

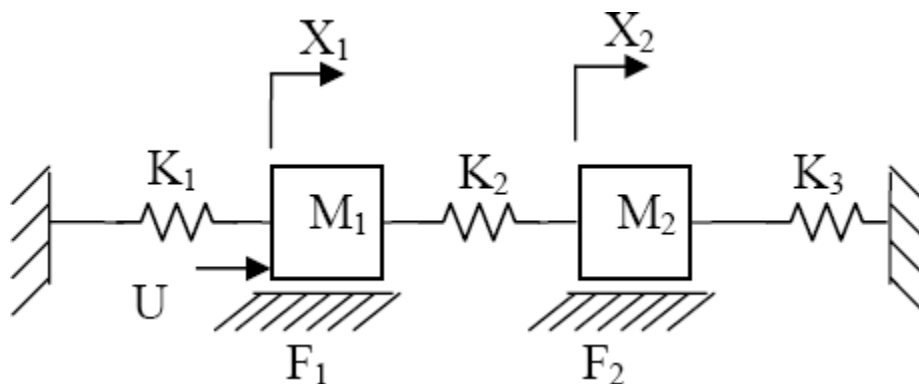
Control Assignment

Guidelines:-

1. This assignment may be submitted individually or as a group. The maximum number of group members is 3 students
2. You must announce any groups using this form. **Even if you do the assignment alone** make a submission in the form with only 1 member in the group.
3. The final deadline is on **Thursday 4/5/2023**.
4. Duplicated assignments will have **ZERO** mark.
5. Late submissions will receive a **50%** grade penalty.

Practical system simulation using Matlab control toolbox

Consider a spring-mass dashpot system



1. Write the dynamic equations of the system and use it to build the **block diagram** of the system (hand analysis). **Don't perform any reduction to the block diagram.**
2. Use MATLAB to enter your detailed **block diagram** and then use MATLAB commands to obtain the following transfer functions: - **X_1/U , X_2/U** .

The system parameters are as follows:

Mass **M1** and Mass **M2** is **100Kg**.

Spring Constant is $K_1=K_3=$ **5** N/m and $K_2=$ **50** N/m.

Viscous Friction Coefficient (F_1 and F_2) is **100** Kg/sec.

3. For any of the two transfer functions (i.e. **X_1/U**) study the stability of the system.

4. If a fixed input force of 1N is applied to the system. Simulate the system under this value of input force showing the response of X_1 , X_2 also from the resulting responses calculate the steady state values of these signals.

5. Suggest a modification to the system such that: the system input is a certain desired displacement X_d (reference input) and displacements X_2 is required to follow this desired displacement (Hint: Use Feedback concept).
6. Simulate the system for a desired level (X_d) of 2 m. showing the response of X_2 .
7. For the response of X_2 calculate the value of the rise time, peak time, max peak, and settling time. Also calculate the value of e_{ss} .
8. As a solution to reduce the value of e_{ss} a proportional controller can be used. Study the effect of the value of proportional controller on both e_{ss} and transient response by simulating the system with the following values of P controller: 1, 10, 100, and 1000. Calculate transient response parameters for each case. Comment on your results.
9. If the desired displacement of the second mass is to be 4 m, is it possible to obtain a steady state error less than 0.01 m using a proportional-only controller? Why?
10. Suggest a suitable controller to eliminate e_{ss} . Then, simulate the system using your proposed controller.

Hint: Get controller constants by try and error, knowing that reference displacement of the second mass is 4 m.

Requirements

- You should submit 3 files in [this](#) form as follows:
 1. Word file having report
 2. Pdf file having same report
 3. MATAB script file having code
- Your submitted files must be named **ELC3252GXX** where **XX** should be replaced with your group number which you obtained when announcing your group in the form linked in the guidelines.
- For example, if you are in group 2 you should submit 3 files named as follows
 1. **ELC3252G02.docx**: Word file having report
 2. **ELC3252G02.pdf**: Pdf file having same report
 3. **ELC3252G02.m**: MATAB script file having code

GOOD LUCK