

## COURSE OUTLINE MATH 493/535: ERGODIC THEORY SPRING 2019

### Instructor

#### Section A01

**Lecturer** Matteo Tanzi, Dr.

**Research Area** Dynamical Systems.

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### General Course Information

**Number of Units** 1.5

**Pre-requisites** Minimum third-year standing and permission of the instructor; no formal experience with measure theory will be assumed.

#### Class Meetings

2:30-3:20 on Monday, Wednesday, and Thursday in Clearihue Building, room B346.  
The lectures will start on Monday 7th of January 2019.

### Office Hours and Assistance

**Office Hours** Monday 3:30-4:20 and Thursday 3:30-4:20 in DTB A453, or by appointment (send an e-mail to book one).

**Math Club** Students in Undergraduate Mathematics and Statistics (SUMS) was founded in 2014 as the reincarnation of a previous undergraduate course union that had been inactive for a few years. Please see <http://www.uvic.ca/science/math-statistics/current-students/undergraduate/sums/index.php> for more information.

### Summary of the Course and Learning Objectives

A dynamical system is a system that changes in time according to an evolution law, e.g. a flow, solution to a given ODEs. Ergodic theory deals with the asymptotic properties of dynamical systems and has at its core the idea of describing what the typical evolution of a system looks like in terms of the measures kept invariant by its dynamics. Ergodic theory originated from statistical physics, and today has ramifications in various mathematical subjects such as number theory (e.g. study of zeta-functions), stochastic analysis (e.g. Markov processes, SDEs), PDEs, and geometry (e.g. study of moduli spaces of Riemann



surfaces) to cite a few. The importance of this discipline in the current mathematical landscape is exemplified by the work of many recent Fields medalists that contributed and/or benefitted from ideas and results in ergodic theory (e.g. Elon Lindstrauss, Artur Avila, Maryam Mirzakhani).

In this course you will encounter four fundamental concepts in ergodic theory: recurrence, ergodicity, mixing, and entropy. Before moving to the core of the course, you will familiarise with basic notions from measure theory. By the end of the course you should comprehend the concepts of ergodicity and mixing, and what these properties imply for the description of systems that possess them. You should also be able to work with the examples of dynamical systems presented in class, as well as with some of the standard techniques that can be applied to determine whether a given system is ergodic/mixing. You should be familiar with different notions of entropy, their interpretation, and procedures to compute or estimate entropy in some cases.

## Course Material

**Textbook** Marcelo Viana and Kjerfve Oliveira, *Foundations of Ergodic Theory*, Cambridge University Press 2016 (full text available online at the library's website).

**Other references** will be given during the course.

## Topics

- Measure-preserving systems, recurrence, and Poincaré theorem;
- ergodicity (equivalent formulations), von Neuman theorem, Birkhoff ergodic theorem;
- mixing (various notions);
- entropy.

## Evaluation and Grading

During the course you will have to hand in 6 homework assignments and take a final exam. Homework assignments must be handed in before the end of class on the due-date and they will be posted one week before the deadline. Your homework grade will be computed from your 5 highest written homework grades (i.e. you have one drop). It is preferable to hand-in a hard copy, but in case of illness or other exceptional circumstances you are welcome to send a scanned version to the instructor's e-mail address. Your final percentage grade will be computed according to the following scheme:

Homework Assignments	Final Exam
75%	25%



**Accessibility** Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL) as soon as possible. The CAL staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations <http://uvic.ca/cal>. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

**Grading** Percentage scores will be converted to letter grades according to the university-wide standard table that you can find online or clicking [here](#).

**Final Examination** Off-schedule final examinations (i.e., deferred examinations) are given only in accordance with the university policy as outlined in the Calendar. If you are unable to write a final examination due to illness, accident or family affliction, please look for the online detailed instructions on how to proceed or click [here](#). Students are **strongly advised not to make plans for travel or employment during the final examination period** as special arrangements will not be made for examinations that conflict with such plans.

**Supplemental Examinations.** The Department of Mathematics and Statistics does not award 'E' grades or offer Supplemental Examinations in any of its courses.

## Policies and Ethics

**Attendance** The university Calendar states (see online or click [here](#)) 'Students are expected to attend all classes in which they are enrolled.'

Our courses are conducted on that basis. If you miss an announcement (information concerning midterms, corrections to assignment, etc.) because you did not attend class, you must accept the consequences of not having learned of the change.

**Guidelines on Religious Observances** Where classes or examinations are scheduled on the holy days of a religion, students may notify their instructors, at least two weeks in advance, of their intention to observe the holy day(s) by absenting themselves from classes or examinations. Instructors will provide reasonable opportunities for such students to make up work or missed examinations.

**Missing homework** No homework make-ups will be offered. In case of continued illness (between the date the assignment is posted and the due-date), you will be excused from the homework under presentation of valid medical documentation, and your mark will be computed from the scores on the other assignments. No work will be excused in case of illness limited to the due-date.

**Academic Integrity** Academic integrity is intellectual honesty and responsibility for academic work that you submit individual or group work. It involves commitment to the values of honesty, trust, and responsibility. It is expected that students will respect these ethical values in all activities related to learning, teaching, research, and service. Therefore, plagiarism and other acts against academic integrity are serious academic



offences.

### **The responsibility of the institution**

Instructors and academic units have the responsibility to ensure that standards of academic honesty are met. By doing so, the institution recognizes students for their hard work and assures them that other students do not have an unfair advantage through cheating on essays, exams, and projects.

### **The responsibility of the student**

Plagiarism sometimes occurs due to a misunderstanding regarding the rules of academic integrity, but it is the responsibility of the student to know them. If you are unsure about the standards for citations or for referencing your sources, ask your instructor. Depending on the severity of the case, penalties include a warning, a failing grade, a record on the students transcript, or a suspension.

It is your responsibility to understand the University's policy on academic integrity. You can search for the policy online or [click here](#).

## **Important Dates and Deadlines**

07 Jan 2019	Lectures start
16 Jan 2019	<b>Homework 1</b> deadline
30 Jan 2019	<b>Homework 2</b> deadline
13 Feb 2019	<b>Homework 3</b> deadline
18-22 Feb 2019	Reading break
28 Feb 2019	Last day for withdrawing
6 Mar 2019	<b>Homework 4</b> deadline
20 Mar 2019	<b>Homework 5</b> deadline
3 Apr 2019	<b>Homework 6</b> deadline
5 Apr 2019	Last day of lectures

The date for the final examination will be communicated by the University in February.

