Cairo University
Faculty of Engineering
Credit Hours System
Communications and Computer Engineering Department

Fall Semester 2021

Course Code:	ELCN304
Course Title:	Control-1
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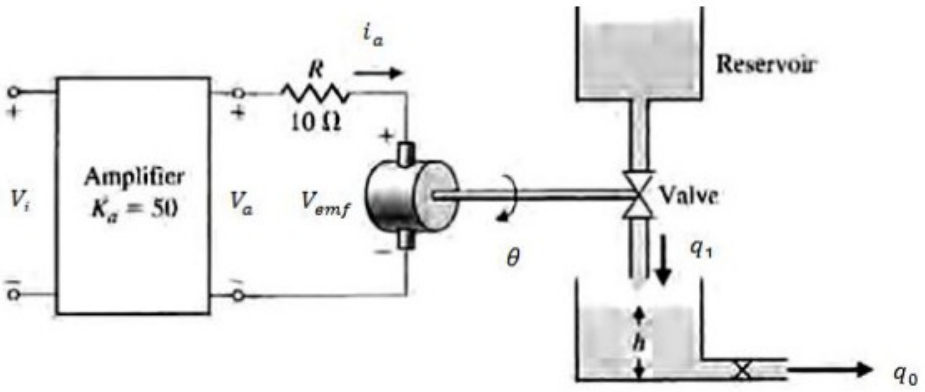
Course TA:	Eng. Hassan El-Menier

Project: Due on Firday, 31st of December, 2021 at 11:59 PM

Question (1):

For the system shown below, neglect the motor inductance ($L_m=0$), the torque constant is $K_T=9.5$, the back-EMF constant is $K_b=0.0704$. The motor inertia equals the valve inertia, $J=0.0058$, and the area of the tank is $51m^2$. Assume that $q_1=82\theta$, where θ is the motor shaft angle. The output flow is $q_0=51h(t)$:



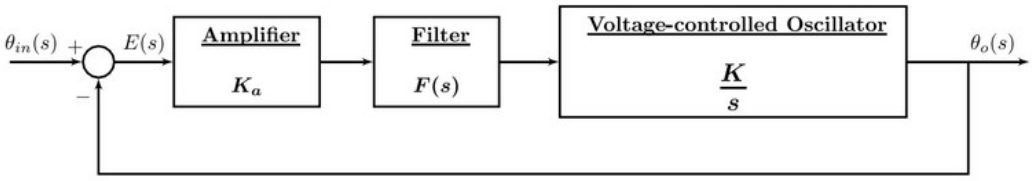
1. Write the dynamic equations of the system and use it to build a state space representation for the system (hand analysis).
2. Check the Controllability and the Observability of the system using MATLAB.
3. Use MATLAB/Simulink to enter your state space representation and then use MATLAB commands to obtain the transfer function $\frac{H(s)}{V_i(s)}$.
4. Study the stability of the system (using poles location).
5. The system is then operated by applying a fixed input voltage of $1V$. Simulate the system response under this value of input voltage, also from the resulting response, calculate the steady state value of the output signal. Comment on your results.
6. Suggest a modification to the system such that: the system input is a certain desired level h_d (reference input) and the liquid level in the tank **h** is required to follow this desired level h_d .
7. Study the effect of adding the following controller $\frac{G_c(s)}{s+1000}$, where $G_c(s)=1$, to the

system. Plot the step response of the output **h**, then calculate the value of the rise time, peak time, max peak, settling time and the value of e_{ss} . Comment on your results.

8. Suggest a controller $G_c(s)$ to satisfy settling time less than 3 sec and maximum overshoot less than 15%.

Question (2):

The linear model of a phase detector (phase-lock loop) can be represented by the following figure:



The phase-lock systems are designed to maintain zero difference in phase between the input carrier signal, and a local voltage-controlled oscillator. Phase-lock loops find application in color television, missile tracking, and space telemetry. The filter for a particular application is chosen as:

$$\frac{10(s+10)}{(s+1)(s+100)}$$

We want to minimize the steady-state error of the system for a ramp change in the phase information signal. Using MATLAB/Simulink answer the following:

1. Determine the limiting value of the gain $K_v = K_a K$ in order to maintain a stable system.
2. Plot the ramp response and measure the steady-state error.
3. Plot the step response, and measure the maximum overshoot, the rise time, and the settling time.

Guidelines:

1. The number of group members is 4 students.
2. The groups can be formed independent of the registration whether in lectures or tutorials.
3. You can use either MATLAB or Simulink for your simulations.
4. Delivery requirements:
   a) Include all the hand analysis and MATLAB/Simulink simulations with its results and your analysis in a .pdf file.
   b) The format of the pdf file is ELCN304_Project_1_Group_[#Group No.]
   c) Only one soft copy to be submitted on Blackboard per group.
5. The deadline is **Friday 31st of December, 2021** at **11:59 PM**.
6. Duplicated assignments will receive **ZERO** mark.

Good Luck!