Syllabus for the course

"Convex and Algebraic Geometry 2"

Area of Specialisation: 01.06.01 Mathematics and Mechanics

Doctoral programs in

01.01.03 Mathematical Physics

01.01.04 Geometry and Topology

01.01.05 Probability Theory and Mathematical Statistics

01.01.06 Mathematical Logics, Algebra and Theory of Numbers

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Syllabus

A. Course Description

a. Title of the Course

“Convex and Algebraic Geometry 2”

Esterov A.

b. Prerequisites

No prerequisites

A.b.i. Course Type (compulsory, elective, optional)

Elective

c. Abstract

This course is aimed as an introduction to a variety of mathematical fields which all have a common theme – convex geometry. The classes consist of either a lecture or a talk by one of the students. The students are encourage to take one of the topics from the course as a research project.

B. Learning Objectives

- Acquaintance with the basic notions, methods, and problems of convex geometry.
- Acquiring an idea of the role of convex geometry in other areas of mathematics (algebra, geometry, analysis, etc.)
- Acquiring the skills of applying methods and constructions of convex geometry to scientific research in various areas of mathematics.
- Acquiring the ability for independent study of topical mathematical literature.

A. Learning Outcomes

- Knowledge of the basic notions, methods and problems of convex geometry.
- Skills of applying methods and construction of convex geometry in other areas of mathematics.
- Experience in independent study of topical mathematical literature

National Research University Higher School of Economics
Syllabus for the course “Convex and Algebraic Geometry 2” for PhD Programs, Area of Specialisation: 01.06.01 Mathematics and Mechanics

A. Course Plan

№	Topics
	2 semester
	Patchworking
	Bernstein-Kushnirenko Theorem
	Fiber polytopes and polyhedral subdivisions
	Tropical Geometry
	Coxter groups and polytopes
	Number of faces of a convex polytope

B. Reading List

Combinatorial algebraic geometry (lecture notes by different authors), freely available at http://web.math.unifi.it/users/ottavian/cimecirmcag/cimecirmcag.html

a. Optional

I. Dolgachev, Introduction to algebraic geometry, freely available at http://www.math.lsa.umich.edu/~idolga/631.pdf

C. Grading System

Homework, Exam

The resulting grade for current control is formed from the student's current results in the following way:

$O_{current} = 0,8 * O_{homework} + 0,2 * O_{independent\ work}$

The instructor grades the students independent work based on the how well they solved problems during the seminar.

The resulting final (midterm) grade is formed in the following way:

$O_{midterm/final} = 0,2 * O_{current} + 0,8 * O_{exam}$

I. Guidelines for Knowledge Assessment

Sample home tasks

- Prove that the Newton polytope of the product of several polynomials is equal to the Minkowski sum of Newton polytopes of the factors.
- Find the Ehrhart polynomial/ triangulation polytope of a given integer polytope.
- Classify the topological types of smooth real algebraic curves of degree 4.

- Classify unbounded convex bodies in the plane up to affine transformations.

A. Methods of InstructionThe classes consist of either a lecture or a talk by one of the students.

J. Special Equipment and Software Support (if required)

No requirements

Competences to be developed: UK-1, 2, 5, PK-1, OPK-1, 2 (according to *01.06.01 Mathematics and Mechanics* Educational Standard).