

Tsinghua Berkeley Shenzhen Institute (TBSI)
Institute of Data and Information
UC Berkeley - Department of Mechanical Engineering

System Miscellanies - 86000742

ME 233: Advanced Control Systems II

Spring 2024

URL: <http://web.learning.berkeley.edu/>

Instructor	Roberto Horowitz	
	Office Hours:	F 1:00-2:30
	Office:	1206 Information Sciences Building
	Email:	horowitz@berkeley.edu
Teaching Assistant	Quin Lou	
Lectures	F 8:00-10:30	811 Information Sciences Building
Discussion	TBD	
Grading Scheme	Midterm 1	30%
	Final Exam	40%
	Homework	30%
Main Text	X. Chen and M. Tomizuka, <i>Introduction to Modern Controls</i>	
Class Notes	ME233 PowerPoint Lectures	
(available in website)	ME233 Class Notes by M. Tomizuka, Part I	
	Other Class Notes	

Tentative Schedule (Subject to change):

Week	Topics
Probability, Estimation and Stochastic Control	
1	Probability Theory—Sample Space, Random Variable, Cumulative Distribution and Probability Density Functions
2	Probability Theory—Random Process, Correlation Function, Spectral Density
3	Least Squares Estimation; Stochastic State Estimation (Kalman Filter)
4	Kalman Filter (continued)
5	Properties of the Kalman Filter
6	Dynamic Programming; Discrete-Time LQ problem; Properties of LQ Systems—Return Difference Equality, Robustness, Closed-Loop Eigenvalues and Symmetric Root Locus
7	Linear Stochastic Control (Linear Quadratic Gaussian (LQG) Control)
Midterm Examination I	
Mechanical System Motion Control Design Techniques	
8	Disturbance Observer
9	Tracking Control; Feedforward Control
10	Labor Holiday
11	Review

Announcements, Resources, etc

Announcements, homework assignments, solutions, and course material will be posted on web learning. The class email list is also controlled through web learning, so please be sure you have access to web learning. Please check the course website frequently for updates.

Ed Discussion

We can also use Web learning as the primary means for answering your questions online. Please post questions you may have about lecture material or homework to Web learning instead of emailing GSIs. The GSIs will monitor the website on a regular basis and we all try our best to answer your questions in a promptly manner. We also rely on you (the students) to help answer questions among yourselves, but please do this in such a way as not to give out the final answer to the homework problem.

You can access Web learning through the ME233 Course page in web learning (bottom of the left side directory column).

Homework 30%

Homework is very important. It is the best way to learn the theory material.

Homework will be posted on web learning on Fridays and will be due on 11:59 pm sharp on the Sunday of the following week.

We will be using Web learning to assign and submit homework. You will receive a link via your Berkeley email. Email the GSI's if you have any issues getting to the ME 233 Web learning website. For help scanning and submitting homework:

Homework solutions will be posted on web learning after the due date or a few days.

Exams - 70% midterm 30%, Final 40%

There are two exams: one midterm and one final. The tentative dates of the midterms are listed above. The two midterms will be conducted during lecture time. The final exam will have a duration of three hours. All three exams will be closed book, closed notes. You will be allowed to bring cheat sheets. The number of cheat sheets will increase with each exam as you will be allowed to bring the cheat sheets from the previous exams. You may bring a calculator.

Main Text:

- Xu Chen and Masayoshi Tomizuka, *Introduction to Modern Controls*, this book will be distributed as PDF file in web learning website

References:**Probability**

- D. P. Bertsekas, *Introduction to Probability*, Athena Scientific
- R.D. Yates and D.J. Goodman, *Probability and Stochastic Processes*, second edition, Willey.
- K. Poolla, *Probability Notes*. The PDF file can be downloaded from the ME233 website
- J. Walran, *EECS126 class notes*. The PDF file can be downloaded from the ME233 website

Linear Quadratic Optimal Control

- B.D.O. Anderson and J.B. Moore, *Optimal Control: Linear Quadratic Methods*, Dover Books on Engineering (paperback), 2007. A PDF can be downloaded from: <http://users.rsise.anu.edu.au/%7Ejohn/papers/index.html>
- Frank L. Lewis, Vassilis L. Syrmos, *Optimal Control*, Wiley-IEEE, 1995.
- E. Bryson and Y-C. Ho, *Applied Optimal Control: Optimization, Estimation, and Control*, Wiley

Stochastic Control Theory and Optimal Filtering

- R. Grover Brown and P. Hwang, *Introduction to Random Signals and Applied Kalman Filtering*, Third Edition, Willey
- Frank L. Lewis, L. Xie and D. Popa, *Optimal and Robust Estimation*, Second Edition CRC
- M. Grewal and A. Andrews, *Kalman Filter, Theory and Practice*, Prentice Hall
- B.D.O. Anderson and J.B. Moore, *Optimal Filtering*, Dover Books on Engineering (paperback), New York, 2005. A PDF can be downloaded from: <http://users.rsise.anu.edu.au/%7Ejohn/papers/index.html>
- K.J. Astrom, *Introduction to Stochastic Control Theory*, Dover Books on Engineering (paperback), New York, 2006.