Fall
2019

SCUPI
Sichuan University - Pittsburgh Institute

MEMS 1045 Automatic Control

(Modifications to this syllabus may be required during the semester. Any changes to the syllabus will be posted on the course website and announced in class)

Instructor:	Qi (Michael) Lu, Ph.D.
Office:	Zone 4-218
Email:	qi.lu@scupi.cn
Lecture time/room:	Mon: 08:15 - 11:00 AM/Zone 4-204
Office hours:	Tue: 4:00 - 06:00 PM Thu: 4:00 - 06:00 PM or by appointment
Teaching assistant (TA):	Xiaolong Shen (xiaolong_shen@qq.com)
TA office hours/room:	Wed: 4:30 - 5:30 PM/Zone 3-323

Note: when emailing the instructor or the teaching assistant, please

- Include the course number, your name and your student number in the subject field of your message;
- And use your university email account.

Catalog Description:

Introduction to analysis and design of control systems, including applications to electromechanical systems. Students learn how characteristics such as stability, transient response, and steady-state error may be changed through dynamic compensation. Students become familiar with classical analysis and design tools in the context of single-input, single-output, linear time-invariant systems. (3 credit hours)

Course Objective:

At the completion of this course, students will be able to

- Understand the benefits of feedback
- Obtain and use transfer function to model dynamical systems
- Assemble complex systems using block diagrams
- Analyze stability of dynamical system
- Quantify system performance
- Design control systems for closed-loop stability and performance
- Understand PID control

Prerequisites:

MEMS-1015 Rigid-Body Dynamics, MEMS-1014 Dynamic Systems, or the permission from instructor.

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Textbook:

N. S. Nise, Control System Engineering, 7th edition, Wiley, 2015.

Website: https://learn.scupi.cn/

Topics Covered:

Linear dynamic systems (differential equations, state space equations), dynamic response (convolution, Laplace transform, transfer functions, eigenvalues, poles and zeros, frequency domain, Bode and Nyquist plot), basic properties of feedforward and feedback control (disturbance reduction, stability, Routh-Hurwitz, PID controller), methods for designing a stabilizing feedback controller (PID control for 2nd order systems, root locus and frequency response loop shaping), and some practical aspects when implementing control.

Tentative Course Schedule:

Week	Chapter	Topic
1 (Sept. 2)	Chapter 1	Introduction; Course Organization; Illustration of Topics;
2 (Sept. 9)	Chapter 2	Dynamic Models; Differential Equations; Review of Laplace Transform;
3 (Sept. 16)	Chapter 2 Chapter 5	Transfer Functions; Block Diagrams; Block Reduction;
4 (Sept. 23)	Chapter 3 Chapter 4	State Space Model; Dynamic Response; Inverse Laplace Transform;
5 (Sept. 30)	Chapter 6	Stability of Linear Dynamic Models; Routh-Hurwitz Criterion;
6 (Oct. 1-7)		National Holiday;
7 (Oct. 14)		Midterm Exam I
8 (Oct. 21)	Chapter 4	Second Order System; Rise, Settling, Peak and Overshoot;
9 (Oct. 28)	Chapter 7	Steady-State Error Analysis; System Type;
10 (Nov. 4)	Chapter 7	Design of P, PI and PID Controller;
11 (Nov. 11)	Chapter 8	Root Locus Techniques;
12 (Nov. 18)		Midterm Exam II

13 (Nov. 25)	Chapter 9	Pole Placement Design;
14 (Dec. 2)	Chapter 10	Frequency Response Analysis;
15 (Dec. 9)	Chapter 10	Bode Plots;
16 (Dec. 16)	Chapter 10	Nyquist Plot; Nyquist Stability Criterion;
17 (Dec. 23)		Research Project Presentation & Review
18		Final Exam

Course Gradings:

- Homework 20 %
- Midterm exam I 20 %
- Midterm exam II 20 %
- Final exam 40 %
- Research project (optional) 10 % (extra credit)

Grading Scale:

While grades may be curved, there is no guarantee of any curve. However, in order to receive a grade of D or better, a student will have to reach 60 % of the total possible points. The grading scale is

A+ ⩾ 95% A ⩾ 90% A- ⩾ 85% B+ ⩾ 80% B ⩾ 76% B- ⩾ 73%
C+ ⩾ 70% C ⩾ 66% C- ⩾ 63% D+ ⩾ 61% D ⩾ 60% F < 60%

Class Policies:

- On-time attendance at all class activities is expected. Student is responsible for any material that was covered, and any changes to the exam dates and homework assignments announced in class.
- In general, no late homework assignments or make up exams will not be accepted. If you have a serious conflict with an exam schedule, you must discuss it with the instructor and **take the exam early**. Failure to contact the instructor prior to the exam or assignment due date will result in **a zero** on that exam/assignment. Exams missed due to a serious illness or a family emergency (these must be documented) will be dealt with on a case-by-case basis according to the University Policy.
- Any questions regarding the grading discrepancy should be brought up within a week of returning the homework or exam.
- "Violations of academic integrity include, but are not limited to, cheating, plagiarism, or misrepresentation in oral or written form. Such violations will be dealt with severely, in accordance with University policy.