RESPOSTAS DOS EXERCÍCIOS PROPOSTOS

CAPÍTULO 7

FUNDAMENTOS DE MECÂNICA ANALÍTICA

7.1:	$2m\ddot{x}_1 + c(\dot{x}_1 + \dot{x}_3) + k(2x_1 + x_3 - \ell) = 0$; $m\ddot{x}_3 + c(\dot{x}_1 + \dot{x}_3) + k(x_1 + x_3 - \ell) - mg = 0$
7.2:	$(m + m_0)\ddot{x} + mL\ddot{\theta}\cos\theta - mL\dot{\theta}^2 \,sen\,\theta + c\dot{x} + kx = f(t)$; $L\ddot{\theta} + \ddot{x}\cos\theta + g\,sen\,\theta = 0$
7.3:	$\left[\frac{1}{3}m_h l_h^2 + \frac{3}{2}m_d r_d^2 + m_d l_h (l_h + 2r_d)\right]\ddot{\theta} + k\theta +$ $+\left[\frac{1}{2}m_h l_h + m_d (l_h + r_d)\right] g\,sen\,\theta = \tau(t)$
7.4:	$2m\ddot{x}_1 + c(\dot{x}_1 + \dot{x}_3) + k(2x_1 + x_3 - \ell) = 0$; $m\ddot{x}_3 + c(\dot{x}_1 + \dot{x}_3) + k(x_1 + x_3 - \ell) - mg = 0$
7.5:	$(m + m_0)\ddot{x} + mL\ddot{\theta}\cos\theta - mL\dot{\theta}^2 \,sen\,\theta + c\dot{x} + kx = f(t)$; $L\ddot{\theta} + \ddot{x}\cos\theta + g\,sen\,\theta = 0$
7.6:	$\left[\frac{1}{3}m_h l_h^2 + \frac{3}{2}m_d r_d^2 + m_d l_h (l_h + 2r_d)\right]\ddot{\theta} + k\theta +$ $+\left[\frac{1}{2}m_h l_h + m_d (l_h + r_d)\right] g\,sen\,\theta = \tau(t)$
7.7:	$4m\ddot{x} + 3mL\ddot{\theta}\cos\theta - 3mL\dot{\theta}^2 \,sen\,\theta = f(t)$; $\frac{169}{48}L\ddot{\theta} + 3\ddot{x}\cos\theta + 3g\,sen\,\theta = 0$
7.8:	$\left(\frac{1}{2}m_d R^2 + \frac{4}{9}m_h L^2\right)\ddot{\theta} + \frac{1}{3}m_h L^2 \ddot{\beta}(\beta - \theta) + \frac{1}{3}m_h L^2 \dot{\beta}^2 + kR^2\theta + \frac{2}{3}m_h g L = \tau(t)$; $\frac{1}{3}m_h L^2 \ddot{\beta} + \frac{1}{3}m_h L^2 \ddot{\theta}(\beta - \theta) - \frac{1}{3}m_h L^2 \dot{\theta}^2 + m_h g \frac{L}{2}\beta = 0$
7.9:	$2m\ddot{x}_1 + c(\dot{x}_1 + \dot{x}_3) + k(2x_1 + x_3 - \ell) = 0$; $m\ddot{x}_3 + c(\dot{x}_1 + \dot{x}_3) + k(x_1 + x_3 - \ell) - mg = 0$

7.10:

$$(m+m_0)\ddot{x}+m\,L\,\ddot{\theta}\cos\theta-m\,L\,\dot{\theta}^2\,sen\,\theta+c\,\dot{x}+k\,x=f(t);$$

$$L\,\ddot{\theta}+\ddot{x}\cos\theta+g\,sen\,\theta=0$$

7.11:

$$\left[\tfrac{1}{3}m_h\,l_h^2+\tfrac{3}{2}m_d\,r_d^2+m_d\,l_h\left(l_h+2r_d\right)\right]\ddot{\theta}+k\,\theta+$$

$$+\left[\tfrac{1}{2}m_h\,l_h+m_d\left(l_h+r_d\right)\right]g\,sen\,\theta=\tau(t)$$

7.12:

$$4\,m\,\ddot{x}+3\,m\,L\,\ddot{\theta}\cos\theta-3\,m\,L\,\dot{\theta}^2\,sen\,\theta=f(t);\;\frac{169}{48}L\,\ddot{\theta}+3\ddot{x}\cos\theta+3\,g\,sen\,\theta=0$$

7.13:

$$\left(\frac{1}{2}m_d\,R^2+\frac{4}{9}m_h\,L^2\right)\ddot{\theta}+\frac{1}{3}m_h\,L^2\,\ddot{\beta}(\beta-\theta)+\frac{1}{3}m_h\,L^2\,\dot{\beta}^2+k\,R^2\,\theta+\frac{2}{3}m_h\,g\,L=\tau(t);$$

$$\frac{1}{3}m_h\,L^2\,\ddot{\beta}+\frac{1}{3}m_h\,L^2\,\ddot{\theta}(\beta-\theta)-\frac{1}{3}m_h\,L^2\,\dot{\theta}^2+m_h\,g\,\frac{L}{2}\,\beta=0$$

7.14:

$$\left(\frac{1}{3}m_1+m_2+m\right)L_1^2\,\ddot{\theta}_1+\left(\frac{m_2}{2}+m\right)L_1\,L_2\,\ddot{\theta}_2\cos(\theta_1-\theta_2)+$$

$$+\left(\frac{m_2}{2}+m\right)L_1\,L_2\,\dot{\theta}_2^2\,sen(\theta_1-\theta_2)+k_{10}\,\theta_1+k_{12}(\theta_1-\theta_2)+\left(\frac{m_1}{2}+m_2+m\right)g\,L_1\,sen\,\theta_1=\tau(t);$$

$$\left(\frac{m_2}{3}+m\right)L_2^2\,\ddot{\theta}_2+\left(\frac{m_2}{2}+m\right)L_1\,L_2\,\ddot{\theta}_1\cos(\theta_1-\theta_2)-\left(\frac{m_2}{2}+m\right)L_1\,L_2\,\dot{\theta}_1^2\,sen(\theta_1-\theta_2)+$$

$$+k_{12}(\theta_2-\theta_1)+\left(\frac{m_2}{2}+m\right)g\,L_2\,sen\,\theta_2=0$$

7.15:

$$m\,\ddot{x}_1+k\,x_1-m\,g=\lambda;$$

$$m\,\ddot{x}_2+c(\dot{x}_2-\dot{x}_3)+k(x_2-x_3)-m\,g=\lambda;$$

$$m\,\ddot{x}_3+c(\dot{x}_3-\dot{x}_2)+k(x_3-x_2)-m\,g=0$$

7.16:

$$m_0\,\ddot{x}+c\,\dot{x}+k\,x=f(t)-\lambda_2;$$

$$L\,\ddot{\theta}+\ddot{x}_C\cos\theta+\ddot{y}_C\,sen\,\theta+g\,sen\,\theta=0;$$

$$\ddot{x}_C+L\,\ddot{\theta}\cos\theta-L\,\dot{\theta}^2\,sen\,\theta=\lambda_2/m;$$

$$\ddot{y}_C+L\,\ddot{\theta}\,sen\,\theta+L\,\dot{\theta}^2\cos\theta+m\,g=\lambda_1/m$$

7.17:

$$\frac{1}{2}m_d\,R^2\,\ddot{\theta}+k\,R^2\,\theta=\tau(t)+\frac{2}{3}L(\lambda_1\,sen\,\theta-\lambda_2\cos\theta);$$

$$\frac{1}{3}L\,\ddot{\beta}+\frac{1}{2}\ddot{x}_B\cos\beta+\frac{1}{2}\ddot{y}_B\,sen\,\beta+\frac{1}{2}g\,sen\,\beta=0;$$

$$\ddot{x}_B+\frac{1}{2}L\,\ddot{\beta}\cos\beta-\frac{1}{2}L\,\dot{\beta}^2\,sen\,\beta=\lambda_1/m_h;$$

$$\ddot{y}_B+\frac{1}{2}L\,\ddot{\beta}\,sen\,\beta+\frac{1}{2}L\,\dot{\beta}^2\cos\beta+g=\lambda_2/m_h.$$

7.18:

$$\left\{\begin{array}{l}
\frac{1}{3}m_1 L_1^2 \ddot{\theta}_1 + \frac{1}{2}m_1 L_1 \ddot{x}_A \cos\theta_1 + \frac{1}{2}m_1 L_1 \ddot{y}_A \operatorname{sen}\theta_1 + k_{10}\theta_1 + \\
+k_{12}(\theta_1 - \theta_2) + m_1 g \frac{L_1}{2}\operatorname{sen}\theta_1 = \tau(t) - L_1(\lambda_3 \cos\theta_1 + \lambda_4 \operatorname{sen}\theta_1); \\
\left(\frac{m_2}{3}+m\right)L_2^2 \ddot{\theta}_2 + \left(\frac{m_2}{2}+m\right)L_2 \ddot{x}_B \cos\theta_2 + \left(\frac{m_2}{2}+m\right)L_2 \ddot{y}_B \operatorname{sen}\theta + \\
+k_{12}(\theta_2 - \theta_1) + \left(\frac{m_2}{2}+m\right) g L_2 \operatorname{sen}\theta_2 = 0; \\
m_1 \ddot{x}_A + \frac{1}{2}m_1 L_1 \ddot{\theta}_1 \cos\theta_1 - \frac{1}{2}m_1 L_1 \dot{\theta}_1^2 \operatorname{sen}\theta_1 = \lambda_1; \\
m_1 \ddot{y}_A + \frac{1}{2}m_1 L_1 \ddot{\theta}_1 \operatorname{sen}\theta_1 + \frac{1}{2}m_1 L_1 \dot{\theta}_1^2 \cos\theta_1 + m_1 g = \lambda_2; \\
(m_2+m)\ddot{x}_B + \left(\frac{m_2}{2}+m\right)L_2 \ddot{\theta}_2 \cos\theta_2 - \left(\frac{m_2}{2}+m\right)L_2 \dot{\theta}_2^2 \operatorname{sen}\theta_2 = \lambda_3; \\
(m_2+m)\ddot{y}_B + \left(\frac{m_2}{2}+m\right)L_2 \ddot{\theta}_2 \operatorname{sen}\theta + \left(\frac{m_2}{2}+m\right)L_2 \dot{\theta}_2^2 \cos\theta + (m_2+m) g = \lambda_4
\end{array}\right.$$