

## SE424: State-Space Methods for Control Design and Analysis

<b>Time &amp; Place:</b>	MWF 3:00pm–4:00pm 114 Transportation Building
<b>Instructor:</b>	Jeff Shamma jshamma@illinois.edu DCL 3251
<b>Office Hours:</b>	Tuesday 1:00pm–2:00pm
<b>TAs:</b>	Aya Hamed (ayah2@illinois.edu) Sarah Toonsi (stoonsi2@illinois.edu)
<b>TA Office Hours:</b>	TBD
<b>Texts (free online):</b>	Hespanha, <i>Linear Systems Theory</i> <a href="#">link</a> Astrom & Murray, <i>Feedback Systems</i> <a href="#">link</a>
<b>Grading:</b>	Assignments, 20%; Midterm Exams (2x), 25% each; Final Exam, 30%.
<b>Homework policies:</b>	<ul style="list-style-type: none"><li>• Assignments are a combination of analytical problems and computational problems.</li><li>• A random subset of analytical problems will be chosen for grading. All computational problems will be graded.</li><li>• Computational assignments are to be completed using MATLAB</li><li>• Assignment due dates can be flexible with prior agreement from instructor.</li><li>• Assignments may be discussed with other students. However, students are expected to submit <b>independent write-ups</b> and <b>independent code</b> for computational assignments. Assignments will be checked for similarity.</li></ul>
<b>Important dates:</b>	
Friday, February 21	Midterm #1 (during class)
Wednesday, April 2	Midterm #2 (during class)
Monday, May 12	Final exam, 8:00am–10:00am (two hours)
<i>also</i>	
Friday, April 4	Engineering Open House (no class)
<b>Modifications:</b>	The instructor reserves the right to modify any and all parts of this syllabus throughout the semester. Any modifications will be announced to the students and posted on Canvas.

## Course Outline

- **Mathematical modeling**
  - First order ODEs
  - Linearization
  - Interconnections
- **Linear ODE solutions**
  - Matrix exponential
  - Convolution
  - Stability
- **State feedback**
  - Controllability
  - Stabilization
- **Output feedback**
  - Observability
  - State observers
  - Observe-based stabilization
- **Time permitting**
  - Frequency domain
  - Input/output stability
  - Lyapunov stability
  - Optimal control

## Campus Policies

**Covid:** Please visit: <https://covid19.illinois.edu/>

**Emergency Response Recommendations:** Emergency response recommendations can be found at the following website:

<http://police.illinois.edu/em/>

You are encouraged to review this website and the campus building floor plans website within the first 10 days of class:

<http://police.illinois.edu/em/building-emergency-action-plans/>

**Academic Integrity:** Students are expected to adhere to the Student Code:

<http://studentcode.illinois.edu>

and in particular, *Article 1, Part 4: Academic Integrity and Procedure*.

Academic dishonesty will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (<https://studentcode.illinois.edu/article1/part4/1-404/>). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code: <https://studentcode.illinois.edu/article1/part4/1-401/>. As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at <https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/>. Ignorance of these policies is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

In this course you are expected to produce your own work in all assignments.

**Religious Observances:** In the case of missed activity for religious observations, please visit:

<https://odos.illinois.edu/resources/students/religious-observances>

Please make requests for accommodations as early as possible in the semester.

**Privacy & FERPA:** Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See

<https://registrar.illinois.edu/academic-records/ferpa/>

for more information on FERPA.

**Accommodations:** To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the as soon as possible. To ensure that disability-related

concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should contact Disability Resources and Educational Services (DRES) and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail [disability@illinois.edu](mailto:disability@illinois.edu). For more information, please visit:

<http://www.disability.illinois.edu/>

**Misconduct Reporting:** The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here:

<http://wecare.illinois.edu/resources/students/#confidential>

Other information about resources and reporting is available here:

<http://wecare.illinois.edu>