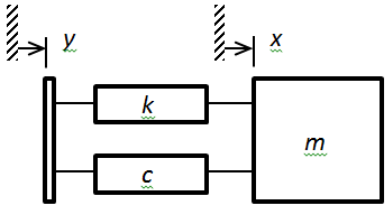
Homework Assignment #5 (ME-190, Fall 2016)

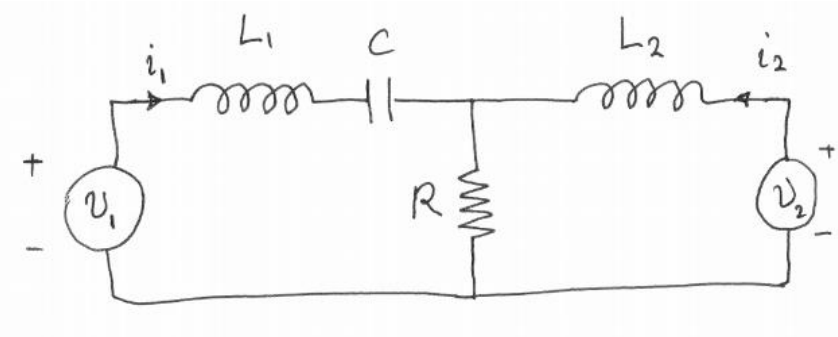
Due date: Thursday, Oct. 20, 2016, 2:00 pm.

Objective: Developing Transfer Function Model for Dynamic Systems.

Problem 1. Derive a transfer function for the following system from input *y* to output *x*, i.e. $G(s) = \frac{X(s)}{Y(s)}$



Problem 2. In the represented circuit diagram, v_1 and v_2 are independent input voltages, and i_1 and i_2 are the resulting output currents.



(a) Write the governing differential equations for the system which relate the outputs to the inputs (You need to use KVL and KCL and come up with two differential equations, one for each loop, with variables being i_1 , i_2 , v_1 , and v_2.

(b) Apply the Laplace transform to the obtained differential equations and obtain the following transfer functions:

$$G_{11}(s) = \frac{I_1(s)}{V_1(s)} \qquad \text{(Transfer Function from input 1 to output 1)}$$

$$G_{12}(s) = \frac{I_2(s)}{V_1(s)} \qquad \text{(Transfer Function from input 1 to output 2)}$$

$$G_{21}(s) = \frac{I_1(s)}{V_2(s)} \qquad \text{(Transfer Function from input 2 to output 1)}$$

$$G_{22}(s) = \frac{I_2(s)}{V_2(s)} \qquad \text{(Transfer Function from input 2 to output 2)}$$

(c) Simulate the unit step response of $G_{11}(s)$ in Matlab For *L1* = 0.1 H, *L2* = 0.2 H, *C* = 0.001 *f*, and *R* = 10 Ω using the "step" command. To create the transfer function model in Matlab you can type "sysName = *tf*(*Num*,*Den*);" where *Num* and *Den* are the vectors associated with the numerator and the denominator polynomial coefficients, respectively.