Measurements and Control Laboratory (0908448)

Assignments 1

Problem 1:

For Electrical circuit shown in the figure 1, assume the output is $V_c\ (t)$

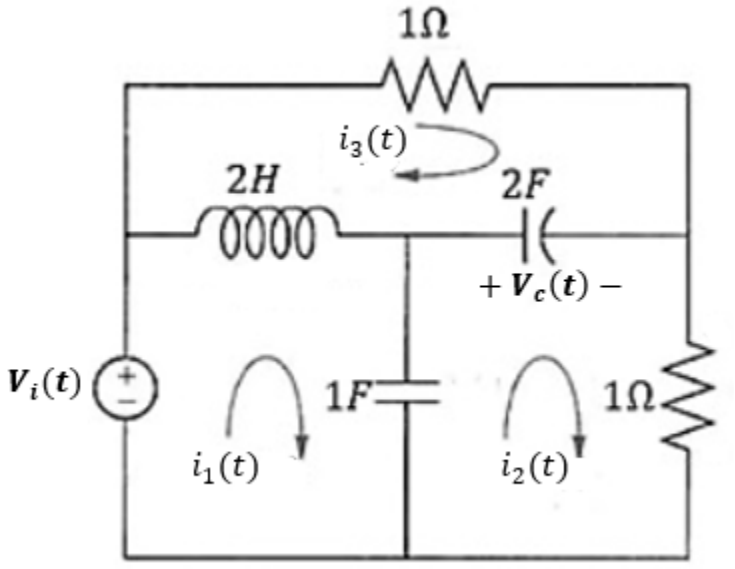

Figure 1: Electrical Circuit

Find the following:

1) The Mathematical Equations (Differential Equations) of System?
2) The Transfer Function between input and output $\frac{V_c(s)}{V_i(s)}$?
3) Draw the state diagram (Signal flow Diagram) depend on part1 **using Simulink block** that used to find the response of output and solve the differential equations ?
4) Using the SimScape Library, **Build the circuit** and **Plot the Response** of the following states, due the input $\boldsymbol{V_i(t) = 10\ u(t)\ , t > 0}$?
   a. Output Voltage on capacitor $V_c(t)$.
   b. The Currents in the $i_1(t), i_2(t)\ and\ i_3(t)$.
   c. The Voltage on Inductor.
5) What is the reason that create undershoot in the response of the voltage $V_c(t)$ and the what the name of system in this case?

Problem 2:

The figure 2 shows a simple model of a car suspension. It consists of a spring and damper connected to a body (represented as a mass), which is agitated by a force.

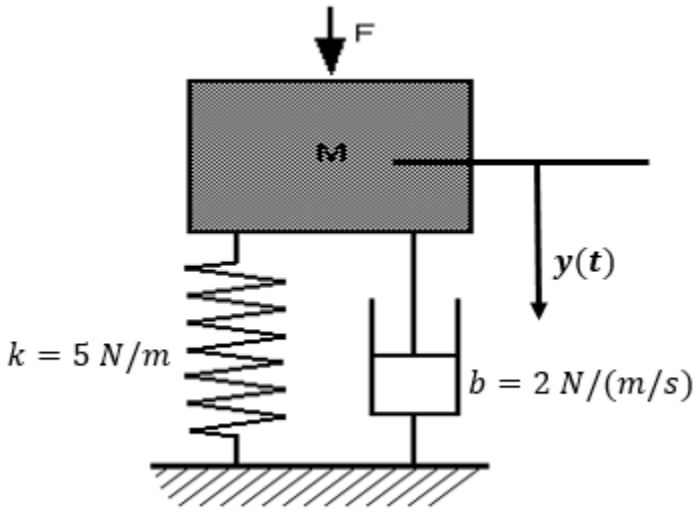

Figure 2: Suspension Model

Build the SimScape Model and Find the following:

1) Build the SimScape Model for the circuit.
2) Find the **Position response $y(t)$** due to the step input $\boldsymbol{F(t) = 5u(t).\, t \geq 0}$

   For **Open Loop System**,
3) Determine the Time specification (Overshoot, settling time, rise time, peak time, and stead state error)
4) Study and **write comment** for the effect of:
   a) Increase and decrease the value of $\boldsymbol{M}$, when the value of $\boldsymbol{k}$ **and** $\boldsymbol{b}$ constant
   b) Increase and decrease the value of $\boldsymbol{k}$, when the value of $\boldsymbol{M}$ **and** $\boldsymbol{b}$ constant
   c) Increase and decrease the value of $\boldsymbol{b}$, when the value of $\boldsymbol{M}$ **and** $\boldsymbol{k}$ constant
5) Repeat the **part 2 and 3** for the **Close Loop System**

Problem 3:

A tank level control system is shown in figure 3. It is desired to regulate the level $\boldsymbol{h}$ in response to a disturbance change q_3. The desired height variation is equal to zero.

The system is describing by the open loop

$$G(s) = \frac{R}{RCs + 1}$$

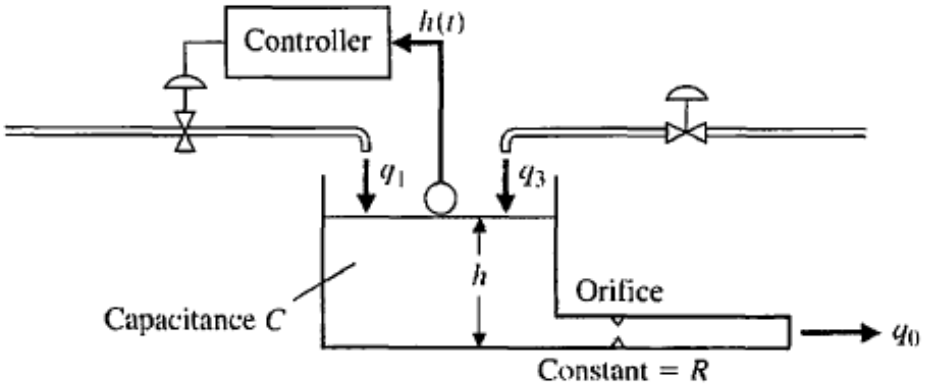

Figure 2: Tank level controller

For this system, Find the following:

1) Identify the system Components

Parameters	
Signals in system	
State in system	

2) Discuss the objective of controller
3) Draw the block diagram that describe the system.