

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY
FACULTY OF MATHEMATICS

Handout 1
General Information

Spring 2023
106929

106929 - Selected Topics in Analysis 2

Instructor: Prof. Igal Sason (office: Meyer 652, e-mail: sason@ee.technion.ac.il).

Time and Location: Ulman 200 – Monday 10:30–12:30, and Tuesday 13:30–14:30.

Pre-requisites: Algebra A, Infi 2, Introduction to Probability Theory, Combinatorics.

Credit Points: 3.0. A joint undergraduate and graduate course.

Grading: Four homework assignments, and a personal discussion at the end of the semester.

Language: The course is taught in English.

Tentative course outline (39 hours):

1. Elementary inequalities & applications in probability, geometry, and graphs (12 hours).
2. Spectral graph theory with applications (10 hours):
 - Spectra of graphs with applications (e.g., the friendship theorem).
 - Strongly regular graphs.
 - Expanders and Ramanujan graphs; the Alon–Boppana bound.
3. Three combinatorial theorems on finite sets with applications (5 hours):
 - Sperner’s theorem;
 - Erdős-Ko-Rado theorem, and Kneser Graphs;
 - The sunflower lemma with applications.
4. Elements of majorization theory and Schur convexity with applications (6 hours).
5. Topics in analytical number theory (6 hours):
 - The infinitude of primes, and Bertrand’s postulate.
 - Cotangent and the Hergolz trick; Riemann’s function at even values.
 - Catalan numbers with applications.

REFERENCES

- [1] M. Aigner and G. M. Ziegler, *Proofs from the Book*, Springer, 6th edition, 2018.
- [2] A. W. Marshall, I. Olkin and B. C. Arnold, *Inequalities: Theory of Majorization and Applications*, second edition, Springer, 2009.
- [3] B. Nica, *A Brief Introduction to Spectral Graph Theory*, European Mathematical Society, 2018.
- [4] M. Steele, *The Cauchy-Schwarz Master Class*, Cambridge University Press, 2004.