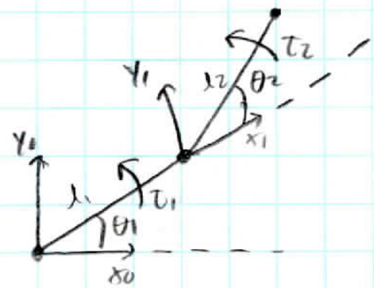

$q_1 = \theta_1$
$q_2 = \theta_2$

- $K = \frac{1}{2}\dot{p}^T M(q)\dot{p}$

$$\Rightarrow M(q) = \begin{bmatrix} m_1 l_{c1}^2 + m_2 l_1^2 + I_1 & m_2 l_1 l_{c2}\cos(q_2) \\ m_2 l_1 l_{c2}\cos(q_2) & m_2 l_{c2}^2 + I_2 \end{bmatrix}$$

$$\rightarrow c_{111} = \frac{1}{2}\frac{\partial m_{11}}{\partial q_1} = 0$$

$$\rightarrow c_{121} = c_{211} = \frac{1}{2}\frac{\partial m_{11}}{\partial q_2} = 0$$

$$\rightarrow c_{221} = \frac{\partial m_{12}}{\partial q_2} - \frac{1}{2}\frac{\partial m_{22}}{\partial q_1} = -m_2 l_1 l_{c2}\sin(q_2)$$

$$\rightarrow c_{112} = \frac{\partial m_{21}}{\partial q_1} - \frac{\partial m_{11}}{\partial q_2} = 0$$

$$\rightarrow c_{212} = c_{122} = \frac{1}{2}\frac{\partial m_{22}}{\partial q_1} = 0$$

$$\rightarrow c_{222} = \frac{1}{2}\frac{\partial m_{22}}{\partial q_2} = 0$$

- $P = m_1 g l_{c1}\sin q_1 + m_2 g(l_1 \sin q_1 + l_{c2}\sin q_2)$

$$\Rightarrow g_1 = (m_1 l_c + m_2 l_1) g \cos q_1 , \quad g_2 = m_2 l_{c2} g \cos q_2$$

$$\rightarrow \boxed{\begin{aligned} d_{11}\ddot{p}_1 + d_{12}\ddot{p}_2 + c_{221}\dot{p}_2^2 + g_1 &= \tau_1 \\ d_{21}\ddot{p}_1 + d_{22}\ddot{p}_2 + c_{112}\dot{p}_1^2 + g_2 &= \tau_2 \end{aligned}}$$