$$\tau_1 = \tau_2 - f_1 \times ({}^1r_{01} + r_{1,c1}) + f_2 \times r_{1c1} + J_1\dot{\omega}_1 + \omega_1 \times (J_1\omega_1) =$$

$$= \begin{bmatrix} 0 \\ 0 \\ m_2 r_2 \left(\ddot{q}_1 l_1 \cos(q_2) + \ddot{q}_1 r_2 + \ddot{q}_2 r_2 + \dot{q}_1^2 l_1 \sin(q_2) + \right. \\ \left. + g\cos(q_1+q_2)\right) + \frac{1}{12}(\ddot{q}_1+\ddot{q}_2)\left(12m_2 r_{l2}^2 + \mathrm{m}_2\left(2l_2 + 3r_{l2}^2\right)\right) \end{bmatrix} -$$

$$- \begin{bmatrix} 0 \\ 0 \\ -r_1\left(m_1\left(\ddot{q}_1 r_1 + g\cos(q_1)\right) + m_2\left(\ddot{q}_1 l_1 \cos(q_2) + \right.\right. \\ \left.\left. + \ddot{q}_1 r_2 + \ddot{q}_2 r_2 + \dot{q}_1^2 l_1 \sin(q_2) + g\cos(q_1+q_2)\right)\right) \end{bmatrix} +$$

$$+ \begin{bmatrix} 0 \\ 0 \\ m_2(l_1 - r_1)\left(\ddot{q}_1 l_1 \cos(q_2) + \ddot{q}_1 r_2 + \ddot{q}_2 r_2 + \dot{q}_1^2 l_1 \sin(q_2) + g\cos(q_1+q_2)\right) \end{bmatrix} +$$

$$+ \begin{bmatrix} 0 \\ 0 \\ \frac{\ddot{q}_1}{12}\left(12m_1 r_{l1}^2 + \mathrm{m}_1\left(l_1^2 + 3r_{l1}^2\right)\right) \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} =$$

$$= \begin{bmatrix} 0 \\ 0 \\ \ddot{q}_1 l_1^2 m_2 \cos(q_2) + \ddot{q}_1 l_1 m_2 r_2 \cos(q_2) + \ddot{q}_1 l_1 m_2 r_2 + \ddot{q}_1 m_1 r_1^2 + \\ + \ddot{q}_1 m_1 r_{l1}^2 + \ddot{q}_1 m_2 r_2^2 + \ddot{q}_1 m_2 r_{l2}^2 + \frac{\ddot{q}_1}{12}\mathrm{m}_1\left(l_1^2 + 3r_{l1}^2\right) + \\ + \frac{\ddot{q}_1}{12}\mathrm{m}_2\left(2l_2 + 3r_{l2}^2\right) + \ddot{q}_2 l_1 m_2 r_2 + \\ + \ddot{q}_2 m_2 r_2^2 + \ddot{q}_2 m_2 r_{l2}^2 + \frac{\ddot{q}_2}{12}\mathrm{m}_2\left(2l_2 + 3r_{l2}^2\right) + \\ + \dot{q}_1^2 l_1^2 m_2 \sin(q_2) + \dot{q}_1^2 l_1 m_2 r_2 \sin(q_2) + \\ + g l_1 m_2 \cos(q_1+q_2) + g m_1 r_1 \cos(q_1) + g m_2 r_2 \cos(q_1+q_2) \end{bmatrix}$$