Applied Math 5460 Spring 2016

Dynamical Systems, Differential Equations and Chaos

Class:	MWF 10:00-10:50 PM	ECCR 116	
Instructor:	J.D. Meiss	ECOT 236	jdm@colorado.edu
Office Hours:	TBA		

Text: Differential Dynamical Systems, J.D. Meiss (SIAM 2007)
Electronic copy: Free download from SIAM (on campus)
<http://epubs.siam.org/doi/book/10.1137/1.9780898718232>
Paper copy: $87 list, 30% discount for SIAM members (students join for free!) or 20% discount with code (ask me!)
<http://bookstore.siam.org/mm14/>

Prerequisites: Undergraduate courses equivalent to APPM 2360, 3310

Outline

Dynamical Systems & Modeling

Linear Systems (Mostly a Review)
- Eigenvalues and Vectors
- Exponentials of Operators
- Floquet Theory
- Stability

Existence and Uniqueness
- Contraction Maps
- Lipschitz Functions

Dynamical Systems
- Flows
- Stability
- Lyapunov Functions
- Topological Conjugacy
- Omega Limit Sets, Attractors Basins

Invariant Manifolds
- Stable & Center Manifolds
- Normal Form Theory

The Phase Plane
- Topological Phase portraits
- Poincaré-Bendixson Theory
- Index Theory

Chaotic Dynamics
- Lyapunov Exponents
- Hyperbolicity
- Strange Attractors
- Homoclinic Bifurcations to Chaos

+ at least one more topic:
- Bifurcation theory
- Perturbation Theory
- Hamiltonian Systems

Web Page & Software: I will be posting a lecture schedule, homework assignments, Maple or Matlab notebooks, typos in the text, etc. on the web page
http://www.colorado.edu/amath/course-pages/5460

Grading: Grades in the course will be based on:

(i) homework sets (assigned roughly biweekly during the semester). (60%)
(ii) Class participation (10%)
(ii) Project presentation and report (30%)

There will be no exams.

Ground rules for the homework sets are as follows. You may use any reference book; however please do not search the web for solutions. You are encouraged to discuss the homework problems with other students in the class, and even to work on the problems together, **until** you get to the point that you understand how to solve the problem. Each student is required to write up and to submit his/her own homework. You are **not** permitted to copy another student's homework, even if you worked on the problems together.

Projects: I will give a list of possible projects around the 2rd week of class. You should select your project and have it approved by me by the 4th week. Projects will consist of a 15 minute presentation to the class during the last week of the semester or the final exam period and a written report. Project can involve computation, but need not.

Special Accommodations: If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner, so that your needs may be addressed. Disability Services <http://www.Colorado.edu/disabilityservices> determines accommodations based on documented disabilities. Contact: 303-492-8671 or Willard 322.

Religious Observances Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please let me know of any conflict at least two weeks in advance. See <http://www.colorado.edu/policies/fac_relig.html>

Academic Honesty: Students may discuss homework problems with each other. However, all work turned in must be your own. Violation of the CU Student Honor Code <http://www.colorado.edu/academics/honorcode/> will result in a course grade of F.

References: The following may be useful references:

Arnold, V. I. (1983). Geometrical Methods in the Theory of Ordinary Differential Equations. New York, Springer-Verlag.

Arnold, V. I. (1992). Ordinary Differential Equations. New York, Springer-Verlag.

Arrowsmith, D. K. and C. M. Place (1990). An Introduction to Dynamical Systems. Cambridge, Cambridge University Press.

Chicone, C. (1999). Ordinary Differential Equations with Applications. New York, Springer-Verlag.

Chow, S. H. and J. K. Hale (1982). Methods of Bifurcation Theory. New York, Springer-Verlag.

Guckenheimer, J. and P. Holmes (1983). Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields. New York, Springer-Verlag.

Hale, J. K. and H. Koçak (1991). Dynamics and Bifurcations. New York, Springer-Verlag.
Hirsch, M. W. and S. Smale (1974). Differential Equations, Dynamical Systems and Linear Algebra, New York Academic Press.
Kuznetsov, Y. A. (1995). Elements of Bifurcation Theory. New York, Springer-Verlag.
Perko, L. (2000). Differential Equations and Dynamical Systems. New York, Springer-Verlag.
Robinson, C. (1999). Dynamical Systems: Stability, Symbolic Dynamics, and Chaos. Boca Raton, Fla., CRC Press.