MATH 731: Dynamical Systems II

Instructor: Stephen L. Campbell

Information concerning the course will be posted here throughout the semester.

MA 731 uses some ideas from MA 531 at the beginning. After that MA 731 is a largely self-contained course. MA 531 is listed as a prerequisite for MA 731 but over the years a number of students have taken MA 731 without MA 531 and done well as long as they have some comfort with differential equations.

Class meets **10:15 - 11:30 TuTh** in Daniels 232.

Texts: We will use two texts. One is *Linear Systems*, by Panos J. Antsaklis and Anthony N. Michel. This was the MA 531 text. It is only used a few times for reference. You do not need to purchase this book. We will make considerable use of *Optimal Control (Third Edition)* by Frank Lewis, Draguna Vraabie, and Vassilis Syrmos. **THIS IS A NEW ADDITION** Students are encouraged to consult other material as the course proceeds. There will be some MATLAB projects. The *MATLAB Primer* by Kermit Signmon is available by download as either a PDF or a PS file.

[(matlab_primer.pdf)](matlab_primer.pdf)

[(matlab_primer.ps)](matlab_primer.ps)

While some commands will be mentioned in class, students are expected to learn MATLAB on their own. Other students are an excellent resource in this regard.

Office Hours: Office: SAS 4201
2:00-3:00 pm (TT) and by appointment.
Office Phone: 515-3300 (Can leave message)
FAX: 515-3798
email: slc@ncsu.edu

There will be 1 or 2 tests, a Final, and some homeworks (both analytical and computational). Some homework is for the students own practice and learning. Some homework will be graded. We will make clear in class which is which. All remaining reference to homework in this syllabus is to graded homework. Homeworks will vary from small exercises to mini-projects. Unless stated otherwise a homework assignment is due two class periods after it is assigned. If school is not held, say for instructor's health or weather reasons, that day does not count as one of the two class days. Some larger homework may have more than two class days allowed. Final course grades will use plus/minus grading. Usually there is one exam other than the final.

Test 1: To be determined. Probably in March.

Final: Thursday, May 2, 8:00-11:00 AM. **PLAN TRAVEL ACCORDINGLY.**

Students who are not planning on taking the Mathematics Control Qualifier have the option of an oral class presentation during the last two weeks of class instead of a written final examination. The presentation must be on your research area and also related to the class. Topic must be approved ahead of time with the instructor.

Syllabus: This is a topical Syllabus. Material may be covered in a different order

- Introduction to Optimal Control Problems. Some introductory comments.
- Review of finite dimensional constrained and unconstrained optimization (Chapter 1)
- Optimal control of discrete time systems. The discrete time case can be done just with Chapter 1 and serves to motivate some of the continuous time results.
- Optimal Control of Continuous Systems (Chapter 3). Includes calculus of variations and introduction to LQR Tracking problem (Chapter 4)
- Constrained Control Problems (Pontryagin Maximum Principle) (Chapter 4) Includes minimum time and minimum fuel problems.
- Computational Methods for Optimal Control Problems. This will include both solution of the necessary conditions from the texts and the use of more general purpose methods such as direct transcription. The use of professional software packages that can be used within the Matlab environment will be emphasized. Needed software will be provided.
- As time permits, we may touch on additional topics of interest to the class. In particular we will try to work in some game theory and robust control.

Official University Statements

1. Determination of grades: +/- system is used

If there are two tests the grading will be each exam 18% for a total of 36%, homework 34%, final 30%. If there is one test, then the grading will be exam 25%, homework 40% final 35%. See statements below.

In addition,the following clarifications are used in this course:

2. Policy on incomplete grades and late assignments:

Incomplete grades will not be given, you must complete the assignments for the course as the semester progresses.

Late assignments: will not be accepted without prior permission of the instructor.

Missed Tests: There are no scheduled make up tests. If you must miss an exam, you must notify the instructor as soon as is possible. Note there is both email and a message recorder in his office. Make up exams will be scheduled when there is a valid reason and when prompt notification is given. For example, if your car breaks down on the way to school that may explain why you would need to take the exam later that same day. It would not be an acceptable excuse two days later.

3. Policy on absences (excused and unexcused) and scheduling makeup work:

The attendance policy is consistent with the Academic Regulations which can be found at http://www2.ncsu.edu/unity/project/www/ncsu/provost/info/academic_regulations/attend /reg.htm (link)

In addition, the following clarifications are used in this course:

Attendance is required.

Class Absences: if you miss class for any reason, you are responsible for the material covered. Except in very special circumstances, Prof. Campbell will not provide extra help when you miss the class. Every student is expected to have someone in the class whom they can get missed material or assignments from.

Exam Absence: NCSU policy is strictly enforced. Documentation is required for all absences.

Final Exam: The exam will be given at the date and time specified by NCSU Reg & Records. It is your responsibility to arrange travel around this date. The only exceptions are (1) a documented excused absence, or (2) 3 exams in 24 hours (the student is responsible for the paperwork, as indicated in the Handbook for Advising and Teaching)

4. Course Prerequisites / Restrictive Statements:

The prerequisites are listed at http://www2.acs.ncsu.edu/reg_records/crs_cat/MA.html (link).

In addition,the following clarifications are used in this course:

If you are unsure about the prerequistes, please contact Prof. Campbell.

5. Academic Integrity Statement:

Students are expected to follow university guidelines available at http://www.ncsu.edu /provost/academic_regulations/integrity/reg.htm (link)

In addition, the following clarifications are used in this course:

All graded assignments are to be the work of the individual student. General discussions with others are permitted. Ie., asking what is the MATLAB command for eigenvalues and what is its syntax is ok to ask a fellow student. Essentially copying some one else's work, or letting them copy yours is not. The same goes for analytical assignments.
 Students failing to following these guidelines will receive no credit for the assignment.

6. NC State policy on working with students with disabilities:

Information can be found at http://www2.ncsu.edu/ncsu/stud_affairs /counseling_center/dss/ (link)

7. Statement on laboratory safety or risk assumption in courses requiring physical activity or field trips:

Students have no special physical activity or field trips for this course.

8. Statement on "pass-through" charges e.g. , lane rental at bowling alley, field trip costs, etc.:

There are no such charges for this course.

Further Information:

- NCSU Academic Regulations can be found at http://www2.ncsu.edu/unity/project /www/ncsu/provost/info/academic_policies/ (link)

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