

UNIVERSITY OF CRAIOVA
Faculty of Mathematics and Computer Science
Department of mathematics
Fundamental domain : Exact sciences
Domain: Mathematics
Master: Applied mathematics
Form: Day classes
Duration of studies: 2 years
Academic year 2009-2010

Ergodic Theory of Dynamical Systems Syllabus

Course coordinator: Prof. dr. Constantin P. Niculescu
Code: MA213
Second Cycle: MASTER
Second Year, Semester 1, Course 42 hours, Seminar 14 hours
No. of credits: 6
Domain: Mathematics
Type: compulsory
Category: speciality

Objectives: The presentation of some of the most important ergodic theorems and the illustration of these results by applications from number theory and dynamical systems.

Necessary background: Special topics in functional analysis, Real and complex analysis, Probability theory.

Evaluation: Exam (E).

Contents:

1. Dynamical systems with an invariant measure. Poincaré's recurrence. The Bogoliubov-Krylov theorem.
2. The ergodic theorems of von Neumann and Birkhoff. Weyl's ergodic theorem.
3. Mixing and ergodicity.
4. Metric entropy. Topological entropy. The variational principle.
5. Special classes of mappings. Piecewise monotonic mappings. Denjoy diffeomorphisms. Billiards.
6. Recurrence and its applications to combinatorics. The theorems of van der Waerden and Szemerédi.
7. The ergodic theorem of Oseledec. Liapunov exponents. Applications to chaotic dynamical systems.

Bibliography:

1. V.I. Arnold et A. Avez, *Problemes Ergodique de la Mecanique Classique*. Gauthier-Villars, Paris, 1967.
2. A. Boyarsky and P. Góra, *Laws of Chaos. Invariant Measures and Dynamical Systems in One Dimension*, Birkhäuser, 1997.
3. M. Gidea and C. Niculescu, *Chaotic Dynamical Systems. An Introduction*. Universitaria Press, Craiova, 2002.
4. R. Gologan, *Applications of Ergodic Theory*, Editura Tehnica, Bucharest, 1989 (Romanian)
5. R. Mañé, *Ergodic Theory and Differentiable Dynamics*, Springer-Verlag, 1987.
6. W. Parry, *Topics in Ergodic Theory*, Cambridge Univ. Press, 1980.
7. Ya. G. Sinai, *Topics in Ergodic Theory*, Princeton Univ. Press, Princeton N.J., 1994.
8. M. Viana, *Dynamics: A Probabilistic and Geometric Perspective*, Proceedings of the International Congress of Mathematicians, Vol. I (Berlin, 1998). Doc. Math. 1998, Extra Vol. I, 557-578 (electronic).
9. P. Walters, *An Introduction to Ergodic Theory*, Springer-Verlag, New York, Heidelberg, Berlin, 1982.
10. K. Yosida, *Functional Analysis*, 5th ed., Springer-Verlag, Berlin, 1995.