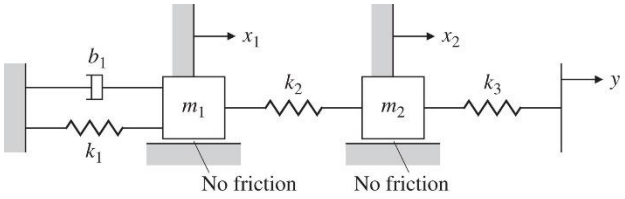
ME 5200/6200 Classical Controls **Fall 2020**

Homework 01 **Due Tues, Sept. 8 by 11:59 pm (Submit via CANVAS)**

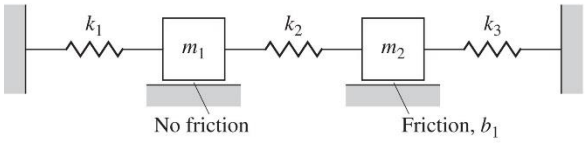
Do the following problems and show all your work for full credit. Note: not all problems will be graded, but you must complete all problems to get full credit.

Problem 1 [30 pts]

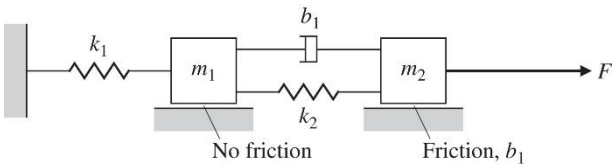
For the three mechanical systems shown on the right, find the differential equations that govern their behavior. Please follow the procedures outlined in lecture and be sure to include detailed free-body diagrams, labeling forces, coordinate systems, etc.



(a)



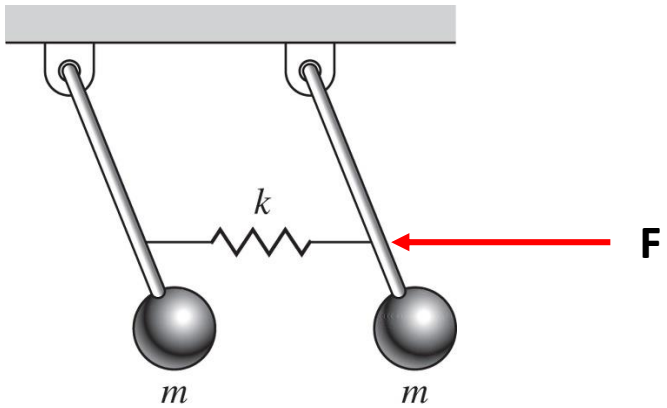
(b)



(c)

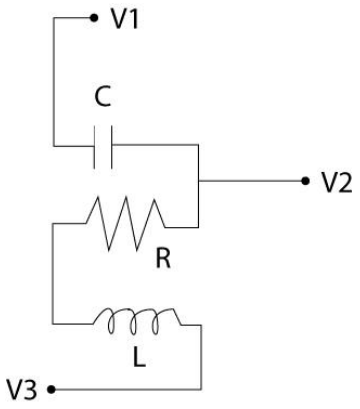
Problem 2 [10 pts]

This problem shows two pendulums connected together by a spring, and there's a force acting horizontally as shown. Write the equations of motion for this system, where you can assume small angles. By doing this, the spring will appear to be horizontal. Please follow the procedures outlined in lecture and be sure to include detailed free-body diagrams, labeling forces, coordinate systems, etc.



Problem 3 [10 pts]

Consider the following circuit. Find the differential equation that governs the behavior of the voltage V2 – note, your result should be a **differential equation** and it must be written in the time domain; and assume the inputs are V1 and V3. Your result shown not be expressed in the Laplace domain or as a transfer function.



Problem 4 [10 pts]

Consider the following op-amp circuit, where V1 and V2 are input voltages, and Vout is the output voltage. Write the differential equation that governs the behavior of the circuit. Note, your result should be a **differential equation** and it must be written in the time domain. Your result shown not be expressed in the Laplace domain or as a transfer function. Note further that you may need to review op-amp circuits from ME3220 as well as Chapter 2 of the text.