ECE-320: Linear Control Systems
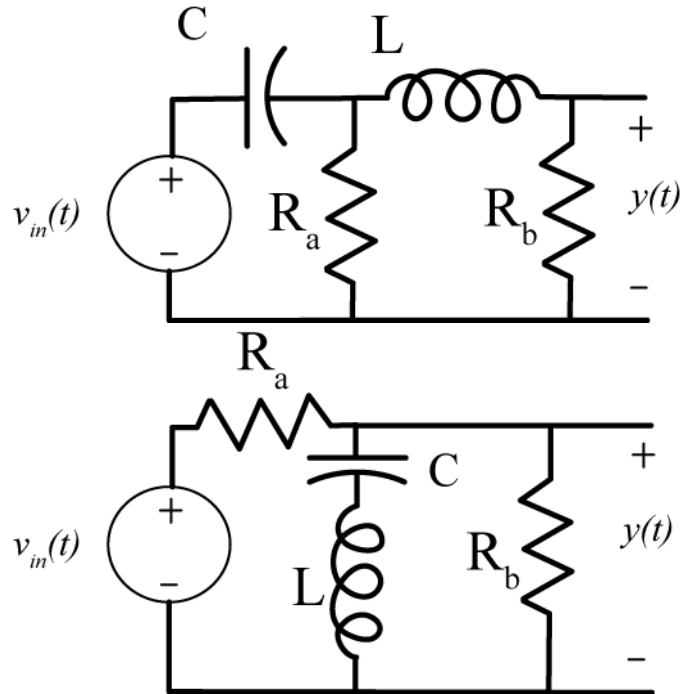Homework 6

Due: Tuesday January 27 at the beginning of class

1) For the following two circuits,

show that the state variable descriptions are given by

$$\frac{d}{dt}\begin{bmatrix} i_L(t) \\ v_c(t) \end{bmatrix} = \begin{bmatrix} -\dfrac{R_b}{L} & -\dfrac{1}{L} \\ \dfrac{1}{C} & -\dfrac{1}{R_a C} \end{bmatrix}\begin{bmatrix} i_L(t) \\ v_c(t) \end{bmatrix} + \begin{bmatrix} \dfrac{1}{L} \\ \dfrac{1}{R_a C} \end{bmatrix}v_{in}(t) \quad y(t) = \begin{bmatrix} R_B & 0 \end{bmatrix}\begin{bmatrix} i_L(t) \\ v_c(t) \end{bmatrix} + [0]v_{in}(t)$$

$$\frac{d}{dt}\begin{bmatrix} i_L(t) \\ v_c(t) \end{bmatrix} = \begin{bmatrix} -\dfrac{R_a R_b}{L(R_a + R_b)} & -\dfrac{1}{L} \\ \dfrac{1}{C} & 0 \end{bmatrix}\begin{bmatrix} i_L(t) \\ v_c(t) \end{bmatrix} + \begin{bmatrix} \dfrac{R_b}{L(R_a + R_b)} \\ 0 \end{bmatrix}v_{in}(t) \quad y(t) = \begin{bmatrix} -\dfrac{R_a R_b}{R_a + R_b} & 0 \end{bmatrix}\begin{bmatrix} i_L(t) \\ v_c(t) \end{bmatrix} + \begin{bmatrix} \dfrac{R_b}{R_a + R_b} \end{bmatrix}v_{in}(t)$$

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2) For the following circuit, the state variables are the current through the inductor and the voltage across the capacitor. Determine a state variable model for this system. Specifically, you need to identify the A, B, C, and D matrices/vectors/scalars.