# IIT Bombay
# Systems and Control Engineering
# Intelligent Feedback and Control

SC 645

***Assignment 01***

**Deadline**
Date: 29.01.24, 11.30pm

Maximum Marks: 10

**Instructions:**

- Submit the answers to this assignment on or before 11.30 pm, 29th January 2024. This is a strict deadline, and no request for any extension will be entertained.
- All the results and the associated observations/analysis must be compiled in a pdf file. This pdf and the associated code must also be submitted in a single zip folder on Moodle on the relevant submission link.
  Label this folder in the form: FirstName_RollNumber_AS01.
- Please preserve the code and the report till the end of this semester.
- The questions involve MATLAB simulation.
- Assumptions made, if any must be clearly stated and must be justified.
- The total marks obtained by you would be appropriately scaled to suit the weightage this assignment has in the grading policy.

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1. Consider a plant with the following transfer function:

$$G(s) = \frac{0.1e^{-2s} + s}{s^2 + 4s + 0.1} \tag{1}$$

Suppose that the actuator of the system has known saturation limits: [0, 10](i.e., the actuator saturates beyond this range).

- Simulate the Plant incorporating the actuator characteristics. (Hint: One may use the specifying time delays). Record its step response and frequency response characteristics. Hint: Use lsim commend /lti viewer.
- Design and simulate a bump test for the system (with actuator saturation present) and compare it with the model generated using the system identification toolbox. Report your choice of experimental design parameters in the pdf file.
- What type of model would you associate with this experimental data? Justify. Report the model, its associated parameters and the procedure of doing so in the pdf file.
- Compare the step and frequency responses of the plant and the model. Hint- one may use lti viewer.

[05]

2. Consider a plant with the following transfer function:

$$G(s) = \frac{1}{(s+1)^4} \tag{2}$$

- Select any two *two-parameter* models to approximate this transfer function.
- Using the system identification toolbox, obtain the parameters of these two models chosen.
- Compare the step and frequency response of the four models thus obtained with the original plant.
- Document the steps for calculation, the parameters of the models obtained, and the responses systematically in the file.

[05]

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