MATH 614, Section 600

Dynamical Systems and Chaos

Spring 2016

Instructor: Yaroslav Vorobets
Time: MWF 1:50 – 2:40 p.m.
Location: BLOC 160
Web page: `http://www.math.tamu.edu/~yvorobet/MATH614/`

Office: BLOC 223b (e-mail: `yvorobet@math.tamu.edu`)

Office hours: Monday 3:00–4:00 p.m., and by appointment.

Text: Robert L. Devaney, *An Introduction to Chaotic Dynamical Systems*, 2nd ed., Westview Press, 2003 (ISBN 978-081334085-2).

Prerequisites: MATH 308 (ordinary differential equations), MATH 601 or equivalent (linear algebra and complex analysis).

Course content: The course is an introduction to the theory of dynamical systems with emphasis on the chaos theory. The topics to be covered include: dynamical systems with discrete and continuous time, Poincare maps, symbolic dynamics, chaos, attractors, fractals, computer simulation of dynamical systems.

Grading system: The grade will be determined by homework (40 %) and a project (60 %) according to the 90–80–70–60 % scale.

Late homework will be accepted only for legitimate reasons and may be penalized if circumstances warrant.

Academic integrity: Copying another student's homework is forbidden (it is dishonest and academically worthless). Information about the Honor Council Rules and Procedures can be found at `http://aggiehonor.tamu.edu/`

Students with disabilities: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 845–1637. For additional information, visit `http://disability.tamu.edu/`

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Course outline

Part I ($\approx$ 5.5 weeks): *One-dimensional dynamics*

- Introduction and preliminaries
- Hyperbolicity
- Quadratic maps
- Symbolic dynamics
- Definition of chaos
- Structural stability
- Bifurcation theory
- Maps of the circle
- Period-doubling

Devaney's book: Part One

Part II ($\approx$ 3 weeks): *Higher-dimensional dynamics*

- Dynamics of linear maps
- The horseshoe map
- Attractors
- Stable and unstable manifolds
- The Hopf bifurcation

Devaney's book: Part Two

Part III ($\approx$ 3.5 weeks): *Complex analytic dynamics*

- Complex quadratic maps
- Classification of periodic points
- The Julia set
- The Mandelbrot set

Devaney's book: Part Three

Part IV ($\approx$ 1.5 weeks): *Brief introduction to ergodic theory*

- Invariant measure
- Ergodic theorem
- Ergodicity and mixing
- Spectral properties of a dynamical system