Control Engineering

Syllabus

Seventh Semester

Electrical Engineering Department
College of Engineering
Salahaddin University - Erbil

September 2023

Course Name : **Control Engineering**
Course Number : **2128**
Type of Study : **Semester, In Class**
15 Weeks , 3 hrs./week
Academic Year : **2023-2024**
Instructor : **Assist. Prof. Dr. Fadhil T. Aula**

Course Description

➢ **Introduction to theory and practice of automatic control for continuous-time systems.**

➢ **Representations of the system: transfer function, block diagram, signal flow graph, differential state equation and output equation.**

➢ **Analysis of control system components: Transient and steady-state performance.**

➢ **System analysis: Routh-Hurwitz, root-locus, Nyquist, Bode plots.**

➢ **System design: PID controller, and lead-lag compensators, pole placement via state feedback, observer, stability margins in Nyquist and Bode plots.**

➢ **Emphasis on design principles and their implementation. Design exercises with a MATLAB package for specific engineering problems.**

Course Objectives

- ➢ **Understand the importance of automation and feedback control in modern society.**

- ➢ **Identify all the subsystems in a closed loop system block diagram, and discuss their roles.**

- ➢ **Reconstruct the block diagram of any feedback control application.**

- ➢ **Derive mathematical models for electrical, mechanical, electromechanical and hydraulic systems in time domain and frequency domain.**

- ➢ **Manipulate and simplify block diagrams.**

- ➢ **Differentiate between transient response and steady state response.**

- ➢ **Understand and explain the step response of a proportional system, first order lag system, and second order lag system.**

Course Objectives

➢ **Model a system as a first order system using system step response.**

➢ **Understand and explain the frequency response of a proportional system, first order lag system, and second order lag system.**

➢ **Identify the properties of feedback system in terms of good transient response, tracking accuracy, disturbance rejection, and sensitivity to model errors.**

➢ **Evaluate the performance of a closed system in terms of percentage of steady state error, tracking, percentage of overshoot, rise time, settling time, gain margin and phase margin.**

➢ **Explain the effect of P,PI, PID controllers on closed loop system performance if the reference signal is a constant or a ramp signal and in the presence of constant disturbances.**

Course Objectives

➤ **Differentiate between the different implementation of PID controllers: series PID and parallel PID implementation.**

➤ **Review Bode plots, and analyze and evaluate the frequency response of closed loop system.**

➤ **Designing and analyzing system in state space modeling.**

➤ **Ability of using MATLAB software for studying different types of control system aspects.**

Course Requirements

Textbooks:

1. Norman S. Nise, "Control Systems Engineering," 8th Edition, John Wiley & Sons, Inc, 2019

2. Katshuhiko Ogata , " Modern Control Engineering ", 5th Edition, Prentice Hall , 2009.

3. John Van De Vegter , " Feedback Control Systems ", 3rd Edition, Prentice Hall, 1994.

Prerequisites:

Mathematics, Circuits, Engineering Analysis, MATLAB.

Course Outline

1. Modeling of electrical and mechanical systems; transfer function, state space representations
2. Time domain response; rise time, settling time, overshoot Block diagrams, signal flow graphs,
3. Mason's gain formula Stability, Routh-Hurwitz tabulation
4. Steady state errors in feedback systems
5. Analysis and design using root locus
6. PI, PD, and PID controllers; lead and lag compensation
7. Analysis and design in the frequency domain; Bode plots, Nyquist plots
8. State space, canonical forms, controllability, observability, state feedback, observers

Course Progress

Week	Subject
1st	Introduction
2nd	Modeling in Frequency Domain
3rd	Reduction of Multiple Subsystems
4th – 5th	Time Response Analysis
6th	Stability Analysis
7th	Steady-State Error
8th	Midterm Exam
9th	Root Locus Technique
10th	Frequency Response Methods
11th – 13th	Modeling in Time Domain
14th	PID Controller
15th	Dead Weak

Assignments

➢ **Homework assignments are part of this course.**

➢ **In addition to performance in the tests, students can demonstrate their abilities through the way of the presentation of solutions to homework assignments and/or projects.**

Attendance

> ➢ **Will be taken occasionally.**

> ➢ **Positive attitude is a key to success.**

Grading Policy

➢ **Midterm Exam** **20 %**

➢ **Assignments + Quizzes + Project** **20 %**

➢ **Final Exam** **60%**

➢ *Total* *100%*

Academic Honesty and Plagiarism

➢ Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidently copying from a source without acknowledgement.

➢ You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Student should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

➢ If plagiarism if sound in your work when you are in first year, your lectures will offer you assistances to improve your academic skills. They may ask you to look at some online resources or resubmit your work with the problem fixed. However, more serious instance in first year, such as stealing another student's work or paying someone to do your work, may be investigated under student the Student Misconducted Procedures.

➢ Repeating plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconducted Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matter (like plagiarism in an honors thesis) even suspension from the university.

End of Control Engineering Syllabus!