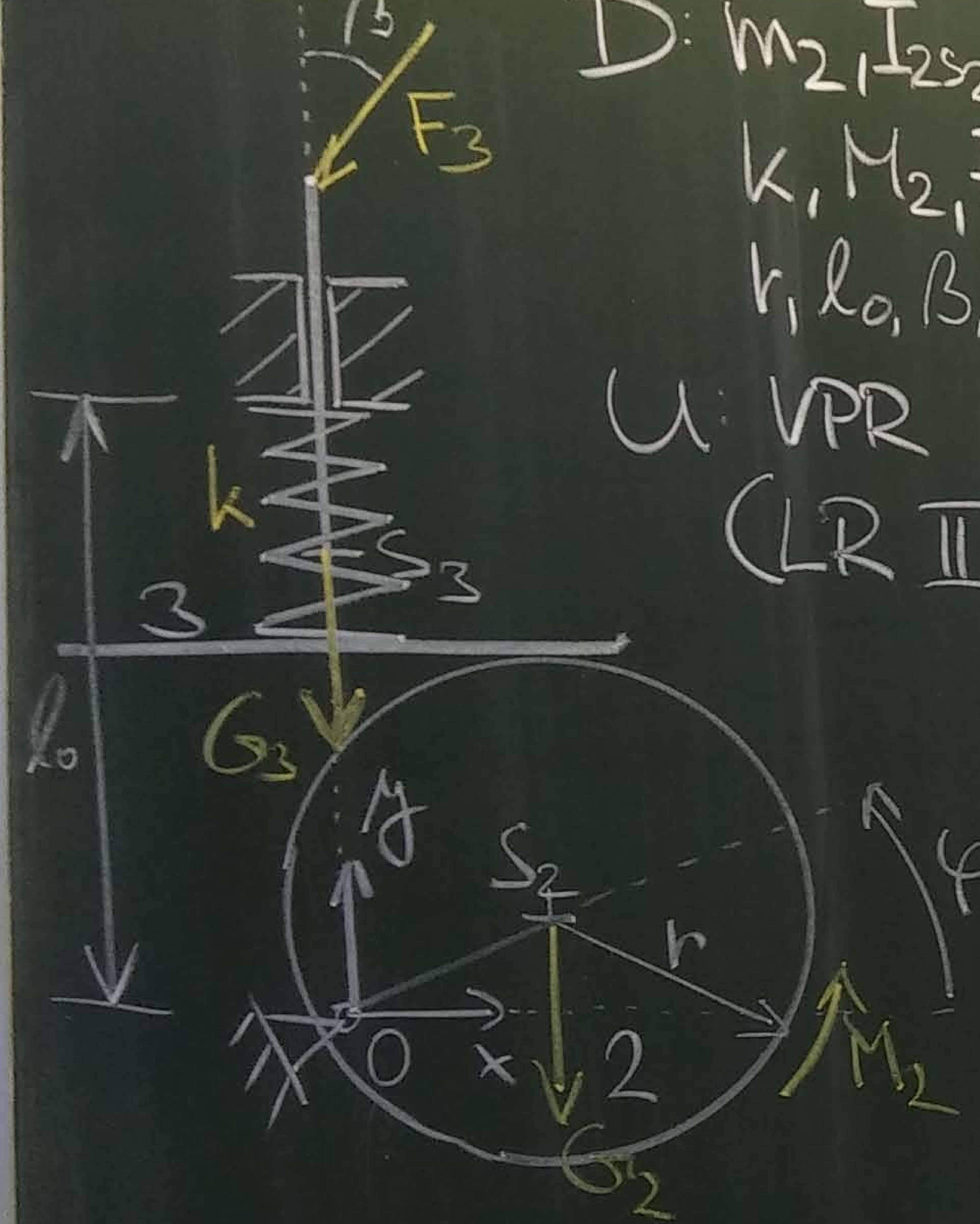

D: m_2, I_{2S_2}, m_3

k, M_2, F_3

$r, l_0, \beta, \overline{OS_2} = e$

U: VPR

(LR II. druhu)

$$\boxed{\frac{d}{dt}\left(\frac{\partial E_k}{\partial \dot q}\right) - \frac{\partial E_k}{\partial q} = Q}$$

1° volnosti $\rightarrow q = \varphi$

$x_{S_2} = e\cos\varphi$

$y_{S_2} = e\sin\varphi$

$\dot x_{S_2} = -e\sin\varphi\,\dot\varphi$

$\dot y_{S_2} = e\cos\varphi\,\dot\varphi$

$\dot x_{S_2}^2 + \dot y_{S_2}^2 = e^2\dot\varphi^2$

$y_{S_3} = e\sin\varphi + r + konst.$

$\dot y_{S_3} = e\cos\varphi\,\dot\varphi$

$$E_k = \frac{1}{2}m_2(\dot x_{S_2}^2 + \dot y_{S_2}^2) + \frac{1}{2}I_{2S_2}\dot\varphi^2 + \frac{1}{2}m_3\dot y_{S_3}^2$$

$$E_k = \frac{1}{2}m_2 e^2\dot\varphi^2 + \frac{1}{2}I_{2S_2}\dot\varphi^2 + \frac{1}{2}m_3 e^2\cos^2\varphi\,\dot\varphi^2 = \frac{1}{2}\underbrace{\left(I_{2S_2} + m_2 e^2\right)}_{I_{20}}\dot\varphi^2 + \frac{1}{2}m_3 e^2\cos^2\varphi\,\dot\varphi^2$$

$$E_k = \frac{1}{2}\left(I_{20} + m_3 e^2\cos^2\varphi\right)\dot\varphi^2$$

$$\frac{\partial E_k}{\partial\dot\varphi} = \frac{1}{2}\left(I_{20} + m_3 e^2\cos^2\varphi\right)2\dot\varphi;\quad \frac{d}{dt}\left(\frac{\partial E_k}{\partial\dot\varphi}\right) = \left(I_{20} + m_3 e^2\cos^2\varphi\right)\ddot\varphi + m_3 e^2 2\cos\varphi(-\sin\varphi)\dot\varphi\cdot\dot\varphi$$

$$\frac{\partial E_k}{\partial\varphi} = \frac{1}{2}\left(m_3 e^2 2\cos\varphi(-\sin\varphi)\right)\dot\varphi^2$$

$$Q\,\delta q = M_2\,\delta\varphi - G_2\,\delta y_{S_2} - G_3\,\delta y_{S_3} - F_3\cos\beta\,\delta y_{S_3} - F_p\,\delta y_{S_3},\quad F_p = k(e\sin\varphi + r)$$

$$Q\,\cancel{\delta\varphi} = M_2\,\cancel{\delta\varphi} - G_2 e\cos\varphi\,\cancel{\delta\varphi} - \left[G_3 + F_3\cos\beta + k(e\sin\varphi + r)\right]e\cos\varphi\,\cancel{\delta\varphi}$$

$$\boxed{\begin{aligned}&\left(I_{20} + m_3 e^2\cos^2\varphi\right)\ddot\varphi - 2m_3 e^2\sin\varphi\cos\varphi\,\dot\varphi^2 + m_3 e^2\sin\varphi\cos\varphi\,\dot\varphi^2 =\\ &= M_2 - \left[G_2 + G_3 + F_3\cos\beta + k(e\sin\varphi + r)\right]e\cos\varphi\end{aligned}}\ \text{VPR}$$