

MATH 552  
*Introduction to Dynamical Systems*  
**Course Outline**  
2017W T1 (Sep–Dec 2017)

Ideas, methods and applications of dynamical systems and bifurcation theory: differential and difference equations, local bifurcations, perturbation methods, chaos. Prerequisite: two semesters of undergraduate differential equations.

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Recommended textbook (optional, not required):

- Y. A. Kuznetsov, *Elements of Applied Bifurcation Theory*, Springer, New York (3rd ed. 2004).

Topics:

1. *Linear Dynamical Systems*: Linear continuous-time systems (ODEs, vector fields, flows); linear discrete-time systems (difference equations, maps); stable, unstable and centre subspaces; Floquet multipliers.
2. *Nonlinear Dynamical Systems*: Nonlinear continuous-time systems; nonlinear discrete-time systems; Poincaré maps; linearization and hyperbolicity; stable and unstable manifolds; two-dimensional Hamiltonian systems; Lyapunov functions.
3. *Local Bifurcations*: Fold, Hopf and other local bifurcations; normal forms; centre manifolds.
4. *Topics in Global Dynamics*: Homoclinic bifurcations in the plane; Melnikov's method; chaos.

Additional references:

- C. Chicone, *Ordinary Differential Equations with Applications*, Springer, New York (2006).
- J. Guckenheimer & P. Holmes, *Nonlinear Oscillations, Dynamical Systems and Bifurcations of Vector Fields*, Springer, New York (1983).
- J. Hale, *Ordinary Differential Equations*, Krieger, Malabar (1980).
- M. Hirsch, S. Smale & R. Devaney, *Differential Equations, Dynamical Systems and an Introduction to Chaos*, Academic Press, New York (2004).
- J. Meiss, *Differential Dynamical Systems*, SIAM, Philadelphia (2007).
- S. Wiggins, *Introduction to Applied Nonlinear Dynamical Systems and Chaos*, Springer, New York (2003).