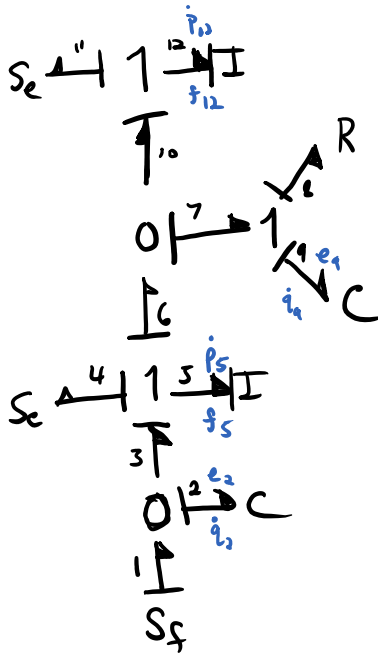


- HW #8 Due Wed. Nov 27
- Lab # 4 Due Mon. Dec 2
- No class on Wed. Nov 27 (but there most likely will be a video you are responsible for watching before Mon. Dec 2)



State variables: q_2, p_5, q_9, p_{12}

Inputs: S_{e1}, S_{e4}, S_{e11}

① $\dot{q}_2 =$

① $\dot{q}_2 = S_{f1} - \frac{p_5}{I_5}$

② $\dot{p}_5 = e_5$

② $\dot{p}_5 = \frac{q_2}{c_2} - S_{e4} - \left[\frac{q_9}{c_4} + R_9 \left(\frac{p_5}{I_5} - \frac{p_{12}}{I_{12}} \right) \right]$

③

④ $\dot{p}_{12} = e_{12}$

③ $\dot{q}_9 = f_9 = f_7 = f_6 - f_{10} = \frac{p_5}{I_5} - \frac{p_{12}}{I_{12}}$

④ $\left[R_8 \left(\frac{p_5}{I_5} - \frac{p_{12}}{I_{12}} \right) + \frac{q_9}{c_4} \right] - S_{e11}$

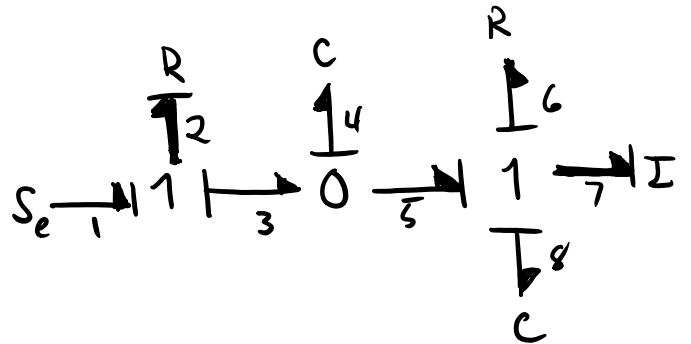
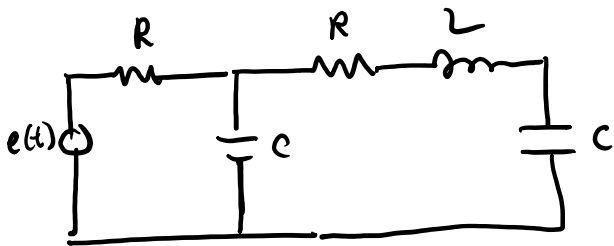
Linear model, put into state space form

$$\begin{matrix} 4 \times 1 \\ \dot{\bar{x}} \end{matrix} = \begin{matrix} 4 \times 4 \\ A \end{matrix} \bar{x} + \begin{matrix} 4 \times 3 \\ B \end{matrix} \bar{u}$$

$$\begin{bmatrix} \dot{q}_2 \\ \dot{p}_5 \\ \dot{q}_9 \\ \dot{p}_{12} \end{bmatrix} = \begin{bmatrix} 0 & -\frac{1}{I_5} & 0 & 0 \\ \frac{1}{c_2} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} q_2 \\ p_5 \\ q_9 \\ p_{12} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} S_{e1} \\ S_{e4} \\ S_{e11} \end{bmatrix}$$

$$\begin{bmatrix} \dot{v}_2 \\ \dot{P}_5 \\ \dot{q}_9 \\ \dot{P}_{12} \end{bmatrix} = \begin{bmatrix} 0 & -\frac{1}{I_5} & 0 & 0 \\ \frac{1}{C_2} & -\frac{R_8}{I_5} & -\frac{1}{C_9} & \frac{R_8}{I_{12}} \\ 0 & \frac{1}{I_5} & 0 & -\frac{1}{I_{12}} \\ 0 & \frac{R_8}{I_5} & \frac{1}{C_9} & -\frac{R_8}{I_{12}} \end{bmatrix} \begin{bmatrix} v_2 \\ P_5 \\ q_9 \\ P_{12} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} S_{f1} \\ S_{e4} \\ S_{e11} \end{bmatrix}$$

Exercise



Inputs: S_{e1}

State variables: q_4, P_7, q_8

- ① $\dot{q}_4 = f_4 = \frac{1}{R_2} (S_{e1} - \frac{q_4}{C_4}) - \frac{P_7}{I_7}$
- ② $\dot{P}_7 = e_7 = \frac{q_4}{C_4} - R_6 (\frac{P_7}{I_7}) - \frac{q_8}{C_6}$
- ③ $\dot{q}_8 = f_8 = \frac{P_7}{I_7}$