



Catalog Description:

Systems of linear, first-order differential equations; existence and uniqueness theorems; qualitative theory (phase plane analysis, linearization, stability, bifurcations, limit cycles, chaos); and physical applications.

Prerequisite:

C- or better in 2153, 2162.xx, 2173, 2182H, or 4182H; or credit for 254.xx, 263, 263H, or 264H.

Text:

Nonlinear Dynamics and Chaos, Steven H. Strogatz, published by Westview Press, ISBN 9780738204536

Topics List:

1. One-dimensional flows: geometric way of thinking; fixed points and stability; population growth and other applications.
2. Bifurcations in one-dimensional flows: saddle-node, transcritical and pitchfork bifurcations; imperfect bifurcations.
3. Theory: existence; uniqueness; continuous dependence.
4. Phase planes: phase portraits; vector fields; nullclines; fixed points; stability;
5. Linear systems: classification of linear systems; what do linear systems say about the nonlinear system?
6. Limit cycles; introduction; Poincare-Bendixson theorem; conservative systems.
7. Bifurcations of two-dimensional flows; Hopf bifurcation theorem.
8. XPPAUT: phase planes; bifurcations; applications.
9. Global bifurcations: homoclinic orbits; Poincare map; stability of periodic orbits.
10. Singular perturbations: Relaxation oscillators; averaging.
11. One-dimensional maps: Logistic map.
12. Smale horseshoe: symbolic dynamics.
13. Applications.