

## AME 522 – Fall 2013

### Nonlinear Dynamical Systems, Vibrations, and Chaos

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OFFICE: RRB 215, WED,FRI 3:30-4:30 PM

CLASS: OHE 100C, FRI 12:00-2:50 PM



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#### COURSE DESCRIPTION

This course provides a broad introduction to nonlinear mechanical systems. The course will focus on analytical methods for simulation and characterization of dynamical systems that are nonlinear in nature. Topics covered include:

- Overview of nonlinear mechanics of particles and nonlinear oscillations
- Lagrange's equations and nonlinear differential equations
- Flows on a line and bifurcations
- Multi-dimensional flows and linear systems
- Phase portraits, stability, and limit cycles
- Dissipative systems, reversible systems, Index theory
- Weakly nonlinear oscillations and two-timing methods
- Poincare maps, Hopf bifurcations, and global bifurcations of cycles
- One dimensional maps and Lyapunov exponents
- Chaotic oscillations and strange attractors in mechanical systems

#### REQUIRED TEXT

- Nonlinear Dynamics and Chaos (1994) by Steven H. Strogatz.

#### REFERENCES

- Practical Numerical Algorithms for Chaotic Systems (1989) by T.S. Parker and L.O. Chua.
- Nonlinear Systems (2001) by Hassan K. Khalil.
- A Treatise on Analytical Dynamics (1981) by L.A. Pars.

#### GRADING

Homework – 30%  
Midterm – 30% (8<sup>th</sup> week)  
Final – 40%