AME 522: Nonlinear Dynamical Systems (4 units)
Prof. P.K. Newton, OHE 4th Floor, 740-7782 (newton@usc.edu)
Fall 2021
Time: M,W 12:00-1:50, GFS 136

The course will provide a comprehensive introduction to nonlinear dynamical systems and chaos with an emphasis on applications in physical sciences, biology, and engineering. The lectures will develop the theory primarily by introducing examples that have served as useful prototypes. There are 3 parts to the course which will follow the textbook of S. Strogatz:

1. One-dimensional flows
2. Two-dimensional flows
3. Chaos

Part 1 will focus on flows on a line, introduce the geometric point of view, stability theory, bifurcations, and periodic flows (flows on a circle). Part 2 will focus on two-dimensional flows, phase plane dynamics, limit-cycles, and bifurcation theory. Part 3 will focus on chaotic dynamics, introducing the Lorenz equations from atmospheric sciences, iterated maps, fractals, and strange attractors. Throughout the semester we will discuss models such as the logistic model and Gompertzian model for tumor growth, nonlinear oscillators and lasers, superconducting Josephson junctions, relaxation oscillations, predator-prey models, game-theory models and the replicator dynamics, chemical oscillators, damped-driven pendula, the chaotic waterwheel, and other models. Problem sets will be assigned througout the semester.

Book (Required):
• S.H. Strogatz, *Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry and Engineering*, 2nd Edition CRC Press (Paperback)