

First Simulation Project. Control engineering.
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“In accordance with the Tecnológico de Monterrey Student Code of Honor, my performance in this exam will be guided by academic honesty.”

You should upload a **word** or **PDF** file in which all the results are provided. The word or PDF should be self-explaining, i.e. it should contain images of the Simulink[®] diagram, the transfer function of the system, the control equation, the Sisotool plots (if needed), the output of the system and the input to the system. Also, you can do your mathematical computation on a paper and include images of them.

The report should be presented by System, not by question. You should also include a .m file per system, which generates all the required variables, and a Simulink[®] file per system. The exam will be graded with both the word or PDF file and the workspace. Follow the structure defined and attached on the 1st simulation project. It is very important that you upload a ZIP file, otherwise the name of the variables will be changed.

The simulation project is **individual** and depends on the following parameters. If there were 2 people with the same data, both exams will be cancelled with a violation to Academic Honesty will be reported, with a final grade of the course equal to 1/100.

Part 1. 80 points. The parameters for this section are:

$a = \text{Birth Day}, b = \text{Birth Month}$ and $c = a + b$
(For instance, for someone born in Sep 16th $a = 16, b = 9$ and $c = 25$)

make sure to include the values used for a, b and c at the beginning of the report.

System 1. (15p)

$$G(s) = \frac{Y(s)}{U(s)} = \frac{a}{cs + b}$$

System 3. (15p)

$$G(s) = \frac{Y(s)}{U(s)} = \frac{4a e^{-0.006s}}{(s + 2b)(s + b)}$$

System 2. (15p)

$$G(s) = \frac{Y(s)}{U(s)} = \frac{ac e^{-0.004s}}{6s^2 + c(a/25)s + c^2}$$

System 4. (15p)

Identification of the assigned Step Response.
(Make sure to include the validation plot in your report)

Symbology:

M – Requires Math computation. It can be made in paper or in Matlab[®]. Make sure it's easy to follow on your report.

S – Requires Simulink[®] Simulation. Include clear images of the plots and the Simulink Diagram.

D – Requires Diagrams, for instance in Sisotool[®].

For each of the enlisted systems Compute, Design and Simulate as required:

1 . (6p) **M** **S**

Characterization of the system in open loop. The final value, settling time and, if necessary, damping factor, Natural frequency and Damped Natural Frequency. Assume the input $u(t)=a/2$.

2 . (6p) **M** **S**

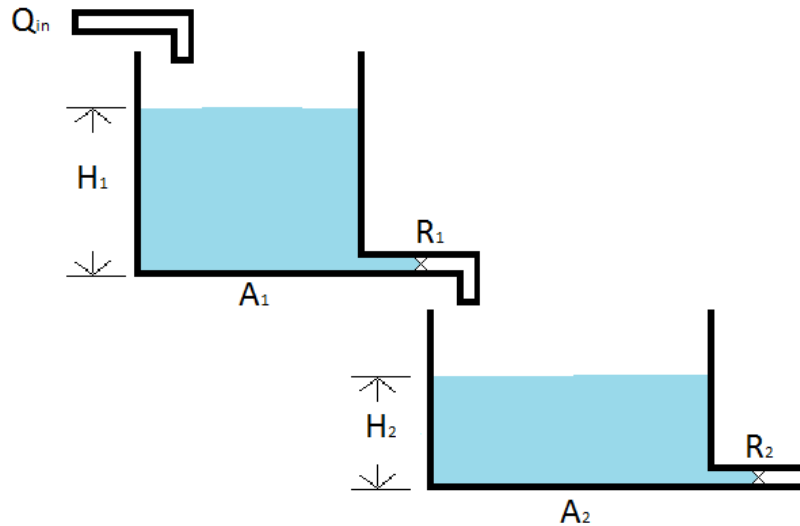
Characterization of the system. The final value in closed loop with a control gain $K=b$ and a reference $r(t)=a$.

3. (3p) **D**

Gain range for stability. The set of gains for which the system is stable in closed loop.

Sistema 5. (40p)

Consider the following system. The flow in the tank above is the input to the system (manipulated variable Q_{in}). The parameters for this example are given in the Workspace file for this project, and individually assigned.



Parameters H_1 and H_2 can be the output of the system. Parameter H_{1max} and H_{2max} correspond to the real height of the tank and will be used on the final question. Finally, parameters A_1 , R_1 and A_2 , R_2 are the area and the resistance to the laminar flow of Tank 1 and Tank 2 respectively.

1. (6p, 3p each) Obtain the symbolic transfer function **M**
 - a. $H_1(s)/Q_{in}(s)$
 - b. $H_2(s)/Q_{in}(s)$
2. (4p, 2p each) Obtain the numeric transfer function with the parameters assigned to you. **M**
 - a. $H_1(s)/Q_{in}(s)$
 - b. $H_2(s)/Q_{in}(s)$
3. (5p) For $H_1(s)/Q_{in}(s)$ Assume an input equal to the assigned variable Q_{in_1} . Compute the final value of H_1 and the settling time **M S**
4. (5p) For $H_2(s)/Q_{in}(s)$ Assume an input equal to the assigned variable Q_{in_2} . Compute the final value of H_2 , the settling time, the natural frequency of the system, the damping factor and the damped natural frequency. **M S**

Variable assignation.

1	A00226442	14	A01631925
2	A00343779	15	A01632255
3	A00344416	16	A01632734
4	A01113720	17	A01632954
5	A01113836	18	A01633178
6	A01114172	19	A01633231
7	A01114202	20	A01633279
8	A01227225	21	A01633926
9	A01228853	22	A01634022
10	A01229268	23	A01634734
11	A01229469	24	A01634847
12	A01233216	25	A01756444
13	A01364714	26	A01756812

To use the variables, use the workspace named: PS1.mat

The assignation for each student is on the table above and it will be used in code as a variable "n".

For System 4, use the variable DataID.

You can access such variable with: `MyVariable=DataID{n}`

MyVariable can have any name and will have two columns.

You can plot them using: `plot(MyVariable(:,1), MyVariable(:,2))`

To access the rest of the variables, use `VariableName(n)`

For instance, for a student with n=15, `A1(15)` is the Area of the first tank.