Instructor: Zak M. Kassas

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Course Webpage: Available through iLearn
Office Hours: Tue., 3:30 pm – 5:30 pm, and by appointment
Teaching Assistant: Habib Gharavi, hghar002@ucr.edu
TA Office Hours: Mon. 2 pm – 3 pm, Wed. 4:30 pm – 5:30 pm, WCH 109

Lectures: Tue. & Thu., 11:10 am – 12:30 pm, WCH 142
Discussions: Mon., 9:10 am – 10:00 am, WCH 142


Suggested References:

Prerequisites: EE132: Automatic Control

Course Objective: This course develops an understanding of the mathematical tools and fundamental concepts of linear systems. The topics covered include: advanced linear algebra, solutions of state equations, system stability, controllability and observability, system realization, state feedback and observers, and an introduction to optimal control and estimation.

Homework Assignments: Homework assignments will be assigned on a regular basis and will be due at the beginning of the lecture. Late submissions will not be accepted (unless it is the result of an officially excused absence). You may discuss homework problems with other students, but you are not allowed to copy from others. If you decide to discuss your solutions with other student(s), you must provide the name(s) of the student(s) with whom you have worked. University disciplinary procedure will be invoked if any form of cheating is detected. The lowest homework assignment grade will be dropped.

Exams: There will be one midterm exam and a final. Missed exams may not be made up (unless it is the result of an officially excused absence).

Project: There will be a final project, which integrates many of the topics introduced in the course. The project will require the use of computer-aided control system design tools (e.g., MATLAB and LabVIEW).

Attendance and Course Policy: Attendance is expected. You are responsible for material covered in class and in the reading assignments.
Grading:

Homework Assignments 15%
Project 10%
Midterm Exam 35%
Final Exam 40%

Final Grade Assignment:

A+: ≥ 97%, A: ≥ 93%, A−: ≥ 90%, B+: ≥ 87%, B: ≥ 83%, B−: ≥ 80%, C+: ≥ 77%,
C: ≥ 73%, C−: ≥ 70%, D+: ≥ 67%, D: ≥ 63%, D−: ≥ 60%, F: < 60%

Tentative Topical Coverage:

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10/02</td>
<td>Models of Linear Systems: State space, transfer functions, linearization</td>
<td>1</td>
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<tr>
<td>2</td>
<td>10/07, 10/09</td>
<td>Vectors and Vector Spaces: Definitions, linear independence, basis, rank, inner products, norms, orthonormalization, projection theorem</td>
<td>2</td>
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<tr>
<td>3</td>
<td>10/14, 10/16</td>
<td>Linear Operators on Vector Spaces: Definitions, range and null spaces, simultaneous linear equations</td>
<td>3</td>
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<tr>
<td>4</td>
<td>10/21, 10/23</td>
<td>Eigenvalues and Eigenvectors: Definitions, Jordan canonical forms, singular value decomposition</td>
<td>4</td>
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<td>5</td>
<td>10/28, 10/30</td>
<td>Functions of Vectors and Matrices: Linear functionals, quadratic forms, functions of matrices, Cayley-Hamilton theorem</td>
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<td>Solutions to State Equations: Time-invariant systems, homogeneous systems, time-varying systems, discrete-time systems</td>
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<td>7</td>
<td>11/13</td>
<td>Midterm</td>
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<tr>
<td>8</td>
<td>11/18, 11/20</td>
<td>Controllability and Observability: Definitions, controllability &amp; observability of time-invariant systems, Kalman decomposition, controllability &amp; observability of time-varying systems, controllability &amp; observability of discrete-time systems</td>
<td>8</td>
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<tr>
<td>9</td>
<td>11/25</td>
<td>System Realization: Minimal realizations, canonical realizations, balanced realizations</td>
<td>9</td>
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<tr>
<td>10</td>
<td>12/02, 12/04</td>
<td>State Feedback and Observers: State feedback for SISO systems, observers, separation principle</td>
<td>10</td>
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<td>11</td>
<td>12/09, 12/11</td>
<td>Introduction to Optimal Control and Estimation: Linear quadratic regulator, Kalman filter</td>
<td>11</td>
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<tr>
<td>12</td>
<td>12/19</td>
<td>Final Exam</td>
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