Polynomial Methods in Combinatorics
MATH 60610
Fall 2018
Professor Abdul Basit

This course will explore recent applications of polynomials and algebraic geometry to combinatorics and other areas of mathematics. The "polynomial method", as it has come to be called, has seen several surprising and elegant applications to problems in combinatorial geometry, harmonic analysis, number theory and computer science. More recently, there have been several results in model theory related to this approach.

Early examples of the use of this method include the finite field Kakeya problem, the joints problem, and the distinct distance problem in the plane. All of these were considered deep and difficult problems in combinatorial geometry. The first main goal of the course will be to study these proofs.

The next goal of the course will be to study connections to other areas mentioned above. This would depend on the interest of the audience, and would likely involve studying more recent applications of these ideas to combinatorics (such as the cap sets problem) and model theory (such as generalizations of combinatorial theorems to model theoretic structures).

The first part of the course will use the text: "Polynomial Methods in Combinatorics" by Larry Guth (ISBN: 978-1-4704-2890-7). For the remainder of the course, we plan to study recent results (since this is an active area of research, no book in itself can do the course justice).