Syllabus – Nonlinear Dynamic Systems

Instructor
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(352)392-4550
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Course Time: MWF 11:45AM-12:35PM
Office/Lab Hours: MF 12:35PM–1:40PM

Course Description
This course will discuss state space and geometric theory of nonlinear ordinary differential equations, perturbation and other analytical methods; the use of local linear approximation, attractor dimension and Lyapunov exponents, Floquet theory, bifurcations and center manifold theory, and experimental methods. These concepts will be reinforced with a number of examples from recently published research, including nonlinear machining dynamics and biological systems. Reading for the course will be taken from the course text and recent literature. Course projects will encourage students to investigate nonlinear behavior that relates to their particular interests.

Course Materials

Web Site: http://plaza.ufl.edu/bmann

Evaluation
Exam: 40% TBA
Course Project: 20% TBA
Homework: 40% TBA

Homework & Exams
- Homework assignments are due at the beginning of class. No credit will be given for late homework unless an extension is granted prior to the submission date.
- No late homeworks.
- Collaboration on homework problems is strongly encouraged, but each person should submit his/her own work.

Course Project
Students can work alone or in small group (say two students) to analyze nonlinear phenomena of dynamical systems. All project topics require instructor approval or they must come from the list of acceptable topics...systems must also be nonlinear. Some class time will be allocated to discuss the student interest and time at the end of the semester will be allocated for presenting the efforts of each project.
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Computer Use
It is the formal policy of this class that computers are necessary. This includes access to and the use of the Internet. Additional requirements are the use of Matlab or equivalent.

Pseudo Course Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Reading</th>
<th>Exercise</th>
</tr>
</thead>
</table>
| 1    | Eqns. motion, SDOF  
  \[ \sum \vec{F} = m\vec{a}, \text{ Lagrange Eqns.} \]  
  Periodic Forcing, Transfer Functions | Review  
  Undergrad Material | HW1 Assg. |
| 2    | State Space, N-DOF Systems  
  Linear vs. Nonlinear  
  Numerical Integration | | |
| 3    | Linearization, Pendulum  
  Local Stability, Fixed Points | | |
| 4    | Poincare Sections  
  Flows: Phase Space  
  Bifurcations | | |
| 5    | Harmonic Balance, Stability  
  Variational Eqns., Floquet | | |
| 6    | Periodic Coefs., Variational Eqns., Hills Determinant | | |
| 7    | Perturbation Methods  
  In-class demo | | |
| 8    | Perturbation Methods  
  Test Review | | |
| 9    | Time-delay systems  
  Biological Examples  
  Regenerative Chatter | | |
| 10   | Time-delay systems  
  Interrupted turning  
  Dynamic Maps, Poincaré Sect. | | |
| 11   | Pseudo Phase Space  
  Choosing \( \tau \)-delay | | |
| 12   | Pseudo Phase Space  
  Invariants, Dimension | | Test 1 |
| 13   | Dimension, Fractals, Chaos  
  Liapunov Exponents | | |
| 14   | Biological Oscillators, Chaos  
  Biological Examples | Class Notes |
| 15/16| Course Project Presentations | | |
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Class attendance
Attendance to lectures is expected. If you must miss lecture for any reason, you should obtain the lecture notes from another student.

Other behavior expectations
Students are expected to take a sincere interest in learning the classroom material. Keeping with this expectation, students should: 1) not create distractions (i.e. turn cell phones off); and 2) show up to class on time; and 3) be courteous to other students and the instructor.

Collaboration
As mentioned previously, collaboration on homework problems is encouraged. However, each person must submit his/her own work. A refined description of what is allowed is listed below:

- Copying homework is a violation of the Honor Code. In particular, showing other students a copy of the actual manuscript to be submitted as homework is not allowed and is subject to the strictest disciplinary sanctions.

- Students are free to consult among themselves on the approach taken to solve any given homework problem as long as the above provision is not violated. Acceptable consultation includes discussing which equations in the textbook should be used for solving a problem, as well as writing down relevant relationships, etc.

Make-up Exam Policy
No make-up exams will be given. Students who do not attend an exam session at the scheduled time will receive a score of zero points in that exam.

Exceptions will be made only in extraordinary circumstances (for example, conflicts with plant trips for job interviews). In such cases students may receive only partial credit in a make-up exam. Full credit is reserved only for regularly scheduled exams.

Accomodations for Disabilities
Students with disabilities who are requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodations.

Academic Honesty
As a result of completing the registration form at the University of Florida, every student has signed the following statement: “I understand that the University of Florida expects its students to be honest in all of their academic work. I agree to adhere to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University.
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Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal arguments governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

Other Student Resources
University Counseling Center - (352) 392-1575 - http://www.counsel.ufl.edu/default.asp
Mental Health Services - (352) 392-1171 - http://www.health.ufl.edu/shcc/smhs.htm
Alachua County Crisis Center - (352) 264-6789

Important Semester Dates

Important Due Dates

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<tr>
<th>Description</th>
<th>Important Semester Dates</th>
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<tr>
<td>Homework 1</td>
<td>19 Jan 05</td>
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<tr>
<td>Homework 2 &amp; Project Description</td>
<td>31 Jan 05</td>
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<tr>
<td>Homework 3</td>
<td>14 Feb 05</td>
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<tr>
<td>Take Home Exam 1 &amp; Revised Project Description</td>
<td>23 Feb 05</td>
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<td>Homework 4</td>
<td>14 Mar 05</td>
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<td>Homework 5</td>
<td>28 Mar 05</td>
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<td>Homework 6</td>
<td>11 Apr 05</td>
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<tr>
<td>Project Report &amp; Take Home Exam 2</td>
<td>27 Apr 05</td>
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