ECE 762/862 - Digital Control Systems:  
Topics on Estimation, Kalman Filtering and Optimal Control  
Old Dominion University  
Department of Electrical & Computer Engineering

COURSE INFORMATION  
Spring 2013

Instructor: Oscar R. González  
Kaufman Hall Rm. 231-H  
Phone: 757-683-4966  Dept.: 757-683-3741  
Fax: 757-683-3220  
e-mail: gonzalez@ece.odu.edu


Office Hours: TR 1:00 - 2:00, W 3:00-4:00, and by appointment

Textbooks:  

Software:  
Matlab

Prerequisites:  
To begin this course you should be proficient in the following topics:

1. Linear algebra and matrix operations  
2. Laplace transform operations and properties.  
3. Introduction to state-space system representations and analysis.  
4. Probability and random variables

Grading Policy:  
The final course grades will be determined from the students’ performance on the examinations, course project, and problem sets, according to the following percentages:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Problem Sets</td>
<td>35%</td>
</tr>
<tr>
<td>Online participation</td>
<td>5%</td>
</tr>
<tr>
<td>Mid-Term Exam</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
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Mid-Term Exam: Wednesday, March 7, 2013  
Final Exam: Friday, May 2, 2013, 3:45 – 6:45 pm

Course Objective:  
This is a special topics course that will present the theoretical and numerical implementation foundation to solve estimation problems in control, navigation, and guidance problems. The course will present topics in mean square estimation, Kalman filtering, extended Kalman filtering, and discrete-time linear quadratic optimal control. Computer-aided simulation, analysis, and design techniques with Matlab and Simulink will be used extensively.

Honor System:  
The Honor System at Old Dominion University is based on individual integrity. In registering for ECE 762/862, you have agreed to adhere to the following Honor Pledge.

"I pledge to support the Honor System at Old Dominion University. I will refrain from any form of academic dishonesty or deception, such as cheating or plagiarism. I am aware that as a member of the academic community it is my responsibility to turn in all suspected violators of the Honor Code. I will report to an Honor Council hearing if summoned."
You must follow the Honor System principles in all the work you turn in, that is, the work you turn in must be yours. It is permitted to ask questions on problem statements and analytical approaches only while working in the problem sets.

Course Policies:

1. ECE 862 students can expect different problems and a higher expectations on their work.
2. Late problem sets will not be graded. It is encouraged that students work together. Not all the problems in a problem set may be graded.
3. Examinations must be taken at the scheduled times. Only valid excuses such as illness requiring a physician's care, death in the family, or court appearance will be accepted. Always notify me or the ECE department secretary at 683-3741 before the exam.
4. Reasonable accommodations are provided for students with disabilities. Students should present a letter from Disability Services as soon as possible.
5. The use of a computer-aided control system design package (CACSD) is required. It will be used in problem sets and in examinations. The CACSD package to be used is MATLAB. It will be used to analyze, design, and perform simulations.
6. Matlab's online pdf manuals and html help files are the best resource of information. In addition, the textbooks have some MATLAB examples and more examples will be introduced in the course. Matlab is available on campus and remotely via the Virtual Computing Lab (see Blackboard). A student version with the most current version is available from mathworks.com
7. Students need to use Blackboard to access the course materials.
8. An online discussion group using Piazza will be created for students to post questions and answer or edit responses to posted questions. This discussion group is the only way to ask questions outside of regular office hours. When in doubt about a question, it can be posted anonymously (only the instructor can see anonymous posts) and then converted to include the student’s name.

Preliminary Schedule:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lewis-Xie-Popa</th>
<th>Grewal-Andrews</th>
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<tbody>
<tr>
<td>Introduction and Review of Random Variables and Sequences</td>
<td></td>
<td>Chap. 1 and Secs. 3.1-3.3</td>
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<tr>
<td>Classical Estimation Theory Part 1</td>
<td>Secs. 1.1 – 1.4</td>
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<tr>
<td>Random Processes and Stochastic Systems</td>
<td>Sec. 2.2</td>
<td>Chap. 3</td>
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<tr>
<td>Classical Estimation Theory Part 2</td>
<td>Sec. 1.5</td>
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<tr>
<td>Discrete-time Kalman filter</td>
<td>Chap. 2</td>
<td>Chap. 1 and 4</td>
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<td>Kalman Filter Design and Implementation</td>
<td>Chap. 4</td>
<td>Chap. 6</td>
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<tr>
<td>Estimation of Nonlinear Systems</td>
<td>Chap. 5</td>
<td>Chap. 7</td>
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<tr>
<td>Stochastic Control</td>
<td>Sec. 9.3</td>
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