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INTERMATHS

September 2020 - September 2026

Erasmus Mundus Joint Master
Degrees

Interdisciplinary Mathematics



Objective

"InterMaths - Interdisciplinary Mathematics" is a newly formed Consortium of five European universities: University of L'Aquila (UAQ, Italy), Autonomous University of Barcelona (UAB, Spain), University of Côte d'Azur (UCA, France), TU Wien (TUW, Austria) and TU Hamburg (TUHH, Germany). The programme addresses applications of Mathematics to Biomedical Sciences and Industrial Engineering, with the twofold aim of producing professional scientists with enhanced mathematical competences for European private industries and enterprises and, at the same time, introducing a unique, integrated, advanced joint programme in Applied Mathematics in the EMJMD catalogue, in line with cutting-edge domains of science and technology. A group of private enterprises will join the programme as "industrial partners", providing co-supervision and placements in the thesis semesters. InterMaths stems from a deep and complex networking process touching key items of European integration such as higher education, mobility, transfer of knowledge. As part of such process, some Universities from Eastern Europe are part of the Consortium as Associated Partners in view of existing double-degree agreements with UAQ.

Social impact

InterMaths addresses challenges in today's society in the areas of Biomedical Sciences, Industrial Engineering and Logistics. It does so by forming professional scientists with interdisciplinary skills, equipped with expertise in advanced mathematical modelling and scientific computing, who are able to translate real-world problems into complex models, to solve them in reasonable time and

InterMaths is structured as follows:

- Semester 1 based in UAQ, common to all students on Foundations of Applied Mathematics;
- Semester 2 based in TUHH or TUW focused on Numerical-Modelling Training;
- Semester 3 based in one of the five partner universities focused on Interdisciplinary Training, with each partner covering a specific specialization branch;
- Semester 4 entirely devoted to the elaboration of the Master's Thesis.

Semester 3 consists of a set of advanced competences on selected interdisciplinary mathematical methodologies, each one focusing on a field of application depending on the branch:

- UAQ#1: Cancer Modelling and Simulation
- UAQ#2: Modelling and Simulation of Infectious Diseases
- TUHH: Computational Methods in Biomedical Imaging
- TUW: Computational Fluid Dynamics in Industry
- UCA: Stochastic Modelling in Neuroscience
- UAB: Decision Making and Applications to Logistics

All the departments involved have a common topic in the key expression "mathematical modelling", which represents the methodological "glue" of the five branches.

at reasonable cost, and to apply them in specific practical situations in a team with scientists from other disciplines. Furthermore, the programme brings together students from many different countries with a large variety of views and backgrounds, and gives them a joint mathematical education, thereby emphasizing how science can and needs to overcome barriers to advance society.

Contribution of TUHH to the project

The mathematical education for InterMaths students at TUHH is offered by the School of Electrical Engineering, Computer Science and Mathematics at TUHH and also involves teaching staff from the Department of Mathematics at the University of Hamburg. In the first part, it puts an emphasis on courses that concentrate on numerical methods for ordinary differential equations, parallelization and programming, as well as courses on Probability Theory and Variational Calculus.

This is followed by a second part that addresses both classical and modern mathematical modelling and simulation techniques in biomedical imaging. In total, this part conveys an understanding of the complete range of engineering, programming and mathematical aspects of biomedical imaging. It contains courses on Computer Tomography (covering the mathematical instruments involved in the process of transforming data into images with a particular focus on CT and MRI), on Medical Imaging (geared towards the underlying physics of imaging and the respective numerical algorithms and their

efficient implementation), on Mathematical Image Processing (dealing with concepts of image processing and their mathematical background), on Advanced Machine Learning (giving a thorough overview on theory and applications of neural networks) and finally a course on Intelligent Systems in Medicine (providing another perspective by addressing topics such as kinematics, tracking systems, navigation and image guidance in clinical contexts).

The study programme is managed by a local coordinator at TUHH, who is in close contact with his colleagues at the partner universities to ensure a smooth running of the overall programme. In addition, a project assistant takes care of the non-academic affairs of the programme at TUHH. In particular, she provides detailed support regarding visa and enrolment, accommodation, health insurances, study counselling and a lot of practical information to guide the students safely through this demanding study programme in Hamburg.

Partners



TUHH
Technische
Universität
Hamburg



UAB


UNIVERSITÉ
CÔTE D'AZUR

Contact

TUHH

Hamburg University of Technology
Institute of Mathematics

Prof. Anusch Taraz | taraz@tuhh.de
Am Schwarzenberg-Campus 3, 21073 Hamburg

Tutech

Tutech Innovation GmbH
Consultancy & Competence Development

Monica Schofield | euoffice@tutech.de
Harburger Schloßstrasse 6-12, 21079 Hamburg



NZEBRA

September 2023 - August 2026

ERASMUS-KA220-HED

Intensive blended course in Climate Neutral Buildings to address nZEB regulation and complex behavior of buildings



nZEBRA

Objective

The nZEBRA project aims to develop an intensive blended learning course in the form of a summer school, on climate neutral buildings, to meet new requirements for complex conditions and nearly zero energy buildings, which means that the buildings should have nearly zero energy consumption required. The course will be at a graduate level and be based on micro-credentials.

Interdisciplinary and challenge-based in its nature, the course seeks to empower master students in architecture, civil and energy engineering and the like, to design innovative solutions for climate neutral buildings. It will address the labour market demand for high-qualified professionals in the field, thus contributing to the global actions towards mitigating climate change.

A course methodological framework will be co-created based on field study, including online surveys, focus groups, interviews, and design-thinking sessions.

The course content will include theory and challenge- and project-based learning scenarios (CBL, PBL) to activate students. A train-the-trainer toolkit will be designed to address the needs for training in BIM/BEM software and CBL pedagogy. Learning and teaching activities will validate the innovative blended learning course among research, businesses, and learners.

The nZEBRA project hopes to result in creating an intensive blended course on climate neutral buildings. It will be composed of a methodological framework, which outlines an innovative course syllabus, blending in-class education with virtually facilitated individual and group assignments. The course is divided into theoretical content and a course booklet with challenge-based & project-based learning scenarios, and based on micro-credentials. A train-the-trainer toolkit will tackle students' educational needs.

Societal impact

The nZEBRA project is dedicated to the development of an intensive blended course focusing on Climate Neutral Buildings, employing a micro-credentials assessment framework. A significant social repercussion of this initiative lies in its capacity to inspire students, aspiring engineers, and designers, fostering a heightened awareness of the social dimensions inherent in sustainable construction. This includes considerations for user comfort, living standards, and the broader societal implications of environmentally conscious architectural practices.

The courses developed within the nZEBRA project will seamlessly integrate disciplines such as architecture, civil

engineering, energy, and material engineering. This interdisciplinary approach aims to provide a comprehensive understanding of sustainability aspects in building design, construction, and performance. Consequently, learners will be equipped to elevate their societal consciousness, recognising their role within a collaborative working environment that respects diverse disciplines, thus contributing to multifaceted solutions. Ultimately, the course will serve as a guiding pathway towards efficient ownership and leadership in the realm of sustainable construction.



Contribution of TUHH to the project

In the context of the nZEBRA project, the Institute of Circular Resources Engineering and Management (CREM) at TUHH assumes a pivotal role in generating educational materials pertaining to Life Cycle Assessment (LCA), low embodied carbon, and recycled materials. This contribution encompasses the creation of challenge-based learning scenarios intended for use in the short-term nZEBRA

blended course, as well as in other opportunities for continuous learning with accredited European Credit Transfer and Accumulation System (ECTS) credits. Furthermore, CREM will spearhead the piloting of the course through the implementation of summer schools tailored for students within the university.

Partners



Contact

TUHH
Hamburg University of Technology
Institute Circular Resource Engineering and Management
Prof. Kerstin Kuchta | kuchta@tuhh.de
Blohmstrasse 15, 21079 Hamburg

Tutech
Tutech Innovation GmbH
Consultancy & Competence Development
Monica Schofield | euoffice@tutech.de
Harburger Schloßstrasse 6-12, 21079 Hamburg



ZERO C

November 2023 - October 2026

ERASMUS-EDU-2023-CBHE

Enhancing Knowledge and Skills at WB HEIs in Preparation for Zero Carbon Maritime Transport and Logistics Society

Objective

The Paris Agreement's goals are being addressed by the International Maritime Organization (IMO) and the European Union (EU) who have established policies to decrease Greenhouse gas (GHG) emissions in the shipping sector for maritime transport, logistics, and port operations. Over the coming years, these policy reforms will force ship owners and builders to find ways to improve their ship's and port's energy efficiency and install new or retrofit existing ship's engines for supporting new marine fuels with lower carbon intensity. These policy reforms ultimately support the goal of achieving zero carbon emissions in the sector. The demand for enhanced energy efficiency and decarbonisation will drive optimisation in logistics and port operations. The Zero C project aims to provide students in Albania and Montenegro with the required competencies to face these challenges. Therefore, the educational capacities of the West Balkan Higher Education Institutes will be increased and improved.

The project's main activities include developing of shipping industry specific skills-oriented course catalogues and innovative teaching / training materials and method

ology. Furthermore, lecturers will be provided with state-of-the-art equipment for supporting industry skills-oriented courses for students and professionals (for lifelong learning). To create the required capacities, a know-how transfer to the Higher Education Institution staff in specific topics will be initialised and a regional network of stakeholders in the shipping sector will be established.

The Zero C project will benefit at least 50+ staff and 300 students from West Balkan Higher Education Institutes, as well as 60 professionals from WB shipping and port companies and governmental institutions. The project's outputs will be delivered through 4 work packages and 15 deliverables.

Societal impact

Within the framework of the Zero C project, the educational capacities of the higher education institutions in the Western Balkans are being increased and improved. Thus, Zero C contributes to educational equity in these countries. In addition, the teaching content developed as part of the Zero C project deals mainly with the climate crisis. Students learn how to encounter this challenge

from a technical and legal perspective and how to develop solutions for the shipping industry in the Mediterranean region. Ultimately, the project aims to create a Zero C network in order to continue the joint activities after the end of the project.



Contribution of TUHH to the project

As a scientific partner, the researchers from the Institute of Maritime Logistics of TUHH will support the West Balkan Higher Education Institution to develop modern curricula dedicated to maritime decarbonization, energy efficiency and port logistics optimization for students and professionals. Therefore, together with the consortium a skill matrix comprising strategic skills within maritime logistics will be defined. Modern teaching materials are developed, which convey relevant content using innovative teaching

methods such as problem-based learning, flipped classroom, and cutting-edge media (e.g. TikTok and Instagram). Eventually, the TUHH will invite the project participants to Hamburg and offer training but also visit the partner and offer guest lectures and contribute actively to the Zero C network.

Partners



Contact

TUHH

Hamburg University of Technology
Institute of Maritime Logistics

Marvin Kastner | marvin.kastner@tuhh.de
Am Schwarzenberg-Campus 4 (D), 21073 Hamburg

Tutech

Tutech Innovation GmbH
Consultancy & Competence Development

Monica Schofield | euoffice@tutech.de
Harburger Schloßstrasse 6-12, 21079 Hamburg