M.Sc. in Applied Mathematics, Diploma Thesis Topics 2026
University of Debrecen, Institute of Mathematics

Convergence properties of one and multidimensional trigonometric Fourier series
Thesis supervisor: Dr. György Gát
Topic description: Investigation of the convergence properties of one and multidimensional trigonometric Fourier series: Rectangle, triangle and spherical partial sums and means. The main aim is to descriebe some known summability methods: Cesaro, de la Vallee-Poussin, Picard and Bessel, Riesz and Weierstrass means. An outlook to theta summation.

Finite projective planes
Thesis supervisor: Dr. Ágota Figula
Topic description: We describe some interesting examples of finite projective planes, for instance: cyclic planes, planes which do not satisfy the Desarguesian theorem, planes of order 2, 3, ….

Invariant functionals
Thesis supervisor: Dr. Eszter Novák-Gselmann
Additional information: Reliable foundation from the following fields is needed: Measure and integration, Functional analysis, Topological spaces and Group theory.
Topic description: Topics intended to be studied can be found in the monograph of Edwin Hewitt and Kenneth A. Ross entitled *Abstract harmonic analysis* and are the following:

- The Haar measure and the Haar integral
- Invariant means defined for all bounded functions
- Invariant means for mean periodic functions

Lie theory
Thesis supervisor: Dr. Ágota Figula
Topic description: Lie theory provides a powerful framework for studying continuous symmetries in mathematics and physics. This thesis introduces the basic concepts of Lie groups and Lie algebras, focusing on their structure, representations. We study classical examples such as matrix Lie groups and their associated Lie algebras, and investigate applications in differential equations, geometry, or physics.
Suggested Literature: Hilgert-Neeb: Structure and Geometry of Lie groups, Springer

Numerical methods for partial differential equations
Thesis supervisor: Dr. Borbála Fazekas
Requirement: Knowledge on partial differential equations.
Topic description: The aim of this work is to demonstrate the finite elements method for solving partial differential equations.

Real-world convex optimization problems
Thesis supervisor Dr. Tibor Kiss
Topic description: The aim of the thesis is to provide an overview of the fundamental concepts of convex analysis and the key tools and results used in convex optimization. The student also examines real-world examples that can be effectively addressed using convex optimization methods.

The ice cream shop location problem
Thesis supervisor: Dr. Zoltán Boros
Topic description: Finding the equilibrium states for several ice cream makers, assuming that each of them looks for a position that maximizes his/her income, is a classical problem in applied game theory. We consider this problem for positions taken at a point from an interval as well as for positions chosen from a finite set.

The Mordell-Schinzel problem
Thesis supervisor: Dr. Szabolcs Tengely
Requirement: LaTeX
Topic description: Mordell stated that the equation xyz=G(x,y) has infinitely many integral solutions, where G is a polynomial with integral coefficients. There are nice results if the degree of G is 2 or 3, here the goal is to study the degree 4 case.

Tomography
Supervisor: Dr. Ábris Nagy
Topic description: Tomography is a discipline, where images of cross-sections of a body are produced in order to reveal the inner structure of the body. During a CT-scan, x-ray beams penetrate through the human body and the change of intensities of these beams are measured. Then the inner structure is revealed with the help of mathematical computations. However, tomographic examinations can be applied not just for the human body, but structures made of metal, or a piece of rock, or even the Earth's atmosphere. The mathematical problem is to reconstruct an unknown distribution of a physical quantity with the knowledge of the values of its line integrals. The discrete version of this problem is when we wish to find an unknown finite point set in the plane having only the number of elements contained by a finite set of lines. Discrete tomography deals with the solution of this problem, where methods of combinatorics and graph theory arise naturally. The reconstruction of binary matrices by their line and column sums is a special topic where several different solution methods can be applied.