MECH468 Modern Control Engineering
MECH522 Foundations in Control Engineering
Syllabus

1st semester, 2016/17. MonWedFri, 9-9:50am, CEME 1215.

Instructor Information

Instructor	Email	Office Location & Hours
Dr. Ryozo Nagamune	nagamune@mech.ubc.ca	Kaiser 3104, by appointment

General Information

Course Description and Goals

This course is an introductory course on linear control systems based on the state-space models. The main goal of the course is to provide students with basic tools in modeling, analysis and design for control and estimation. The analysis in this course includes stability, controllability, observability, realization and minimality of the state-space model, while the design methods are divided into pole placement for state feedback and observer design, and optimal methods such as linear quadratic regulator, Kalman filter and linear quadratic Gaussian control. Students will also learn how to apply the theory to engineering problems with MATLAB. The course will cover both continuous-time and discrete-time systems, as well as both time-invariant and time-varying systems. Simple examples from mechanical and electrical engineering will be used to show the applicability of the theory.

This course will give the basic knowledge for advanced control courses, such as nonlinear control, robust control, optimal control, adaptive control, digital control, sampled-data control, hybrid control, and system identification.

Course Materials

Required Textbooks

None. Lecture notes and slides will be provided.

Optional Textbooks

Linear System Theory and Design (4th Edition) Oxford University Press, 2012, Chi-Tsong Chen

Linear State-Space Control Systems Wiley, 2007, Robert L. Williams II and Douglas A. Lawrence

A Linear Systems Primer Birkhauser, Boston, 2007, Panos J. Antsaklis and Anthony N. Michel

Control System Design: An Introduction to State-Space Methods Dover Publications, 2005, Bernard Friedland

Modern Control Theory Prentice Hall, 1991, William L. Brogan

Optimal State Estimation John Wiley & Sons, 2006, Dan Simon

Optimal Filtering Dover Publications, 2005, Brian D. O. Anderson and John B. Moore

Optimal Control and Estimation Dover Publications, 1994, Robert F.Stengel

Course Schedule

Week	Topic	Homework
1-2	Introduction, State space model, linearization, discretization	HW1
3	BIBO stability, Internal stability, Lyapunov Theorem	
4-5	Controllability, observability, Kalman decomposition	HW2
6	Realization, Minimal realization	HW3
7-8	State feedback control, observer, observer-based control	HW4
9-10	Linear quadratic regulator, Kalman filter	HW5
11-12	Project presentation	

Exam Schedule (tentative)

Date	Subject
October 17 (Monday)	Midterm (Topics to be covered will be announced later.)
December (TBD)	Final (All topics may be covered.)

Additional Information and Resources

Exam Policies

- Open-book. Calculators are not allowed.
- Alternative exams can be arranged ONLY for medical reasons and with doctor's notes. For other reasons, talk with the instructor BEFORE the exam dates.

Project (Only for students taking MECH522)

Each student is required to formulate a realistic control problem (preferably related to his/her own research, or otherwise we can help), to do analysis and design for the problem using the course material, to analyze the designed controller in simulation (and in implementation if possible), to give a seminar, and to submit a report. The project should show the usefulness and/or the limitation of linear control systems theory.

Grading Scheme (Tentative. The instructor reserves the right to change the scheme.)

MECH468 (3 credits): Homework 10%, Midterm 20%, Final 70%

MECH522 (4 credits): Homework 10%, Midterm 20%, Final 50%, Project 20%

Remark: To pass the course, students MUST take both midterm and final exams.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences. Link to the relevant Calendar section: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0