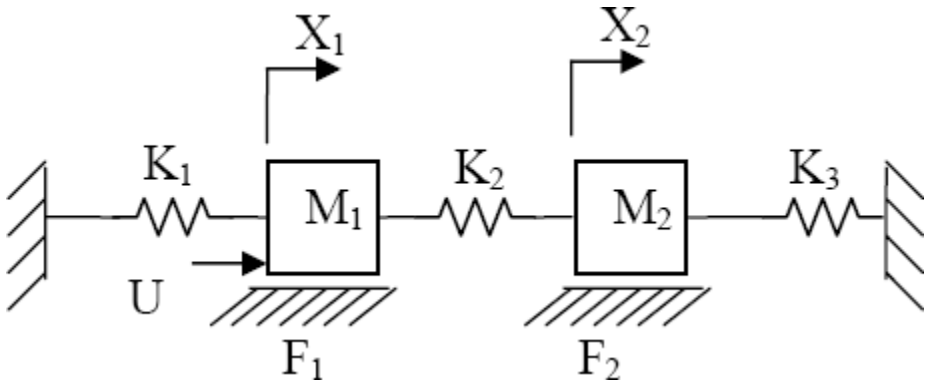
Control Assignment

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.

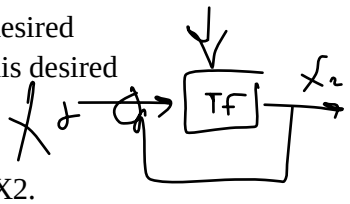
2. Use MATLAB to enter your detailed block diagram and then use MATLAB commands to obtain thefollowing transfer functions: - **X1/U, X2/U.**

The system parameters are as follows:
Mass M1 and Mass M2 is 100Kg.
Spring Constant is K1=K3=5 N/m and K2=50 N/m.
Viscous Friction Coefficient (F1 and F2) is 100 Kg/sec.

3. For any of the two transfer functions (i.e. **X1/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 inputforce showing the response of X1, X2 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 X2 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 X2.

7. For the response of X2 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 foreach 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 secondmass 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. MATALB 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:** MATALB script file having code

GOOD LUCK