2025 ICTP-EAUMP SUMMER SCHOOL ON REAL AND HARMONIC ANALYSIS

University of Rwanda, Kigali, Rwanda, July 21 to August 01, 2025

Outline

The proposed School is the next one in a series of summer schools organized in a collaboration between the Eastern Africa Universities Mathematics Programme (EAUMP), ICTP - Trieste, and recently CIMPA/AMU under the African Mathematical Schools programme. In 2025, we are proposing to organize a two-week School on the theme of Real and Harmonic Analysis. The planned host and location of the school is the Department of Mathematics of the University of Rwanda, Kigali, Rwanda.

EAUMP is a collaboration between Mathematics Departments in Eastern Africa, started in 2002 with core funding from the International Science Programme (ISP) based at Uppsala University in Sweden. One of its main aims is to improve the pure mathematics Masters and Postgraduate training in the region. The member Universities of the EAUMP are University of Dar es Salaam, Tanzania; University of Nairobi, Kenya; University of Zambia, Zambia; University of Makerere, Uganda; University of Rwanda, Rwanda.

The ICTP-EAUMP schools, recently all designated as African Mathematical Schools by CIMPA also, have formed a cornerstone of pure mathematics Masters education in East Africa and beyond. The most recent schools were organized in 2019 at Makerere University, Uganda on Algebraic Topology; in 2021 as a remote school on Topics in Concrete Mathematics; in 2022 in Nairobi, Kenya on Mathematical Programming; in 2023 in Arusha, Tanzania on Enumerative Combinatorics; and in 2024 in Kampala, Uganda on the Mathematics of AI. All schools attracted between 30 and 45 participants. Alongside ISP/EAUMP, ICTP and CIMPA/AMS funding, the schools have received additional funding from the London Mathematical Society, Elsevier, the Compositio Foundation, as well as the participating institutions.

Our proposed theme for 2025, real and harmonic analysis, brings fundamental tools to a wide range of applications within pure and applied mathematics related to, for instance, partial differential equations, complex analysis and number theory (in the more pure side) and signal processing, image reconstruction and data analysis (in the more applied side). The topics complement well some of the areas of interest of the local community (e.g. in classical analysis, ODEs and PDEs, and data science), and have not been very explored in previous editions of this series of schools. We hope some students of the course will consider applying to the existing further education programmes available in this area.

Lead International Coordinators of the School are: Prof. Balazs Szendroi, University of Vienna, Austria (balazs.szendroi@univie.ac.at) and Prof. Emanuel Carneiro, ICTP, Italy (carneiro@ictp.it).

Lead Local Organiser of the School is Dr. Celestin Kurujyibwami, University of Rwanda, Rwanda (celeku@yahoo.fr).

Description of the School

Aims

- To introduce the participants to some of the basic tools in real and harmonic analysis, and provide connections to some of the modern applications.
- To provide a forum for African mathematicians to interact, exchange ideas and initiate collaborations.
- Identify talented students for possible PhD programs.
- To produce digital lecture material for dissemination, which contributes to the training of master students in the Eastern Africa region.

Dates of the school and workshop

The School and Workshop will run from July 21 to August 01, 2025 (Mon-Fri for two weeks).

Junior participants

The expected number of in-person junior participants will be around 40, including 20 from Rwanda, 4-5 from Kenya, Tanzania and Uganda, 3 from Zambia, and around 4-6 participants from elsewhere in Sub-Saharan Africa, recruited via an electronic application process hosted by ICTP. We expect a minimum of 15 female participants. The target group will be Masters and Doctoral students.

School programme

Here is the proposed course structure. There will be 6 minicourses, 3 per each week.

Course structure

Week 1: Core material - (1) Essentials of real analysis; (2) Essentials of Fourier analysis; (3) Introduction to the theory of singular integrals and regularity of elliptic PDEs.

Week 2: Modern themes and applications - (4) Sampling, Interpolation and Fourier uncertainty principles; (5) Discrete harmonic analysis and connections to boolean analysis and computer science; (6) Hilbert spaces of entire functions and connections to complex analysis and differential equations.

Lecturers and subjects (details still to be clarified)

Emanuel Carneiro (ICTP, Italy): Essentials of real analysis
Andrea Olivo (BCAM - Bilbao, Spain): Essentials of Fourier analysis
Gabrielle Nornberg (CMM - Universidad de Chile): Regularity of elliptic PDEs.
Luz Roncal (BCAM - Bilbao, Spain): Theory of singular integrals.
Mateus Sousa (BCAM - Bilbao, Spain): Sampling, interpolation and uncertainty.
Job Bonyo (Multimedia University, Kenya): Complex analysis and operator theoy.
Diogo Oliveira e Silva (IST - Lisbon, Portugal): Discrete harmonic analysis.
Celestin Kurujyibwami (University of Rwanda): Connections to Lie Theory and Differential Equations.

Teaching assistants

As in previous years, we will work with teaching assistants from the region.

Sample daily timetable

- 9am - 10am Lecture Session 1, followed by coffee break.

- 10:30am - 11:30am Lecture Session 2.
- 11:30am - 12:30am Lecture Session 3, followed by lunch break.
- 2pm - 3pm Problem Session 1.
- 3pm - 4pm Problem Session 2, followed by tea break
- 4:30pm - 5:30pm Problem Session 3 and then close.

Local organizing committee

- Celestin Kurujyibwami (University of Rwanda)
- Minani Froduald (University of Rwanda)
- Banzi Wellars (University of Rwanda)
- Denis Ndanguza (University of Rwanda)
- Solange Mukeshimana (University of Rwanda)
- Venuste Nyagahakwa (University of Rwanda)

Scientific organising committee

- Emanuel Carneiro (ICTP, Italy)
- Stephen Luketero (University of Nairobi, Kenya)
- John Mango (Makerere University, Uganda)
- Balazs Szendroi (University of Vienna, Austria)
- Mateus Sousa (Basque Center for Applied Mathematics, Spain)
- Bengt-Ove Turesson (ISP, Uppsala University, Sweden)
- Paul Vaderlind (Stockholm University, Sweden)

Evaluation

Student progress will be evaluated by mini-projects: participants will be asked to submit mini-projects on the material studied at the School at the end of each week.
As in previous years, feedback will be collected at the end of the course.

Venue

The school will be held at the University of Rwanda, Rwanda. Accommodation, lecture rooms and catering facilities all available on campus or nearby. This venue was successfully used in the past for summer schools.

Applications are now open:

https://indico.ictp.it/event/10852

Deadline for applications is April 01.