



The Hebrew University of Jerusalem

Syllabus

polytopes - 80679

Last update 18-09-2024

HU Credits: 2

Degree/Cycle: 2nd degree (Master)

Responsible Department: Mathematics

Academic year: 2025

Semester: 2nd Semester

Teaching Languages: English

Campus: E. Safra

Course/Module Coordinator: Eran Nevo

Coordinator Email: nevo@math.huji.ac.il

Coordinator Office Hours:

Teaching Staff:

Prof. Eran Nevo

Course/Module description:

Polytopes have fascinated humans since antiquity and are related to many areas of modern mathematics. We will study polytopes, focusing on connections between their geometric and combinatorial properties.

Course/Module aims:

Learning outcomes - On successful completion of this module, students should be able to:

Deduce combinatorial properties of polytopes from their geometry and convexity. To give a lecture to peers.

Attendance requirements(%):

Teaching arrangement and method of instruction:

Course/Module Content:

1. Faces of polytopes:
the face lattice, polarity, simple and simplicial polytopes, projective transformations. basic constructions (e.g. product, join, cyclic polytope, Gale's evenness condition).
2. Graphs of polytopes:
Tell a simple polytope from its graph - Kalai's proof, Balinski's theorem, refinement theorems, the Hirsch conjecture on diameter and Santos' counterexample.
3. Schlegel diagrams.
4. Gale duality.
5. *f*-vectors of simplicial polytopes: *Dehn-Sommerville relations, McMullen's upper bound theorem and shellability; Barnette's lower bound theorem and rigidity; the *g*-theorem.*
6. Fiber polytopes: *the associahedron and the permutohedron.*
7. Realization spaces of polytopes.
8. Subfamilies: *centrally symmetric polytopes, cubical polytopes, balanced polytopes.*

Required Reading:

Günter Ziegler, Lectures on Polytopes

Additional Reading Material:

Branko Grünbaum, Convex Polytopes

Igor Pak, Lectures on Discrete and Polyhedral Geometry

Grading Scheme:

Presentation / Poster Presentation / Lecture 80 %

Attendance / Participation in Field Excursion 20 %

Additional information: