Course: Regularity and combinatorial structures

Teacher(s): Luka Milićević

Course status: elective

ECTS: 12

Prerequisites: -

Goal

The idea of quasi-randomness plays a key role in many theorems of combinatorics, as well as in other fields such as number theory or ergodic theory. The aim of the course is to deal with different regularity lemmas and their application in order to find combinatorial structures in different contexts.

Outcomes

Upon completion of the course, the student will be able to use regularity lemmas in their research, recognize situations where they may be useful, and master techniques for finding combinatorial structures.

Contents

Theoretical teaching

Semeredi's lemma on regularity and applications. Removal of hypergraphs and proof of the multidimensional Semeredi theorem. Basics of ergodic theory and ergodic proof of Semeredi's theorem. Tao's proof of convergence of ergodic means for commutating transformations. Green and Thao's theorem on arithmetic progressions of prime numbers. Subgraph removal and regularity in the low-density case. The density version of Hales and Jewett's theorem. Algebraic version of the regularity method. Infinite regularity theorems and their application in the Erdos hypothesis on sums of sets.

Recommended bibliography

1. H. Furstenberg, Recurrence in Ergodic theory and Combinatorial Number Theory, Princeton University Press, Princeton NJ 1981.
2. T. Tao, Higher Order Fourier Analysis, Volume 142, American Mathematical Society, 2012.
3. T. Tao, V. Vu, Additive combinatorics, Cambridge University Press, Cambridge, 2006.

Active teaching hours:	Theoretical: 18 hours (24 classes)	Practical: 6 hours (8 classes)

Methods of teaching

Classical teaching methods are used in the lectures with the use of modern information and communication technologies for interaction with students. Solutions to homework assignments are discussed during practical classes.

Knowledge estimation: (max 100 points)

Seminar work: 50 points, written exam: 50 points.