

ECE 602: Lumped System Theory

Fall 2018

When and where: TTh 1:30-2:45pm, Wang 2579.

Instructor: *Jianghai Hu*. **Office:** MSEE 220. **Phone:** 496-2395.

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Office hours: Tuesday 11am-12:00pm (or send e-mail for appointments).

Course Materials

- **Class Notes:** These will be the primary materials for this course. They will be uploaded to Blackboard the day prior to the class
You are expected to print them and bring them to class by yourself.
- **Additional References:** Besides class notes, you may find the following sources useful for more detailed discussions, different perspectives, additional exercise problems, advanced topics, etc.
 - *Linear System Theory and Design, 3rd Edition*, Chi-Tsong Chen, Oxford University Press, 1999. ISBN 0-19-511777-8. Although it is the official designated textbook, having it is optional.
 - Parts of the class notes are derived from those by Prof. Stephen Boyd at Stanford:
 - EE 263: Introduction to Linear Dynamical Systems
 - EE 363: Linear Dynamical Systems
 - *Linear System Theory*, F. M. Callier and C. A. Desoer, Springer-Verlag, 1991.
 - *Linear Systems*, T. Kailath, Prentice Hall, 1980.
 - *Linear System Theory*, W. J. Rugh, Prentice-Hall, 1996.

Prerequisite:

- Knowledge of Laplace transform, ordinary differential equations (e.g. ECE 202).
- Knowledge of undergraduate feedback control (e.g. ECE 382) is not strictly needed for most of topics, but will definitely increase appreciation of some of the topics covered.
- Knowledge of linear algebra (MATH 511, for example) is **needed**. Although officially MATH 511 is listed as a co-prerequisite of this course, in practice, students who took them in the same semester often found it challenging as the pace of the two courses may not be fully synchronized. Some references that can help you freshen up on linear algebra include:
 - *Linear Algebra and Its Applications*, 4th ed., G. Strang, 2006.
 - *Introduction to Linear Algebra*, 4th ed., G. Strang, Wellesley-Cambridge Press, 2009.

Some basic facts of linear algebra will also be reviewed in this course (though only briefly).

- Access to Matlab for solving homework problems.

Online Course Access:

- Blackboard is the main portal for this course. Consult it for up-to-date information including handouts, homework/exams and solutions, as well as other announcements.
- This course is also available on Piazza.com: piazza.com/purdue/fall2018/ece602/home. Students can ask course related questions, answer other students' questions, and collaborate on answers. The instructor will also provide answers or endorse existing answers.
- The recorded lectures can be accessed at <https://engineering.purdue.edu/ProEd/OnCampus> from on-campus IP addresses, with Course Login ID Number 9999975016, and Course "ECE60200".

Grading:

- **Homework:** 20%

Homework is assigned approximately biweekly and may involve Matlab programming. Homework is collected in class for on-campus students and online via Blackboard for distance learning students.

Late homework will **not** be accepted. I will try as much as possible to return graded homework within one week after collection. You are strongly advised to solve independently as many of the homework problems as you can. This will serve you well come exam time.

- **Midterms:** 40% (each 20%)

There will be two midterms, tentatively scheduled as follows:

- Midterm 1: Oct. 2, Tuesday
- Midterm 2: Nov. 15, Thursday

- **Final exam:** 39.5%

The final exam schedule will be released approximately one month into the semester.

For both the midterms and the final, you are allowed to bring a letter-size single-side scribe sheet and a non-graphing calculator, but nothing else, to the exam.

- **Completing the course survey:** 0.5%

You will be given the credit if you complete the course survey by the time it closes (typically the weekend the classes end).

Catalog Description of Courses:

An investigation of the basic theory and techniques of modern system theory, emphasizing linear state model formulations of continuous and discrete time systems in the time domain and frequency domain. Coverage includes notions of linearity, time invariance, discrete and continuous time state models, canonical forms, associated transfer functions and impulse response models, the state transition matrix, the Jordan form, controllability, observability, and stability.

Lecture Schedule:

Topics	Number of lectures (estimated)
Systems and state variables	1
State-space models of lumped linear systems	2
Linear algebra review	1
Functions of square matrices	1
Matrix exponential	2
Solution of linear time-invariant systems	2
Solution of linear time-varying systems	1
Stability	2
Lumped nonlinear systems	1
Quadratic forms and singular value decomposition	1
Controllability	2
Observability	2
Minimality, BIBO stability and canonical forms	1
State feedback control	2
Output feedback observer	2
Linear quadratic regulation	3
Model order reduction	1

Campus Emergency:

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. In such an event, notification will be provided in class and through Blackboard. Additional information is available from the following link: http://www.purdue.edu/epps/emergency_preparedness/index.html.

Academic Misconduct:

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

Incidents of academic misconduct in this course will be addressed by the course instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a failing or zero grade for that particular assignment, and at the instructors discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered.

Purdues Honor Pledge: As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue.

Accessibility and Accommodations:

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. <http://www.purdue.edu/drc/faculty/syllabus.html>.