V.7 EOM in state-space form

$$x = \begin{bmatrix} \tilde{z} \\ \tilde{\theta} \\ \dot{\tilde{z}} \\ \dot{\tilde{\theta}} \end{bmatrix} \qquad u = \tilde{F} \qquad y = \begin{bmatrix} \tilde{z} \\ \tilde{\theta} \end{bmatrix}$$

From V.5

$$\dot{\tilde{z}} = \dot{\tilde{z}}$$

$$\dot{\tilde{\theta}} = \dot{\tilde{\theta}}$$

$$\ddot{\tilde{z}} = -\frac{5}{7} g \tilde{\theta}$$

$$\ddot{\tilde{\theta}} = \frac{1}{\frac{1}{3} m_2 l^2 + m_1 z_e^2} \left(-m_1 g \tilde{z} + l \tilde{F} \right)$$

$$\begin{bmatrix} \dot{\tilde{z}} \\ \dot{\tilde{\theta}} \\ \ddot{\tilde{z}} \\ \ddot{\tilde{\theta}} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -\frac{5}{7} g & 0 & 0 \\ \frac{-m_1 g}{\frac{1}{3} m_2 l^2 + m_1 z_e^2} & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \tilde{z} \\ \tilde{\theta} \\ \dot{\tilde{z}} \\ \dot{\tilde{\theta}} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \frac{l}{\frac{1}{3} m_2 l^2 + m_1 z_e^2} \end{bmatrix} \tilde{F}$$

$$y = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} \tilde{z} \\ \tilde{\theta} \\ \dot{\tilde{z}} \\ \dot{\tilde{\theta}} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} \tilde{F}$$