Computational and Applied Mathematics (CAM)
Master of Science

1. Content of the degree programme

This degree programme is designed for students who appreciate rigorous mathematical analysis or scientific computing to predict phenomena or to optimize processes in the sciences and in engineering.

The students acquire a firm grounding in mathematical modelling and applied analysis as well as in high-performance computing. They learn to derive mathematical models and to reflect upon the models' properties and limitations. CAM aims at making students familiar with current research topics in applied mathematics.

CAM is open to applicants from all over the world. Hence, all mandatory and mandatory elective courses in this international programme are taught in English. Students acquire the mathematical knowledge and the cultural and communicative skills which are needed on international job markets.

Every student specializes in two of the three fields:

- Modelling and Applied Analysis (MApA),
- Numerical Analysis and Simulation (NASi),
- Optimization (Opti).

Hence, every student selects one of the three study areas MApA-NASi, MApA-Opti, NASi-Opti. Following his/her specialization and interests, every student chooses from a basket of mandatory elective courses. The subjects of the mandatory elective courses reflect the mathematical research pursued at the FAU. They range from modelling, analysis of partial differential equations (pde) and numerical simulation in mathematical continuum mechanics (transport processes in complex multi-phase flow, fluid-structure interactions) over multiscale analysis and mathematics in the life sciences to various fields of mathematical optimization, including shape optimization, optimization with pde and discrete optimization.

2. Structure of the degree programme

The standard time to degree is four semesters (two years). Students must acquire 120 ECTS. The programme is structured as follows:

- I. Mandatory part (35 ECTS):
  In the first and second semester, all participants take:
  - i. two courses in modelling and analysis in continuum mechanics (15 ECTS), and
  - ii. two courses on programming techniques and architectures for/of supercomputers (15 ECTS), and
  - iii. a practical course on modelling, simulation, and optimization (5 ECTS).
- II. Mandatory elective part (40 ECTS):
  The student makes his/her selection from a large basket of courses especially designed for CAM. Each course is assigned to one of the three fields of specialization - MApA, NASi, Opti.
- III. Elective modules (15 ECTS):
  Some courses - up to 15 ECTS - may be chosen from the entire portfolio of master level courses offered at the university. This allows to follow up individual interests beyond mathematics or in other fields of mathematics. However, if desired, also courses from the CAM basket (see II.) can be chosen as elective modules.
- IV. The master phase (30 ECTS):

Usually starting in the fourth semester, students have six months to write their Master's thesis on an individual research project from one of the two chosen specialization fields (MApA, NASi, Opti) under the guidance of a professor. Before, they got acquainted with the subject in a master seminar. They present their findings in a master colloquium.

As for the choice of the modules, at least 65 ECTS have to belong to the chosen study area (MApA-NASi, MApA-Opti, NASi-Opti). This comprises the 30 ECTS for the master phase [IV.] and the 5 ECTS for the practical course (I.-iii.). The courses of I.-i. are attributed to MApA.

Every student chooses a professor from the Department of Mathematics as a mentor. The mentor gives the student advice how to design the study plan in accordance with the student's individual interests.

3. Admission requirements

The requirement for admission to the Master's degree programme is a Bachelor's degree in a mathematical programme (mathematics, industrial mathematics/technomathematics, econ-omathematics), or in a closely related field with a substantial content of mathematical courses (45 ECTS).

Basic knowledge in functional analysis and, depending on the aspired specialization, in optimization or in numerics of partial differential equations is recommended.

Furthermore, applicants need to prove their English proficiency on CEFR level 'English level B2 vantage or upper intermediate' (CEFR: Common European Framework of Reference for Languages). This may also be proven through six years of English classes at a German secondary school (Gymnasium). It is also sufficient if the university entrance qualification or the Bachelor's degree was acquired in an anglophone programme.

Qualification or aptitude for the Master's degree programme is examined in the qualification assessment process. Applicants with a degree not in mathematics, but in a related field, can only be admitted after passing an oral exam. The criteria in this oral exam are:

- basic knowledge in functional analysis or in the theory of differential equations,
- basic knowledge in numerics or in optimization,
- ability for discussion on mathematics in English, e.g., on the applicant's Bachelor's thesis.

Applications for the Master's degree programme must be submitted to FAU's Master's Office online via 'campo' and by post; the deadline is July 15th for the subsequent winter semester. See [9].

4. Career prospects

The degree programme prepares graduates for a broad spectrum of professional tasks, including the analysis of complex processes, their mathematical modelling, their computer-based solution by mathematical methods, and the development of mathematical software. Graduates are able to perform research-oriented and application-oriented projects in business, industry, and universities - self-reliant or in international working

groups. Typical employment fields are research and development in business and industry (automotive industry, electrical industry, machine building industry), the software industry, consulting, banking and financial industry, and academia.

5. Addresses

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https://mp.fsi.fau.de/

6. More Information online

[1] **Department of Mathematics** website: www.math.fau.de
[2] Information on the **Master's programme CAM**:
www.studium.math.fau.de/cam
[3] **Module catalogue**:
www.math.fau.de/wp-content/uploads/2020/04/Modulkatalog_CAM_2020-03-23.pdf
[4] **Examination regulations**:
General examination regulations of the mathematics degree programmes:
www.doc.zuv.fau.de//L1/PO/Nat/ABMPO_Mathe_NatFak/konsolidierte_Fassungen/AllgPO_BSc-MSc_Mathematik_ABMPOMathe-NatFak_20150311_idF_20190715.pdf
Examination regulations of Computational and Applied Mathematics:
http://zuv.fau.de/universitaet/organisation/recht/studiensatzungen/NAT1/pdf-englisch/FPO_BA_MA_Technomathematik_FPOTechnoMathe_20150311_idF_20170227_en.pdf
[5] Examinations Office: www.fau.eu/education/advice-and-services/examination-offices/examinations-office-faculty-of-sciences/
[6] Information for students transferring from other universities:
www.fau.eu/education/application-and-enrolment/changing-subjects-or-university/
[7] **FAU course catalogue**: www.vorlesungsverzeichnis.fau.de
[8] **Information on application** for Master's degree programmes: www.master.fau.eu
[9] List of **Master's degree programmes at FAU**:
www.fau.eu/education/degree-programmes/masters-degree-programmes/

App. 1: Curricular overview of the MSc Programme Computational and Applied Mathematics (CAM)

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