

Syllabus for Math 662

Seminar in Algebra. “Groups and Dynamical Systems”

Spring 2015

Section 601

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Class hours: MWF 10:20–11:10 BLOC 163

MATH 662 web page: The web page of the course is

<http://www.math.tamu.edu/~nekrash/teaching/15S/M662.html>

Course Description.

The course is centered around group theoretical aspects of classical dynamical systems. We will study groups appear naturally in the study of hyperbolic dynamics (e.g., iterations of complex rational functions, Mandelbrot set, structure of strange attractors and basic sets of hyperbolic diffeomorphisms, Smale spaces etc.). These groups often possess exotic properties like intermediate growth, non-elementary amenability, infinite recursive presentations, etc.. We will discuss these properties, and also show how group theory can be used to answer questions in dynamical systems, and vice versa.

Prerequisites: basic graduate courses in topology and algebra (e.g., MATH 636 and 653).

Outline of the course.

1. Group actions. Schreier graphs and Cayley graphs.
2. Dynamical systems. Main definitions and examples. Overview of symbolic dynamics.
3. Expanding maps and their iterated monodromy groups.
4. Rigidity of expanding maps.
5. Algebraic properties of iterated monodromy groups of expanding maps.
6. Complex quadratic polynomials. The Mandelbrot set, its structure. Iterated monodromy groups of quadratic polynomials.

7. Hyperbolic dynamical systems. Anosov diffeomorphisms, axiom-A diffeomorphisms. Smale spaces. Solenoid and natural extensions of expanding maps. Anosov flows.
8. Groups and groupoids associated with hyperbolic dynamical systems.
9. Penrose tiling and quasi-crystals.
10. Amenability of groups and actions. Banach-Tarski paradox.
11. Elementary and non-elementary amenable groups. Interesting examples of amenable and non-amenable groups. Open problems.

Recommended texts.

I will distribute handouts (articles and chapters of books, lectures).

Grading. Your grade will be determined by the homeworks and a project in proportion 40:60.

Make-up policy: Make-ups for missed exams will only be allowed for a university approved excuse in writing. Wherever possible, students should inform the instructor before an exam is missed. Consistent with University Student Rules , students are required to notify an instructor by the end of the next working day after missing an exam. Otherwise, they forfeit their rights to a make-up.

Late Homeworks will not be accepted.

Scholastic dishonesty: Copying work done by others, either in-class or out of class, is an act of scholastic dishonesty and will be prosecuted to the full extent allowed by University policy. Collaboration on assignments, either in-class or out-of-class, is forbidden unless permission to do so is granted by your instructor. For more information on university policies regarding scholastic dishonesty, see University Student Rules.

Remember the Aggie Code of Honor: *“An Aggie does not lie, cheat, or steal or tolerate those who do.”*

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