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: 0

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.

<u>*Required Reading:*</u>
  G¨unter Ziegler, Lectures on Polytopes

 <u>*Additional Reading Material:*</u>
  Branko Gr¨unbaum, Convex Polytopes

Igor pak, Lectures on Discrete and Polyhedral Geometry

 <u>*Grading Scheme:*</u>
  Presentation / Poster Presentation / Lecture 80 %
  Attendance / Participation in Field Excursion 20 %

<u>*Additional information:*</u>