CEU

Department of Mathematics and its Applications

Accreditation

- Our **PhD** program is registered to grant PhD in Mathematics and its Applications by the Board of Regents of the University of the State of New York (U.S.A.) for, and on behalf of, the New York State Education Department.
- In 2008/09 we will launch a **Master of Science (MS) Program** in Applied Mathematics

PhD Program
The main strengths

- The faculty team includes well-established mathematicians. Most of them come from the Alfréd Rényi Institute of the Hungarian Academy of Sciences.
- Outstanding scholars are also invited regularly to teach our students, e.g. H. Brezis, France, and Peter D. Lax, U.S.
- The list of courses covers major branches in both mathematics and its applications, making the program extremely attractive and flexible

Our Students

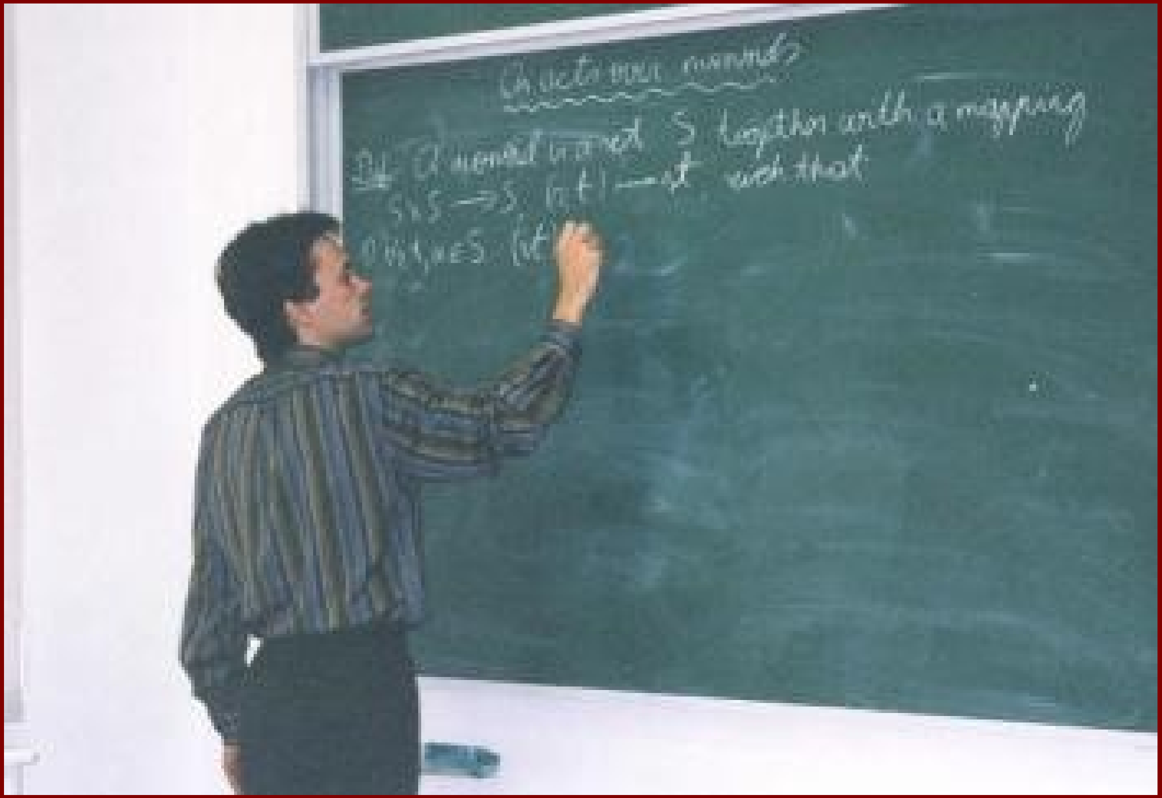
- 19 students
  in total
- Hungarians, 8
  Americans, 2
  Slovakian, 1
  Romanians, 4
  Swedish, 1
  Swiss, 1
  German, 1
  Bulgarian, 1

Our Students

What do the students get here?

- Excellent faculty
- Small classes, with possibilities for discussions, questions
- Wide rage of classes to chose from
- Study room equipped with computers, departmental library and study space
- Full CEU Fellowship, covering all tuition and living expenses
- Research abroad, supported by CEU
- The teeming Budapest mathematical life

Research, Publications and Public Lectures



Public Lectures

Apart from having an outstanding faculty, we invite excellent mathematicians year to year to give public lectures and to meet our students

During the 2004/2005 Academic Year we already had the pleasure to host Professor **PETER D. LAX**, holder of the Wolf Prize (Nobel Prize in Mathematics), and member of several academies

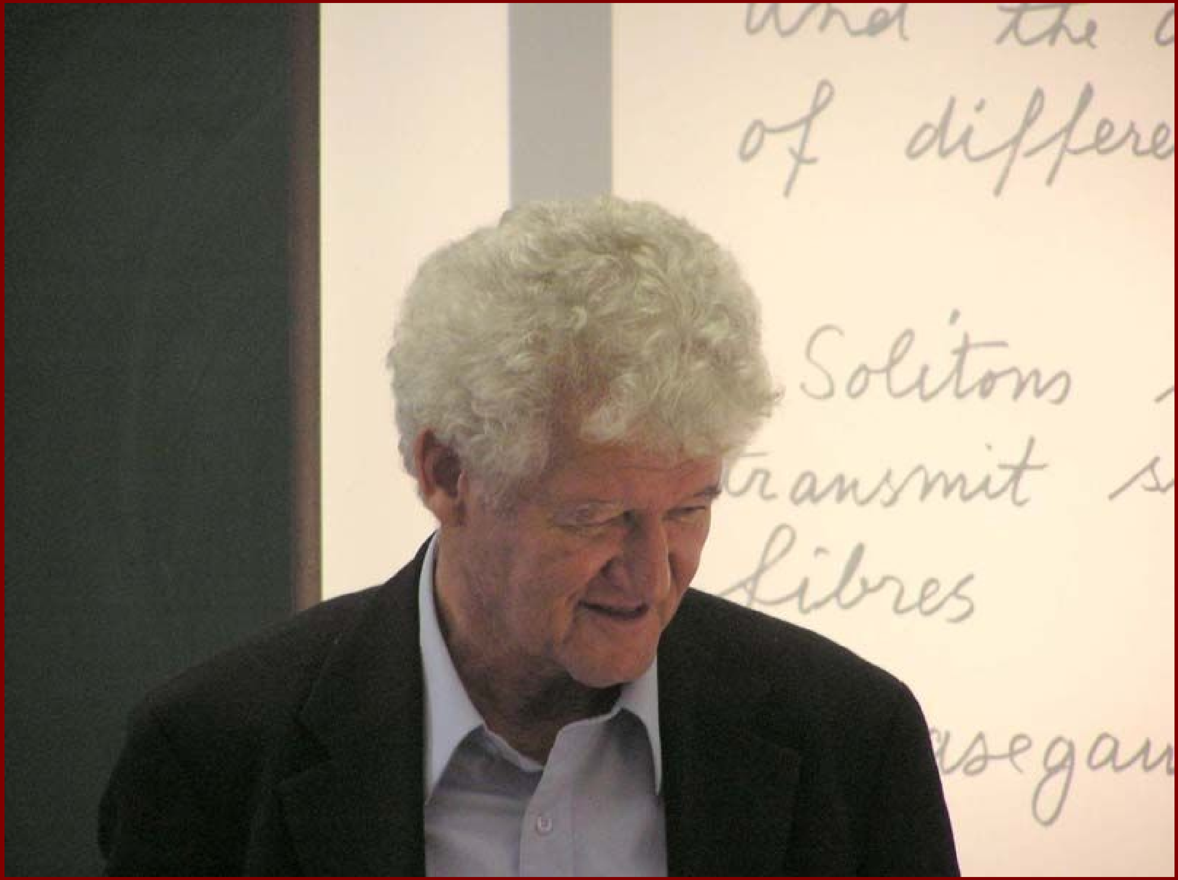
Public Lectures

In 2006 we further had the pleasure to host Professor **Haim Brezis**, Paris VI and Rutgers University, outstanding scholar and member of several academies

The Department also hosts several Post-Doc Fellows each year, who also give public lectures and interact with students

Public Lectures

Professor Peter D. Lax giving a lecture at CEU on October 8, 2004



Public Lectures

Professor Haïm Brézis, May 5, 2005

Research

Due to our large number of faculty, we cover a wide range of research areas both in pure and in applied mathematics.

Algebra

- Analysis
- Combinatorics
- Number Theory
- Algebraic Geometry
- Differential Topology
- Probability & Statistics
- Set Theory & Logic

How to apply?

How to apply?

- WHO: Students holding at least a BSc degree in Mathematics, Physics, Computer Science, Engineering, with a strong background in mathematics
- HOW: Applicants should follow the general CEU regulations

Application Procedure

- In addition, applicants have to prove familiarity with fundamental undergraduate material by taking either a written Mathematics Exam or the GRE Subject Test in Mathematics.
- Alternatively, candidates will be interviewed.

Preparing for the MATH Examination

Preparing for the MATH examination

- Interested applicants can find details of the topics covered and also copies of the Mathematics Entrance examinations from 2003 and 2004, with solutions on our web page at

http://www.ceu.hu/math/ProsStud/entrance-exam.html

Preparing for the MATH examination

Central European University
Department of Mathematics and Its Applications

Entrance Examination: March 6, 2004

Directions: This exam has 10 problems (*10 points each*). To receive full credit your solution must be clear and correct. You have 3 hours. No books or notes.

1. a) Let $\{c_n\}$ be a sequence of real numbers that converges to c. Show that their "average" (arithmetic mean), $S_n = \frac{1}{n}(c_1 + c_2 + \cdots + c_n)$, also converges to c.
   b) Give an example of a sequence that does *not* converge but whose arithmetic mean does converge.

2. a) Let $A = (a_{ij})$ be a self-adjoint $n \times n$ complex matrix (so $a_{ij} = \bar{a}_{ji}$). If it satisfies $A^m = 1$ for some *odd* positive integer m, show that A is the identity matrix.
   b) Does the same conclusion hold for m even? (Justify your assertions.)

3. Let $f(x)$ be a real-valued continuous function defined for all $0 \leq x \leq 1$. Show that
$$\lim_{n\to\infty} \int_0^1 f(x^n)\, dx$$
exists and compute this limit. Justify your assertions.

4. Show that in a group any subgroup of finite index contains a normal subgroup of finite index.

5. Let $f : \mathbb{R} \to \mathbb{R}$ be a differentiable function with continuous derivative. Suppose $|f'(x)| \leq 2$ for all x. Show that there exists $c > 0$ such that the function $g : \mathbb{R} \to \mathbb{R}$ defined by
$$g(x) = x + cf(x)$$
is a bijection (that is, one-to-one and onto) with differentiable inverse.

6. For each of the following, either give an explicit example or else explain briefly why no such example exists.
   a) An ideal $I \subset \mathbb{R}[x]$ which is not principal.
   b) A unique factorization domain which is not a Euclidean domain.
   c) $p(x),\ q(x) \in (\mathbb{Z}/6\mathbb{Z})[x]$, both non-constant, such that $p(x)q(x) = x$.

7. Consider a smooth real-valued function $u(x, y) = u(r)$ that depends only on $r = \sqrt{x^2 + y^2}$.
   a) Compute the Laplacian, $\Delta u := \dfrac{\partial^2 u}{\partial x^2} + \dfrac{\partial^2 u}{\partial y^2}$.
   b) Find all such functions $u = u(r)$ that satisfy $\Delta u = 0$ (except possibly at the origin).

8. Let F be a finite field of odd order and a, b, c nonzero elements of F. Show that the equation $ax^2 + by^2 = c$ has a solution over F in x, y.

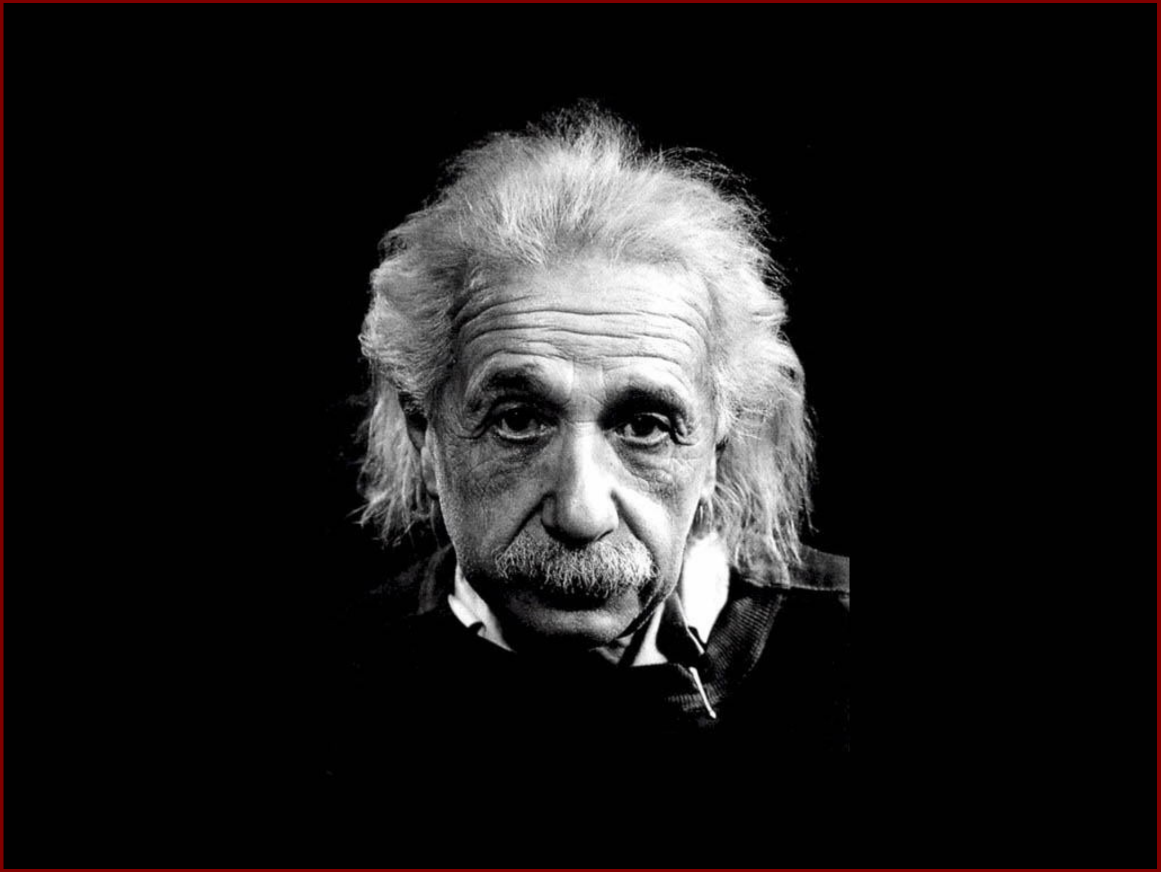
9. Prove that every finitely generated subgroup of the group of rational numbers with respect to the addition is cyclic.

10. Consider the infinite series $\displaystyle\sum_{n=1}^{\infty} \frac{a_n}{n^x}$ where x is a real number. Assume the real sequence $\{a_n\}$ is bounded. Prove that for any $c > 1$ this series converges uniformly for x in the interval $x \geq c$.

What are we searching for?

- We are looking for good students from all over the world
- Cooperation with Mathematics Departments in the region
- Exchange of our Math Research Preprint Series for other such publications

What are we searching for?



- "Everything should be made as simple as possible, but not simpler."

Further information

- For further information, please consult our web page at

http://www.ceu.hu/math

or contact us

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