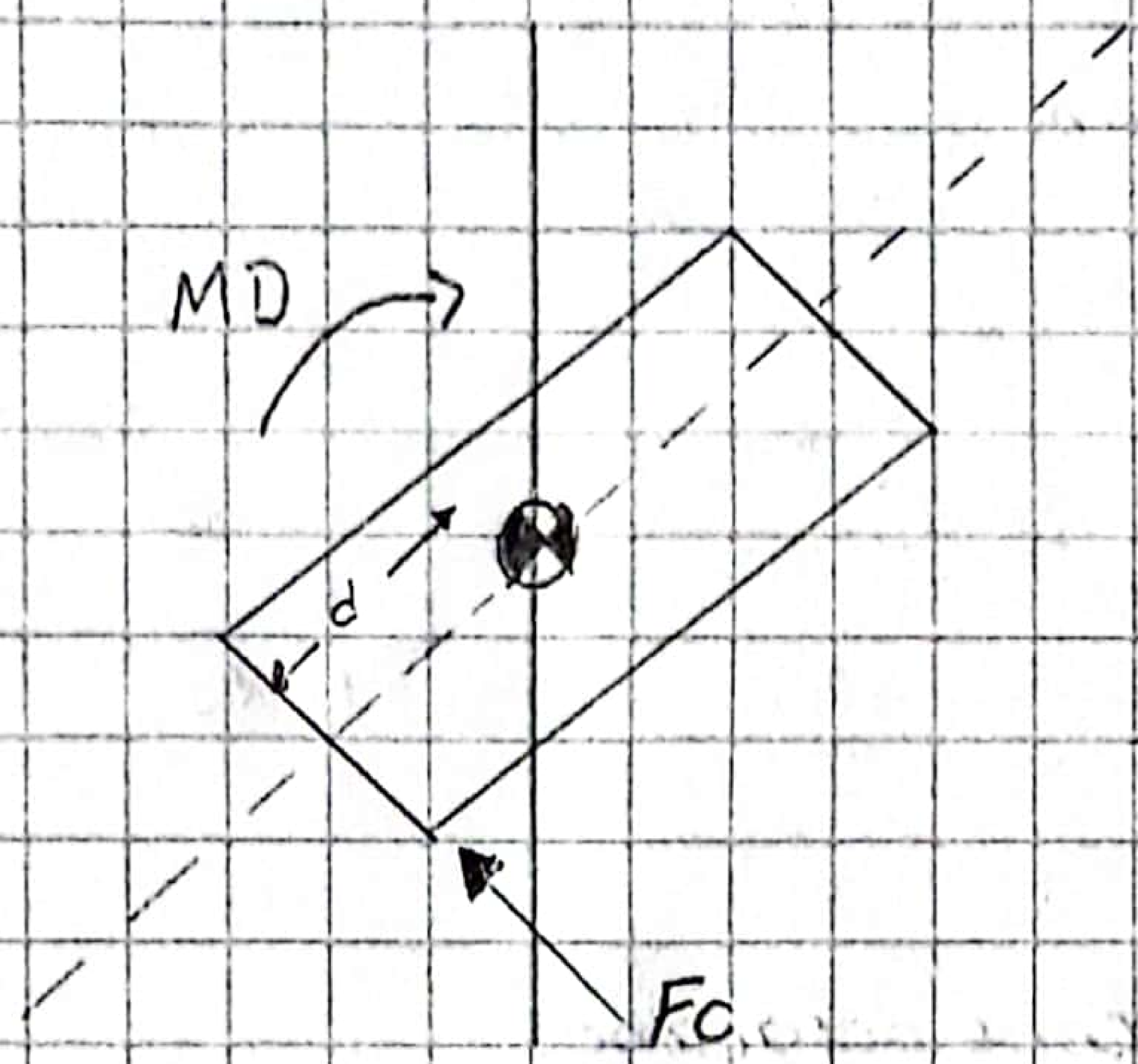
Eje Un satelite presenta una perturbación




$$F_c d + M_D = I\ddot{\theta}$$

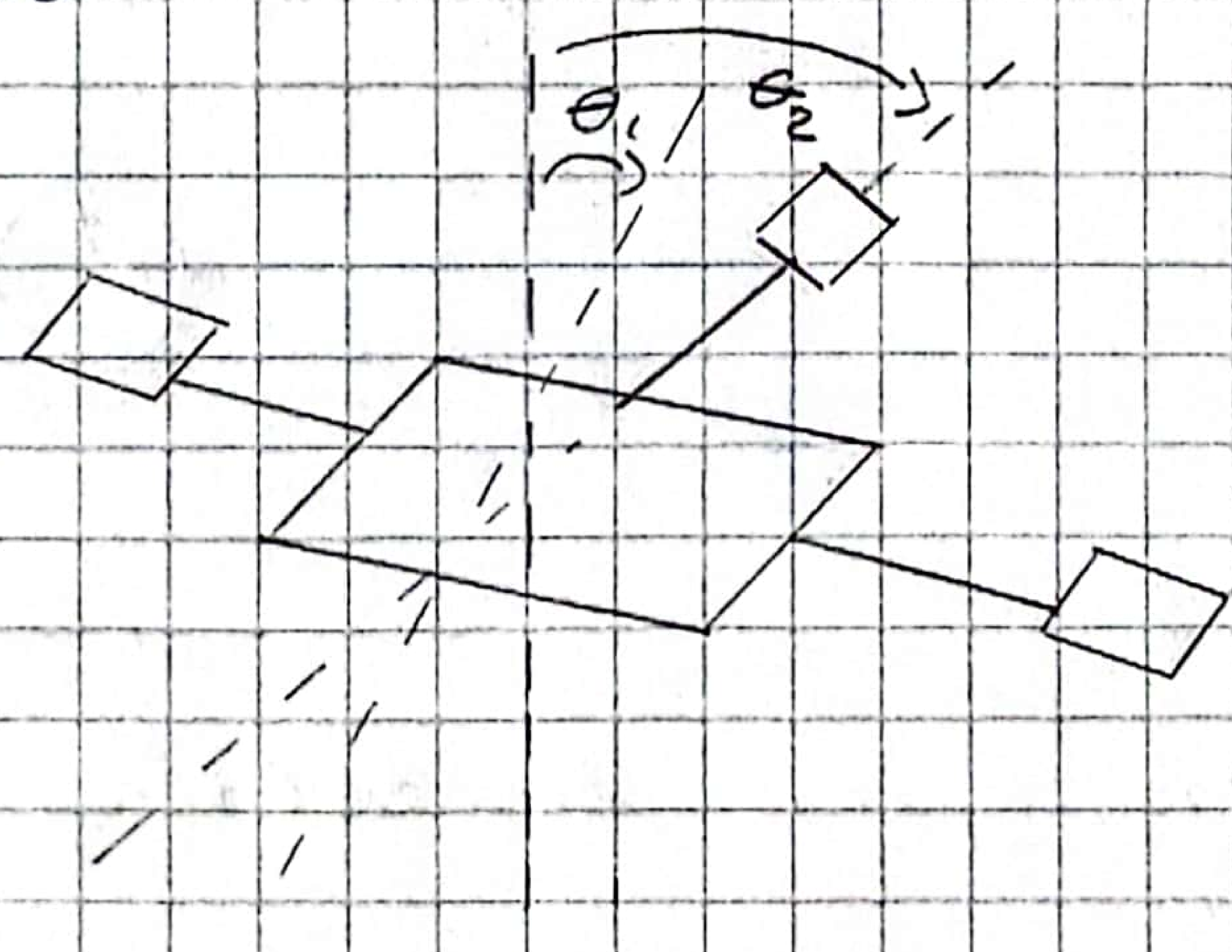
$$u = I\ddot{\theta}$$

$$U(s) = Is^2\,\theta(s)$$

$$\frac{\theta(s)}{U(s)} = \frac{1}{Is^2}$$

Ejercicio

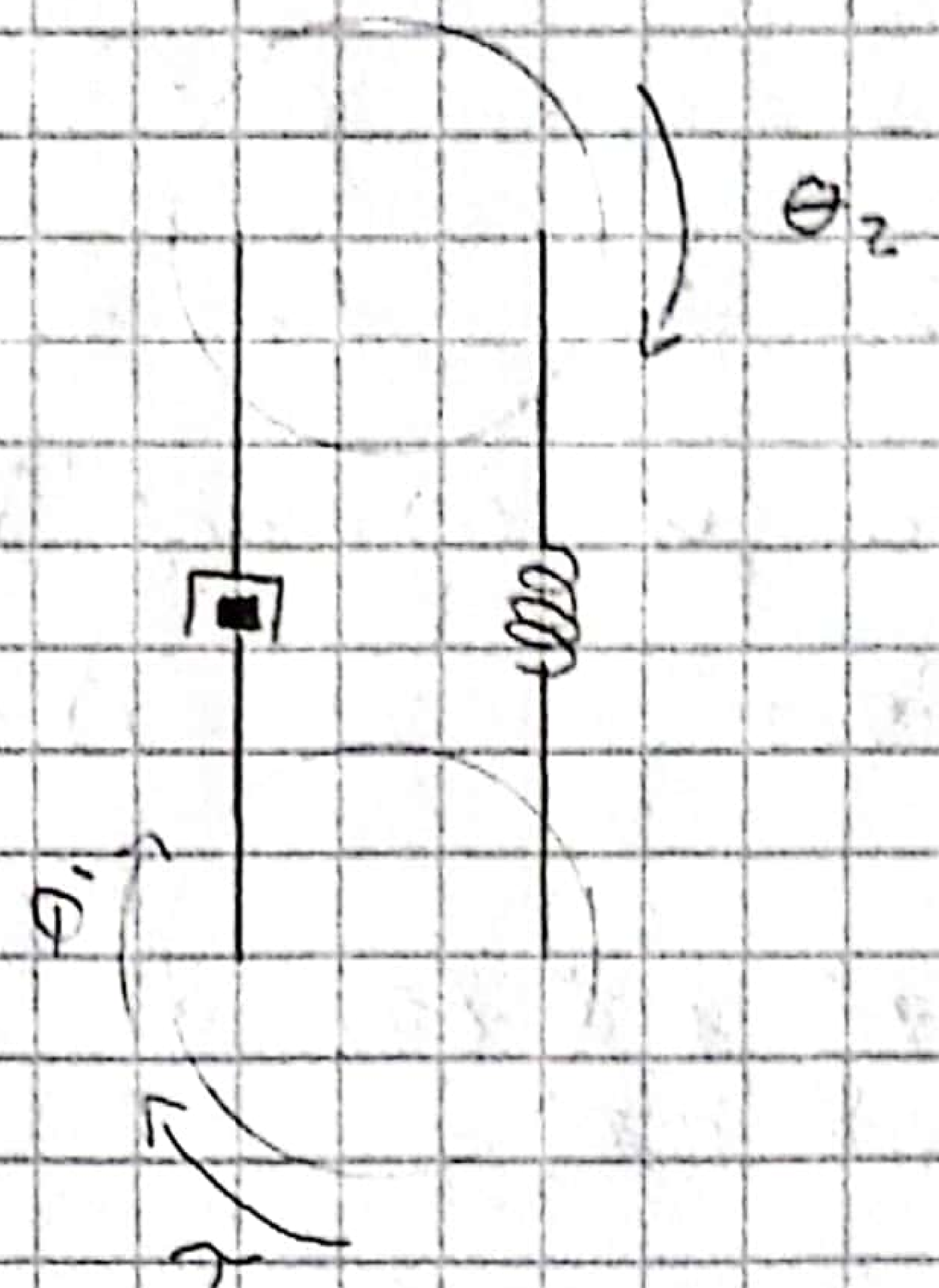
1)

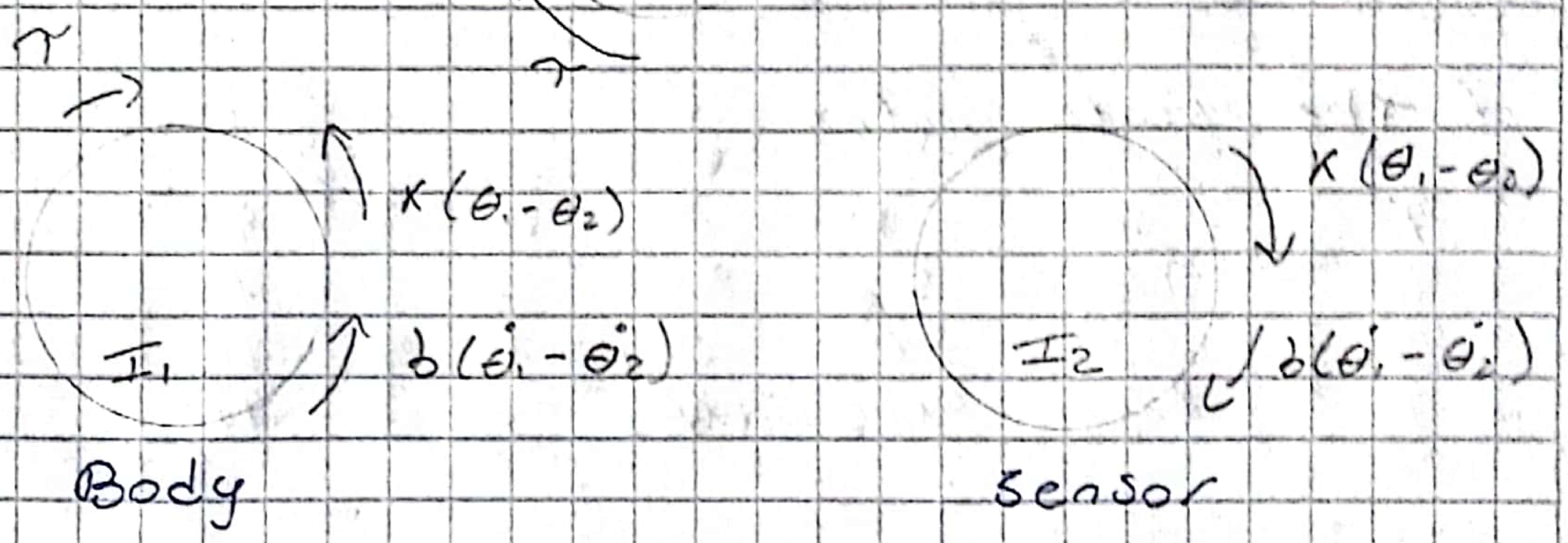



$\theta_1$ : body ; $\theta_2$ = sensor

- Find the state matrix

✓ The Free-Body diagram




✓ The equation for the body

$$\tau_c = K(\theta_1 - \theta_2) + b(\dot{\theta}_1 - \dot{\theta}_2) + I\ddot{\theta}_1$$

$$\ddot{\theta}_1 = \frac{\tau_c}{I_1} - \frac{K}{I_1}(\theta_1 - \theta_2) - \frac{b}{I_1}(\dot{\theta}_1 - \dot{\theta}_2) \qquad (1)$$

✓ The equation for the sensor

$$0 = K(\theta_1 - \theta_2) + b(\dot{\theta}_1 - \dot{\theta}_2) - I_2\ddot{\theta}_2$$

$$\ddot{\theta}_2 = \frac{K}{I_2}(\theta_1 - \theta_2) + \frac{b}{I_2}(\dot{\theta}_1 - \dot{\theta}_2) \qquad (2)$$

✓ The state variable

$q_1 = \theta_1$ ; $q_2 = \dot{q}_1 = \dot{\theta}_1$ ; $\dot{q}_2 = \ddot{\theta}_1$

$q_3 = \theta_2$ ; $q_4 = \dot{q}_3 = \dot{\theta}_2$ ; $\dot{q}_4 = \ddot{\theta}_2$

✓ if we replace in (1) and (2)

$$\dot{q}_2 = -\frac{K}{I_1}(q_1 - q_3) - \frac{b}{I_1}(q_2 - q_4) + \frac{\tau_c}{I_1} \qquad (3)$$

$$\dot{q}_4 = \frac{K}{I_2}(q_1 - q_3) + \frac{b}{I_2}(q_2 - q_4) \qquad (4)$$

✓ The state matrix is

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \\ \dot{q}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -K/I_1 & -b/I_1 & K/I_1 & b/I_1 \\ 0 & 0 & 0 & 1 \\ K/I_2 & b/I_2 & -K/I_2 & -b/I_2 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix}$$

$$+ \begin{bmatrix} 0 \\ 1/I_1 \\ 0 \\ 0 \end{bmatrix} \tau_c$$

$$\begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix}$$