The course will serve as a broad introduction at the undergraduate level to the field of nonlinear dynamics and chaos theory for engineers, physical scientists, and applied mathematicians. We will assume students have working knowledge of multivariable calculus, linear algebra, and some knowledge of ordinary differential equations. We will introduce the subject in a sequence of 12 lectures on nonlinear dynamics, starting with one-dimensional flows, emphasizing the geometric point of view and the notion of bifurcations. Then we will discuss two-dimensional flows and phase plane dynamics. The third section of the class will focus on chaotic dynamics in the context of one-dimensional maps, the Lorenz equations, fractal sets and strange attractors. Lecture topics are listed below.

Grading:

• HW 40%
• Midterm 30% (Monday Oct. 15 in class)
• Final 30% (Friday Dec. 7, 11AM-1PM)

Books:

Lecture 1: Introduction to nonlinear dynamics
Lecture 2: Flows on a line
Lecture 3: Bifurcations (Part I)
Lecture 4: Flows on the circle
Lecture 5: Linear systems
Lecture 6: Phase plane
Lecture 7: Limit cycles
Lecture 8: Bifurcations (Part II)
Lecture 9: The Lorenz equations
Lecture 10: One-dimensional maps
Lecture 11: Fractals
Lecture 12: Strange attractors