MATH 552

Introduction to Dynamical Systems

Course Outline

2018W T1 (Sep–Dec 2018)

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 (e.g. UBC MATH 215 & 316; UBC MATH 215 & 345).

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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, transcritical, symmetric pitchfork and flip bifurcations; normal forms and Hopf bifurcations; centre manifolds.

4. *Topics in Global Dynamics:* Homoclinic bifurcations in the plane; Melnikov's method; transverse homoclinic points and chaos.

Additional references (books published by Springer are available online through the UBC Library):

- 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); republished by Dover, Mineola (2009).

- M. Hirsch, S. Smale & R. Devaney, *Differential Equations, Dynamical Systems and an Introduction to Chaos,* Elsevier, Waltham (2013, 3rd ed.).

- J. Meiss, *Differential Dynamical Systems,* SIAM, Philadelphia (2017, 2nd ed.).

- S. Wiggins, *Introduction to Applied Nonlinear Dynamical Systems and Chaos,* Springer, New York (2003).