ELEC 412 Assignment 1

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1 P1

$$
\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -\frac{k_2+k_1}{m_1} & \frac{k2}{m1} & 0 & 0 \\ \frac{k2}{m2} & -\frac{k2}{m2} & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \frac{k_1}{m_1} \\ 0 \end{bmatrix} u(t)
$$

$$
\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} -1 & 1 & 0 & 0 \\ -\frac{k_2+k_1}{m1} & \frac{k_2}{m_1} & 0 & 0 \\ \frac{k_2}{m_2} & -\frac{k_2}{m_2} & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{k_1}{m_1} \\ 0 \end{bmatrix} u(t)
$$

2 P2

$$
\frac{u_1 - v_1}{R/2} = \frac{v_1 - v_2}{R} + c\frac{d}{dt}v_1
$$

$$
\frac{v_1 - v_2}{R} = \frac{v_2 - v_3}{R} + c\frac{d}{dt}v_2
$$

$$
\frac{v_2 - v_3}{R} + \frac{u_2 - v_3}{R/2} = c\frac{d}{dt}v_3
$$

$$
\dot{v}_{c1} = \frac{-2v_{c1}}{RC} + \frac{2u_1}{RC} - \frac{v_{c1}}{RC} + \frac{v_{c2}}{RC}
$$

$$
\dot{v}_{c2} = \frac{v_{c1}}{RC} - \frac{v_{c2}}{RC} - \frac{v_{c2}}{RC} + \frac{v_{c3}}{RC}
$$

$$
\dot{v}_{c1} = \frac{v_{c2}}{RC} - \frac{v_{c3}}{RC} + \frac{2u_2}{RC} - \frac{2v_{c1}}{RC}
$$

$$
\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} \frac{-3}{RC} & \frac{1}{RC} & 0 \\ \frac{1}{RC} & \frac{-2}{RC} & \frac{1}{RC} \\ 0 & \frac{1}{RC} & \frac{-3}{RC} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} \frac{2}{RC} & 0 \\ 0 & 0 \\ 0 & \frac{2}{RC} \end{bmatrix} \begin{bmatrix} u_1 & u_2 \end{bmatrix}
$$