EE C128 / ME C134 Feedback Control Systems
Fall 2014 Syllabus

Course contents

Analysis and synthesis of linear feedback control systems in transform and time domains. Control system design by root locus, frequency response, and state space methods. Applications to electro-mechanical and mechatronics systems.

Instructor

- Professor Alexandre Bayen
  - bayen@berkeley.edu
  - Office hours
    - 109 McLaughlin Hall
    - (510) 642-3585 (only during OH)
    - Time Tu., Thu., 5:00 - 6:00 p.m. (right after class)

Teaching assistants

- Roy Dong
  - roydong@eecs.berkeley.edu
  - Office hours
    - 337B Cory Hall
    - Thursday, 1:30 – 3:30 p.m.
- Cameron Rose
  - c_rose@eecs.berkeley.edu
  - Office hours
    - 504 Cory Hall
    - Monday, 2:00 - 3:00 p.m.
    - Friday, 2:00 - 3:00 p.m.

Lectures

- 145 Moffitt Undergraduate Library
- Tuesday & Thursday, 3:30 – 5:00 p.m.

bCourses

All students are responsible for checking the bCourses course page for all course content. The GSIs will use bCourses to send out announcements and post homeworks, readings, and labs for the class. Students can set their preferences for email notifications of all posted content under the "Notifications" tab in their personal settings in the top bar of the bCourses site. It is STRONGLY recommended that all students leave the course activities notifications enabled. All of the assignments along with their due dates can be viewed and downloaded under the "Assignments" tab. Additionally, the course will be sectioned into weeks under the "Modules" tab with all of the assignments, labs, and readings posted under their corresponding week. Lab reports and homeworks should be submitted online through the web interface on each assignment's page.

Homeworks

Weekly homeworks, posted on bCourses at least one week before due date, unless specified otherwise. Homeworks are due on Tuesday in class, at the beginning of class, unless specified otherwise.

Labs

See *Lab Policies* document for further details.

- 125 Cory Hall
- Roy
  - Wednesday, 4:00 – 6:00 p.m.
  - Friday, 10:00 a.m. – 12:00 p.m.
- Cameron
  - Monday, 3:00 – 5:00 p.m.
  - Wednesday, 1:00 – 3:00 p.m.

The labs will work as follows. Labs will be done in groups of three; each group needs to submit only one lab report. Reports will be submitted online through bCourses. Most labs have a Pre-lab assignment. Due to limited lab hours, please come to the lab session with the Pre-labs completed.

Due to the large course size, there will be more groups than available stations. In each lab section, equipment time will be divided into 2 1-hour sessions. The TAs will assign time slots for their lab sections on a rotating basis. If you have any questions about equipment scheduling, feel free to email your TAs. Generally, Roy will attend the later Wednesday and Friday sessions and Cameron will attend the Monday and early Wednesday sessions.

Grading

- Homework, 20%
- Lab, 30%
- Midterm, 20%
- Final, 30%

Text

N.S. Nise, *Control Systems Engineering*, 6th edition, Wiley, 2010

Course resources

All course resources will be made available on bCourses. If you are enrolled in the class, but for some reason do not have access to the bCourses site, please let us know as soon as possible.

Recommended software

MATLAB & Simulink Student Version

- Check UC Berkeley Software Central: `http://ist.berkeley.edu/software-central/`
- Available in lab

Course schedule

Week 1	Aug. 25 – Aug. 29	
Th. lec.	Ch. 1	Overview, intro. to FB control, dynamic models
Reading	Ch. 1	Overview, intro. to FB control, dynamic models
	Ch. 2	Modeling in the frequency domain
Week 2	Sep. 1 – Sep. 5	
Mo.		*Labor Day*
Tu. lec.	Ch. 1	Overview, intro. to FB control, dynamic models
Th. evening lec.	Ch. 1	Overview, intro. to FB control, dynamic models
Th. lec.	Ch. 2	Modeling in the frequency domain
Reading	Ch. 1	Overview, intro. to FB control, dynamic models
	Ch. 2	Modeling in the frequency domain
HW	HW 1	
Week 3	Sep. 8 – Sep. 12	
Tu. lec.	Ch. 3	Modeling in the time domain
Th. lec.	Ch. 4	Time response
Th. evening lec.	Ch. 4	Time response
Mo. lab	Lab 1	Modeling & Simulation in MATLAB / Simulink
We. lab	Lab 1	Modeling & Simulation in MATLAB / Simulink
We. lab	Lab 1	Modeling & Simulation in MATLAB / Simulink
Fr. lab	Lab 1	Modeling & Simulation in MATLAB / Simulink
Reading	Ch. 3	Modeling in the time domain
	Ch. 4	Time response
HW	HW 2	
Week 4	Sep. 15 – Sept. 19	
Tu. lec.	Ch. 6	Stability
Th. lec.	Ch. 7	Steady-state errors
Mo. lab	Lab 2	Basic concepts in control system design
We. lab	Lab 2	Basic concepts in control system design
We. lab	Lab 2	Basic concepts in control system design
Fr. lab	Lab 2	Basic concepts in control system design
Reading	Ch. 8	Root locus techniques
HW	HW 3	
Week 5	Sep. 22 – Sep. 26	
Tu. lec.	Ch. 7	Steady-state errors
Th. lec.	Ch. 8	Root locus techniques
Mo. lab	Lab 3	Quanser hardware & proportional control
We. lab	Lab 3	Quanser hardware & proportional control
We. lab	Lab 3	Quanser hardware & proportional control
Fr. lab	Lab 3	Quanser hardware & proportional control
Reading	Ch. 9	Design via root locus
	Ch. 10	Frequency response techniques
HW	HW 4	

Week 6	Sep. 29 – Oct. 3	
Tu. lec.	Ch. 9	Design via root locus
Th. lec.	Ch. 10	Frequency response techniques
Reading	Ch. 10	Frequency response techniques
HW	HW 5	
Week 7	Oct. 6 – Oct. 10	
Tu. lec.	Ch. 9	Frequency response techniques
Th. lec.	Ch. 10	Frequency response techniques
Mo. lab	Lab 4	Model-based position control of a cart
We. lab	Lab 4	Model-based position control of a cart
We. lab	Lab 4	Model-based position control of a cart
Fr. lab	Lab 4	Model-based position control of a cart
Reading	Ch. 11	Design via frequency response
HW	HW 6	
Week 8	Oct. 13 – Oct. 17	
Tu. lec.	Midterm Review	
Th. lec.	Midterm Review	
Th. evening	Midterm	
Week 9	Oct. 20 – Oct. 24	
Tu. lec.	Ch. 11	Design via frequency response
Th. lec.	Ch. 11	Design via frequency response
Mo. lab	Lab 5a	Magnetic levitation
We. lab	Lab 5a	Magnetic levitation
We. lab	Lab 5a	Magnetic levitation
Fr. lab	Lab 5a	Magnetic levitation
Reading	Ch. 11	Design via frequency response
	Ch. 12	Design via state space
HW	HW 7	
Week 10	Oct. 27 – Oct. 31	
Tu. lec.	Ch. 12	Design via state space
Th. lec.	Ch. 12	Design via state space
Mo. lab	Lab 5b	Magnetic levitation
We. lab	Lab 5b	Magnetic levitation
We. lab	Lab 5b	Magnetic levitation
Fr. lab	Lab 5b	Magnetic levitation
Reading	Ch. 12	Design via state space
	Ch. 13	Digital control systems
HW	HW 8	

Week 11	Nov. 3 – Nov. 7	
Tu. lec.	Ch. 12	Design via state space
Th. lec.	Ch. 13	Digital control systems
Mo. lab	Lab 6a	Pole placement for the inverted pendulum
We. lab	Lab 6a	Pole placement for the inverted pendulum
We. lab	Lab 6a	Pole placement for the inverted pendulum
Fr. lab	Lab 6a	Pole placement for the inverted pendulum
Reading	Ch. 13	Digital control systems
HW	HW 9	
Week 12	Nov. 10 – Nov. 14	
Tu.		*Veteran's Day*
Tu. lec.	Ch. 13	Digital control systems *(date and time t.b.d.)*
Th. lec.	Ch. 13	Digital control systems
We. lab	Lab 6b	Luenberger observer design for inverted pendulum
We. lab	Lab 6b	Luenberger observer design for inverted pendulum
Fr. lab	Lab 6b	Luenberger observer design for inverted pendulum
Reading		
HW	HW 10	
Week 13	Nov. 17 – Nov. 21	
Tu. lec.	LQR	Linear quadratic regulator
Th. lec.	LQR	Linear quadratic regulator
Mo. lab	Lab 6b	Luenberger observer design for inverted pendulum
We. lab	Lab 6c	LQR controller design for inverted pendulum
We. lab	Lab 6c	LQR controller design for inverted pendulum
Fr. lab	Lab 6c	LQR controller design for inverted pendulum
Reading		
HW	HW 11	
Week 14	Nov. 24 – Nov. 28	
Tu. lec.	PID	PID controller
Mo. lab	Lab 6c	LQR controller design for inverted pendulum
Th.		*Thanksgiving*
Reading		
Week 15	Dec. 1 – Dec. 5	
Tu. lec.	Filters & KF	LP, HP, EWMA, KF, EKF
Th. lec.	Filters & KF	LP, HP, EWMA, KF, EKF
Mo. lab	Lab 6d	Self-erecting inverted pendulum
We. lab	Lab 6d	Self-erecting inverted pendulum
We. lab	Lab 6d	Self-erecting inverted pendulum
Fr. lab	Lab 6d	Self-erecting inverted pendulum
Reading		
Week 16	Dec. 8 – Dec. 12 (RRR)	
Tu. lec.	Final review	
Th. lec.	Final review	
Week 17	Dec. 19	
Fr.	Final	7:00 – 10:00 p.m.