

Syllabus
MEEG 829 – Applied Nonlinear Control
Fall 2017

COURSE INFORMATION

Lecture:

TuTh 11:00–12:15, Gore 317

Instructor: Bert Tanner

Office: SPL 228
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Email: btanner@udel.edu
Office Hours: Wednesdays 9:30—11:00

Text: *Nonlinear Systems*, by Hassan K. Khalil. Prentice Hall, 2002, third edition.

Prerequisite Information: Formally none, but at least an entry-level linear systems course is strongly recommended. The course does require a basic foundation in calculus, topology, differential equations and linear algebra. Without them, you will be struggling.

Description: An introduction to nonlinear systems theory and control. Stability analysis will be based primarily on the Lyapunov framework. Some related basic feedback control design tools will be introduced. The course is mathematically oriented and intended for intermediate and senior graduate students. It aims at bringing the student at a level which is suitable for self-study of more advanced material. Most, if not all, course-related communication and material sharing, including class note handouts and occasional videos, will be done through Sakai.

Material to be Covered: Examples of nonlinear systems and qualitative behavior; fundamental properties of nonlinear ordinary differential equations; Lyapunov stability; advanced analysis methods; (some) nonlinear design tools.

Specific topics coverage plan:

- (Mechanical, when appropriate) nonlinear models
- Main differences in qualitative behavior between linear and nonlinear systems
- Existence and uniqueness of solutions
- Continuous dependence of solutions
- Comparison principle
- Stability of time-invariant systems
- Stability of time-varying systems
- Converse theorems
- Vanishing and nonvanishing perturbations, input-to-state stability
- Invariance-like theorems
- Special topics

Evaluation methods:

HOMEWORK (20%) is assigned on a weekly basis. Assignments are due one week after they are out, and are supposed to be submitted at *before* the lecture begins. Late homework is accepted at the expense of a 20% penalty for each additional day. Homework problems are selected from the textbook for the most part, with the intention to put in practice the material presented during the lecture.

MIDTERM EXAM (40%) which is to be scheduled close to (shortly before of after) the spring break. Exact date to be determined. It will be an in-class, open-book but closed notes exam. Students bring their own paper and calculators.

FINAL EXAM (40%) which is scheduled at the time and date specified by the University. No modifications on the time or date of the final exam can be made. Students bring their own paper and calculator.

Although attendance is not kept, **CLASS PARTICIPATION** is assessed. Failure to respond to class quizzes and completing course evaluations at the end of the term can result to a penalty of not more than the equivalent of completely missing a homework assignment.

Exams will be open book, closed notes. You will have to bring your own paper.

Grades It is always preferable to submit something than nothing at all, although the importance of thoughtful and complete presentation of any results is important. The instructor will not assume the correct answer on behalf of the student if this answer is incomplete or vague.

The mapping between numerical grades and the A – F scale is as follows.

A	96–100	A-	92–95	B+	88–91	B	84–87
B-	80–83	C+	76–79	C	72–75	C-	68–71
D+	64–67	D	60–63	D-	56–59	F	0–55

Further reading:

- S. Sastry, Nonlinear Systems: Analysis, Stability, and Control, Springer 1999.

- J.J Slotine and W. Li, Applied Nonlinear Control, Prentice Hall, 1991.

POLICIES

Working Together: Collaboration is accepted on homework, but solutions should be given based on individual justification and reasoning, which needs to be clear on your paper. Collaboration on exams is of course is forbidden.

Absences: You are expected to attend every class. It is not acceptable to give priority to assignment completion over class attendance. The 20% penalty on assignments thus applies also to the case where you choose to miss class in order to finish your assignment.

Plagiarism: Definition: <http://www.udel.edu/stuguide/06-07/code.html#honesty>
In this context, students are expected to present their own interpretation of other people's ideas and work. Summarizing and paraphrasing without proper citation and documentation¹ is unacceptable. The same applies to copying assignment solutions from manuals available online. The University's *minimum penalty* for cheating or plagiarism is *a failure in the course*. For the first time the transgression is noted, the assignment will not receive a grade. Repeated offenses may result to dismissal from the University.

Intellectual Property: No student may distribute notes, audio-visual or other material from the class, whether or not for a fee. If any UD student, whether enrolled in the class or not, distributes such material in contradiction of this prohibition, (s)he will be in violation of the Student Code of Conduct.

Disclosures of Instances of Sexual Misconduct If, at any time during this course, I happen to be made aware that a student may have been the victim of sexual misconduct (including sexual harassment, sexual violence, domestic/dating violence, or stalking), I am obligated by federal law to inform the university's Title IX Coordinator. The university needs to know information about such incidents to, not only offer resources, but to ensure a safe campus environment. The Title IX Coordinator will decide if the incident should be examined further. If such a situation is disclosed to me in class, in a paper assignment, or in office hours, I promise to protect your privacy—I will not disclose the incident to anyone but the Title IX Coordinator. For more information on Sexual Misconduct policies, where to get help, and reporting information please refer to www.udel.edu/sexualmisconduct. At UD, we

¹*Defining and Avoiding Plagiarism: The WPA Statement on Best Practices*, 2003. Online: <http://www.ilstu.edu/ddhesse/wpa/positions/WPAplagiarism.pdf> . Accessed August 29, 2006

provide 24 hour crisis assistance and victim advocacy and counseling. Contact 302-831-2226, Student Health Services, to get in touch with a sexual offense support advocate.