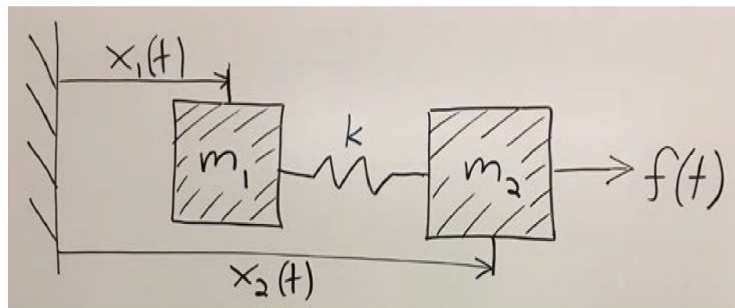


Homework #2
ME EN 5210/6210 & CH EN 5203/6203 & ECE 5652/6652
Linear Systems & State-Space Control

Use this page as the cover page on your assignment, submitted as a single pdf.

Problem 1

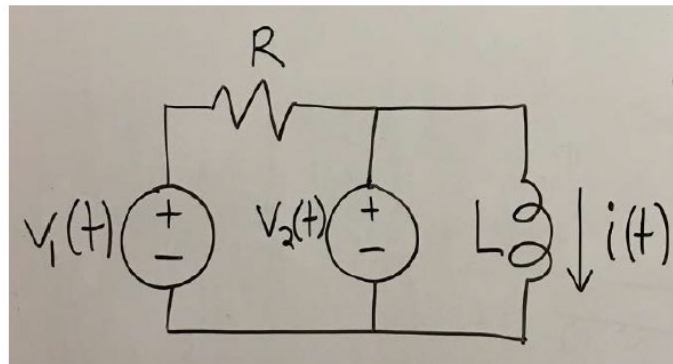
- (a) For the following mechanical system with two masses connected by a spring, find the state-space equations if the input is the force acting on mass m_2 (i.e., $u(t) = f(t)$), the first output is the velocity of mass m_1 (i.e., $y_1(t) = \dot{x}_1(t)$), and the second output is the distance between the two masses (i.e., $y_2(t) = x_2(t) - x_1(t)$). Assume $x_2(t) = x_1(t)$ when the spring is relaxed. Use the following physics-based state definitions:
 $q_1(t) = \dot{x}_1(t)$, $q_2(t) = \dot{x}_2(t)$, $q_3(t) = x_2(t) - x_1(t)$



- (b) Next, find the state-space equations if there is also a third output, which is the position of mass m_1 (i.e., $y_3(t) = x_1(t)$).

Problem 2

- (a) For the following electrical circuit with two input voltages, find the state-space equations if the output is the current flowing through the inductor, as shown.



- (b) Next, find the state-space equations if there is also a second output, which is the current flowing through the resistor (define its positive direction flowing from left to right).