MAK333E SYSTEM DYNAMICS AND CONTROL

Instructors: Assoc. Prof. Dr. Kenan Kutlu

GRADING POLICY:
10% 2 Homeworks
10% 1 Term Project
40% 2 Midterm Exams
40% Final

RULES:

- It is compulsory to ATTEND at least 70% of the classes
- Copied or (suspiciously) similar Projects will get 0 pt.
- Late HW assignments will not be accepted.
- All enrolled students will take the same exams.
- Hw assignments and project will require MATLAB programming.

TEXTBOOK: Modern Control Engineering – OGATA – Prentice Hall
Modern Control Systems, Dorf-Bishop. Addison Wesley.

OTHER REFERENCES:

1)G.F. Franklin, J.D.Powell, A.E.Naeini, Feedback Control of Dynamic Systems,Addison-Wesley,1994.
2)C.L.Phillips, R.D.Harbor, Feedback Control Systems, Prentice Hall, 1996.
3)Otomatik Kontrol Sistemleri, B.Kuo, Çeviren A.Bir, Literatür Yayınları
4)Otomatik Kontrol Temelleri, Özdaş, Dinibütün, Kuzucu – Birsen
5)Otomatik Kontrol, Frekans Cevabı ve Köklerin Geometrik Yeri – Hızal İTÜ
6)Control Tutorials for Matlab: http://www.library.cmu.edu/ctms/ctms/index.htm

TOPICS:

1. Introduction to System Dynamics and Control,
2. Laplace Transformations,
3. Linearization,
4. Transfer Functions and Block Diagrams,
5. System Dynamics, Electrical, Mechanical, Thermal and Fluid Systems,
6. Transient and Steady-State Response of Dynamical Systems,
7. Feedback Control, PID Control
8. Stability, Routh Method,
9. PID Tuning Methods,
10. Control System Performance
11. Frequency Response Analysis(Bode Plots, Nyquist Locus, Bandwidth, Gain and Phase Margins)

TERM PROJECT

The project is a group work. Each group may be composed of 2-3 students. Each group must choose a different control example and work independently. The procedure for the project is outlined below.

PART 1: This part will be accepted as HW1 and submitted via Ninova before Midterm 1

1. Find an example of a feedback control system from suggested textbooks. Some of the examples can be given below:
    - Satellite tracking antenna
    - Magnetic tape drive speed control
    - Automatic ship steering
    - Attitude rate control for an aircraft
    - Stick balancer control
    - Altitude Control of a hot-air balloon
    - Design of a satellite attitude control
    - Lateral and Longitudinal control of a Boeing 747
    - Control of the fuel-air ratio in an automotive engine

(The list of examples will be extended later)

2. (If possible) explain how the system works and what the components are by drawing a rough sketch of the system
3. (If available) give the differential equations of the system, try obtaining the transfer function yourself
4. Analyze the open-loop characteristics of the system (pole locations, impulse and step response)

PART 2: This part will be accepted as HW2 and submitted via Ninova before Midterm 2

5. Analyse the closed-loop characteristics of the system with unity feedback and proportional controller
6. Determine the range of proportional gain for stability using Routh-Hurwitz Stability Criterion
7. Design PI, PD or PID controller for desired response. State the desired performance criteria of the system such as maximum overshoot, damping ratio, steady-state error, rise time, natural frequency.
8. Estimate the initial gains for tuning the controller, try using Ziegler-Nichols method.
9. State the final form and the constants of the controller. Plot the final response of the system. Explain if the desired performance is achieved.

PROJECT REPORT should also include the following topics and all important steps of the project. The project report will also be submitted via Ninova before TBD.

10. Plot the Frequency Response of the system. Indicate the gain and the phase margin on the plot.
11. Write a conclusion. The references should be cited at the end of the report.

- Do not even think about duplicating another team's project by assigning different numbers
- Do not forget to comment on every step, graph, etc. All figures should have captions and axes on all graphs should be labeled.
- Upload your project report file in the form of either MSWord or PDF format to Ninova.
- Project will be graded based on the completeness and the degree of difficulty. Completeness is more important than degree of difficulty.
- **Projects copied directly from the Control Tutorials for Matlab or any other website will NOT be ACCEPTED.**