18.385j/2.036j Nonlinear Dynamics and Chaos.

Mon, Wed, and Fri, 11:00-12:00 PM, in room 2-136.

Textbook: S. Strogatz, *Nonlinear Dynamics and Chaos*, Addison–Wesley.
Most of the theory here (skipping some examples) will be covered — more-or-less. The lectures will not necessarily "follow" the book, and some topics that will be covered may not be in the book.

MatLab: I **strongly urge you to become proficient in MatLab.** The MatLab course scripts will be used in the lectures, and you are expected to use them to reinforce the course materiel. They will also be needed for some of the problem sets. See the course web page for more information about MatLab.

Student MatLab: If you wish to install MatLab in your own computer (not a bad idea, it is a good investment) you should purchase the Student version of MatLab.

More Software: Athena used to give access to "dstool" and "xphased", not sure it still does. I am not maintaining any of these. The first is a very powerful (but tricky to use) Dynamical Systems software package, while the second is more limited, but user friendly.

References:

S. Wiggins, *Introduction to Applied Nonlinear Dynamical Systems and Chaos*, Springer-Verlag. "Alternative" textbook, a bit more mathematical than Strogatz. I will not follow this book, nor cover the materiel in it, though I may use it for some topics.

P. G. Drazin, *Nonlinear Systems*, Cambridge U. P.

H-O Peitgen, H. Jurgens and D. Saupe, *Chaos and Fractals. New frontiers of science*, Springer-Verlag.

T. S. Parker and L. O. Chua, *Practical numerical algorithms for chaotic systems*, Springer-Verlag.

D. W. Jordan and P. Smith, *Nonlinear Ordinary Differential Equations*, Oxford U. P.

P. Berge, Y. Pomeau and C. Vidal, *Order Within Chaos*, Wiley.

S.W. McCuskey, *Introduction to Celestial Mechanics*, Addison Wesley.

Guckenheimer & Holmes, *Nonlinear Oscillations, Dynamical Systems and Bifurcations of Vector Fields*, Springer Verlag. Requires mathematical sophistication. Subject covered at a rigorous level, with proofs requiring knowledge beyond course pre-requisites (say, at the level of **Coddington & Levinson,** *Theory of Ordinary Differential Equations, McGraw-Hill).*

Instructor:	R. Rosales, room 2-337, x3-2784, rrr@math.mit.edu, Off. Hours: TBA.
TA:	TBA.
Exams:	Two (midterm and last week of class). Each 40% of the grade. **NO FINAL.**
Problem sets:	About 8 problem sets (one every 1.5 weeks, more or less). **Worth 20% of the grade.** **Will need a computer, and MatLab.** **DO THEM ALL!** *You cannot learn the material in this course if you do not!*
E-mail:	Make sure I have added your correct e-mail address to the class list. *I will send you lots of IMPORTANT information via e-mail!* **Check your e-mail. If you do not get a "test" mail from me within a week, something is wrong. Warn me at my e-mail address above — or at the lecture.**
WEB page:	http://web.mit.edu/2.036j/www/index.html or http://www-math.mit.edu/18.385/index.html

OUTLINE of the Course: A rough idea follows. Some things may be covered in more detail than this implies, or the reverse. This is just to give you an idea of the "flavor".

- One-dimensional systems and elementary bifurcations.
- Two-dimensional systems; phase plane analysis, limit cycles, Poincaré-Bendixson theory.
- Nonlinear Oscillators, qualitative and approximate asymptotic techniques, Hopf bifurcations.
- Lorenz and Rossler equations, chaos, strange attractors and fractals.
- Iterated mappings, period-doubling, chaos, renormalization, universality.
- Hamiltonian systems; complete integrability and ergodicity.
- Area preserving mappings, KAM theory.
- Other topics (if time permits), such as: Infinite Dimensional Hamiltonian Systems, On-Off Dissipative Systems, etc.