

American University of Beirut
MATH 307K: Introduction to Ergodic Theory
Course Syllabus (2026–2027 Fall)

Course description: Ergodic theory is the study of “statistical” or “long-term” properties of dynamical systems. It originated in attempts by mathematicians to understand the so-called *ergodic hypothesis* in Boltzmann’s statistical mechanics (namely, the equality of time and phase-space averages), but has since developed into a lively branch of mathematics with broader connections to statistical physics, probability theory, information theory, combinatorics, number theory, geometry, and group theory. This course is an introduction to selected standard aspects of ergodic theory.

Tentative contents:

- Measure-preserving transformations
- Poincaré recurrence theorem
- Mean and pointwise ergodic theorems
- Ergodicity and mixing
- Elements of topological and symbolic dynamics
- Geometry of the set of invariant measures
- Unique ergodicity and minimality
- Entropy
- Shannon–McMillan–Breiman theorem
- Further topics (as time permits, depending on the interests of the students)

Suggested references:

- *Foundations of Ergodic Theory* by M. Viana and K. Oliveira.
- *Ergodic Theory: with a view towards Number Theory* by M. Einsiedler and T. Ward.
- *Invitation to Ergodic Theory* by C. E. Silva.
- *An Introduction to Symbolic Dynamics and Coding* by D. Lind and B. Marcus.
- *Topological and Symbolic Dynamics* by P. Kůrka.
- Supplementary notes will be provided.

Note: The electronic versions of the first four books can be accessed via the [university library](#). You may be prompted to login with your AUB account.

Prerequisites:

- A solid background in real analysis (MATH 210) and the topology of compact metrizable spaces (preferably MATH 214).
- Measure theory (MATH 303). May be taken simultaneously. We will briefly review what we need.
- Familiarity with elementary probability theory (at the level of STAT 230/233) is preferred but not required.
- Familiarity with basics of functional analysis is preferred but not required.

Feel free to contact the instructor if you have questions about the prerequisites.

Format of the course:

- Lectures (regular class times).
- Occasional exercise sessions (to be scheduled in agreement with the participants).
- Projects (towards the end of the semester).

Time and location:

- MWF 11:00 am–11:50 am (August 31 – December 4)
- Nicely Hall 324

Instructor: Siamak Taati

- Email: st71@aub.edu.lb
- Office: Bliss Hall 312B

Assessment:

- 40% Assignments followed by exercise sessions
- 40% Final paper and presentation
- 20% Active participation

Course learning outcomes: Upon completion of this course, you should be able to

- Use the notation and terminology of ergodic theory consistently and accurately;
- Recall or readily rediscover basic facts from ergodic theory, and reproduce or locate the statements of central results and recognize their essential hypotheses;
- Apply abstract ergodic-theoretic concepts and results to concrete settings;
- Follow mathematical arguments, develop proof strategies using ideas and techniques from different areas of mathematics, and turn informal arguments and proof sketches into rigorous proofs;
- Critically examine mathematical statements and arguments, identify errors or missing hypotheses, construct counterexamples, and propose reasonable generalizations;
- Read literature on selected topics in ergodic theory and grasp the main ideas and arguments, with the help of additional references when needed;
- Communicate ergodic-theoretic ideas and rigorous mathematical arguments effectively, both orally and in writing.

Program learning outcomes addressed in the course:

- Research Methods: Analyze qualitative and/or quantitative information while conducting research related to their graduate program.
- Advanced Core Knowledge in the Discipline: Analyze core concepts, research and theories in different areas of study in their discipline.
- Scholarly Communication Skills: Demonstrate scholarly communication skills in clear, detailed and well-structured scientific written and oral formats consistent with high standards of their discipline.

Unique Learning Needs of Students with Disabilities: AUB strives to make learning experiences as accessible as possible. If you anticipate or experience academic barriers due to a disability (including mental health, chronic or temporary medical conditions), please inform your lecturer immediately so that we can privately discuss options. In order to help establish reasonable accommodations and facilitate a smooth accommodation process, you are encouraged to contact the Accessible Education Office: accessibility@aub.edu.lb; +961-1-350000, x3246; West Hall, 314.

Academic Integrity: Please refer to AUB [Student Code of Conduct](#), in particular to section 1.1, which concerns academic misconduct including cheating, plagiarism, in-class disruption, and dishonesty. Please be aware that misconduct is vigorously prosecuted and that AUB has a zero tolerance policy.

Non-Discrimination: AUB is committed to facilitating a campus free of all forms of discrimination including sex/gender-based harassment prohibited by Title IX. The University's non-discrimination policy applies to, and protects, all students, faculty, and staff. If you think you have experienced discrimination or harassment, including sexual misconduct, we encourage you to tell someone promptly. If you speak to a faculty or staff member about an issue such as harassment, sexual violence, or discrimination, the information will be kept as private as possible, however, faculty and designated staff are required to bring it to the attention of the University's Title IX Coordinator. Faculty can refer you to fully confidential resources, and you can find information and contacts at [<https://www.aub.edu.lb/president/titleix>]. To report an incident, contact the University's Title IX Coordinator Trudi Hodges at 01-350000 ext. 2514, or titleix@aub.edu.lb. An anonymous report may be submitted online via EthicsPoint at [<http://www.aub.ethicspoint.com>].