MATH 552 (3 Credits)
Introduction to Dynamical Systems
Session 2019W Term 1 (Sep–Dec 2019)

Prerequisite. Two semesters of undergraduate applied differential equations. At UBC, these would be one of MATH 215, MATH 255, MATH 256, MATH 258 and one of MATH 257, MATH 316.

Course Instructor. Wayne Nagata
Contact Details. Drop in to office hours or email `nagata@math.ubc.ca`
Office Hours. M W F 1:00–2:00
Office Location. Mathematics building, room 112

Course Structure. Traditional lectures, 3 per week. Summary notes will be posted after lectures on the **Course Web Page** `http://www.math.ubc.ca/~nagata/m552/`.

Course 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.

Course Textbook (optional).

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

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).

Learning Outcomes. By the end of the course, students should be able to solve mathematical problems that require understanding of the basic theoretical structure of dynamical systems and bifurcation theory, and analyze low-dimensional models from applied mathematics for dynamics and bifurcations.

Learning Assessment. Five homework assignments, each contributing 20% to the final grade.

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