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Course Page:  http://www.mcs.sdsmt.edu/rhoever/Teaching/S10/652/


Lecture Hours:  9:00am - 10:00am MWF
Lecture Location:  MEP 342
Office Hours:  10:00 - 12:00 WF
Prerequisites:  Permission of instructor

Catalog Description:  The study of nonlinear and optimal systems using the phase plane method, describing functions, Lyapunov theory, nonlinear control systems design, linear, dynamic and integer programming, parameter optimization, and system optimization using calculus of variation.

Course topics:  (These topics may be changed/reorganized at the instructors discretion)

Introduction and Background:
A thorough review of linear algebra and differential equations.  Introduction to mathematical modeling and state space analysis of systems of ODEs.  Stability analysis of linear time invariant (LTI) systems, controllability and observability, linear state feedback, and state estimation.  Optimal control of linear systems using LQR and LQG techniques.

Introduction to Nonlinear Systems:
Existence and uniqueness of solutions to nonlinear differential equations.  Introduction to induced norms, signal spaces, continuity, and basic topology.  Determination and analysis of equilibrium points for nonlinear systems.

Stability Analysis:

Design Techniques:
Grading:

- Midterm Exam: 200
- Final Exam: 300
- Homework: 200
- Course Project: 300

Total: 1000

Grades will be assigned as follows (your total/1000): 100%-90% A, 89%-80% B, 79%-70% C, 69%-60% D, 59%-0% F.

Class Attendance: SDSM&T requires attendance in all classes. Excessive absence makes it difficult for students to achieve expected levels of performance.

Makeups: Makeup exams will be given ONLY if the student calls the instructor or the Math and Computer Science office at 394-2471 BEFORE the exam is scheduled to begin and has a legitimate reason. Leave your name, message and time of call on the answering machine if the office is closed. If you must miss a test for a legitimate reason, I will gladly give you a makeup. If you miss a test without a legitimate reason, you will be given a zero. Please do not be offended if I ask you for documentation for an excused absence.

Late Assignments: All assignments will be dropped a letter grade each day they are late.

Academic Integrity: In this course, each student is expected to do their own work. If you cheat on a test or assignment, you may fail the course. At the very least, you will get zero score on that test or assignment. See the document Policies and Procedures at: http://catalog.sdsmt.edu/academic-information/policies-and-procedures/.

Note that according to Policy Governing Academic Integrity in the SDSM&T Undergraduate Catalog, the instructor of record for this course has discretion of how acts of academic dishonesty are penalized, subject to the appeal process, and that Penalties may range from requiring the student to repeat the work in question to failure in the course. (pp. 62-63).

When working on homework or programming assignments, you may consult fellow students but you must DO YOUR OWN WORK AT ALL TIMES. This means that simply copying code from ANY outside reference (Internet, fellow students, etc.) and changing the variable names or structure of the execution will NOT be tolerated. Furthermore, all code written for this course MUST conform to the MCS department coding standard found at:

Electronic Devices Policy: Please turn off cell phones and pagers before class starts*. There is to be no text messaging, no accessing email, no use of audio players and no head- phone use during class. Mute the speakers of any laptops/PDAs used in class. No use of any other electronic or computer device is allowed during class time.
*This class enforces the "Cell phone rings, you bring cookies" rule. If your phone rings during class, you are required to bring cookies or similar snack for the entire class at the next class meeting.

**Freedom in Learning:** Students are responsible for learning the content of any course of study in which they are enrolled. Under Board of Regents and University policy, student academic performance shall be evaluated solely on an academic basis and students should be free to take reasoned exception to the data or views offered in any course of study. Students who believe that an academic evaluation is unrelated to academic standards but is related instead to judgment of their personal opinion or conduct should contact the dean of the college which offers the class to initiate a review of the evaluation.

**Special Needs:** Students with special needs or requiring special accommodations should contact the instructor (Dr. Hoover at 394-2470) and or the campus ADA coordinator (Ms. Jolie McCoy at 394 1924) at the earliest opportunity.

**Course Project**

Because this is a graduate level course, you will be expected to perform research in addition to coursework. Therefore, you will be required to choose a system to analyze throughout the semester. You will need to find at least two peer reviewed technical papers related to your system and analyze both papers in detail (you will most likely have to read them several times to digest everything). You will be required to apply all the techniques learned throughout the course to model your system, analyze your system, and design a controller (both linear and nonlinear) for your system. You should compare and contrast the linear controller design against its nonlinear counterpart. You will be required to write a technical report to accompany your analysis and design (the ultimate goal here would be to publish your work at a conference or Journal but this is not a requirement). You will also be required to present your design and analysis to your peers at the end of the semester. You should plan a 5-7 minute presentation that outlines what was done with your design (this is typical for a conference presentation). We will discuss this further as time progresses!!!