

Master of Science Mathematical Bioscience



Foto: Ritzau Scanpic

” How do we stop the next pandemic?

Mathematical

**Do you want to work with
matemathical modelling
of health, disease
development, and
environment?**

Bioscience

Mathematical Bioscience is a unique master's programme for students with an interest in mathematics as well as biology, and how these two disciplines combined can address challenges facing our society.

The programme lets you specialize in mathematical modelling of societal challenges within health and disease development or the environment, but also allows you to engage in mathematical models of personalized disease progression and treatment. Examples include optimization of cancer and diabetes treatment, prevention or prediction of epidemic outbreaks, design of environmental solutions, or development and implementation of efficient parameter estimation methods based on health care data.

Through problem-oriented project learning and interdisciplinary problem solving, you will learn advanced mathematics and biology, and you will learn to describe biological systems and processes with mathematics. You will perform analysis and numerical explorations of data, as well as model and solve biological relevant challenges through mathematics.

You will gain competencies in planning and executing multi-disciplinary projects, and through student driven activities you will learn to work with and organize biological data and solve complex biological problems using mathematical methods. Computer programming and simulations are integrated parts of the programme.

Example of a study programme

4. semester	Master thesis (30 ECTS)				
3. semester	Parameter Estimation (5 ECTS)	Differential Geometry (5 ECTS)	Pharmacology (5 ECTS)	Specialization Project / Project-oriented Internship (15 ECTS)	
2. semester	Dynamical Systems (5 ECTS)	Probability & Statistics (5 ECTS)	Advanced Eukayotic Cell Biology I (5 ECTS)	Fundamental Mathematical Structures / Scientific Computing and Data Science (10 ECTS)	Biology Elective Course (5 ECTS)
1. semester	Modelling of Biological Systems (10 ECTS)		Biology Elective Course / General Molecular and Medical Biology (5 ECTS)	Modelling Project (15 ECTS)	

Please note: The table shows an example of a course of study. Courses, projects, internships and studies abroad with credit transfer may vary for each student.

Elective courses

BIOLOGY

Each semester the board of studies approves several courses offered by Molecular Health Science, Chemical Biology and Environmental Science.

MATHEMATICS AND DATA SCIENCE

On the second semester you have the possibility to choose between a course in Fundamental Mathematical Structures and a course in Scientific Computing and Data Science.

1.

SEMESTER

The overall objective is to introduce mathematical modelling of biological systems. In the course 'Modelling of biological systems' standard models are analyzed mathematically and on basis of the underlying biological mechanisms. The modelling and analysis competencies are trained further in the semester project. Students with no biological background are advised to follow the course Foundation Course in Biology.

2.

SEMESTER

The overall objective in this semester is to give the student an understanding of the two different methodologies used in biology and in mathematics. Through the courses 'Advanced eukaryotic cell biology', 'Dynamical system analysis' and 'Probability and Statistics' the student will see examples of the biologist's, the statistician's, and the mathematician's logic, reasoning, formalism, and scientific methodology.

3.

SEMESTER

The overall objective in this semester is student specialisation. This is realized through the 15 ECTS specialisation project or the project-oriented internship. Also, the course 'Parameter estimation' focuses on advanced specialised methods in the analysis of model parametrisation. This semester also acts as preparation for the master thesis semester. This semester is the recommended semester for a possible study exchange program.

4.

SEMESTER

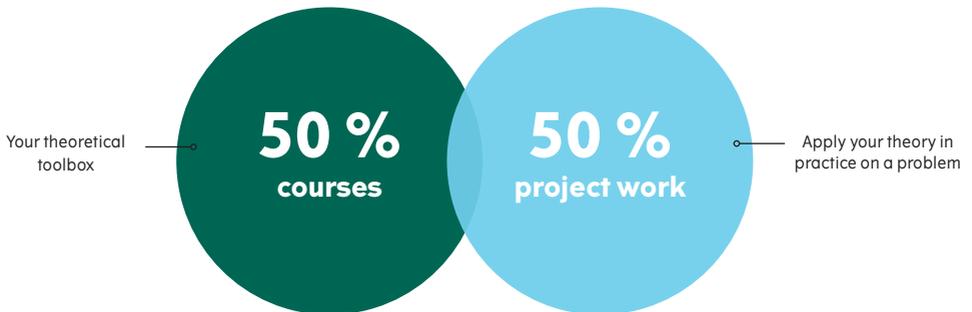
In the master's thesis the objective is that the student shows the ability to apply the skills, knowledge, and competencies obtained in the programme to independently formulate a current research question/hypothesis in the field of mathematical bioscience. The student can investigate the problem by, for example, performing laboratory experiments and analysing the data both statistically and through existing models, design new mathematical models based on existing data, and/or formulate novel and original methods to analyse data and models.

Form of Study

Through your education, you get the opportunity to create your own individual education profile and your own independent specialization in accordance with the idea of the problem-oriented, interdisciplinary and project-oriented teaching method at Roskilde University.

THE STUDY FORM IS A COMBINATION OF

- Problem-oriented project group work
- Courses that are organized as teaching in small groups, where the focus is on theories, methods, and problems in an interaction between teacher and student



The project work and guidance are prioritized at Roskilde University. We also prioritize that you gain experience with the production and processing of empirical data as well as the practical application of theories and methods.

All master's programmes offer project-oriented internships and / or studies at other universities at home and abroad with credit transfer.



Foto: Lisbeth Høfien



In my education at Roskilde University I got a perfect mix of Mathematics and Biology, which has become the foundation of my professional work, where I develop and use mathematical models to describe marine ecosystems.

The marine-ecological models have given me the opportunity to study ecological processes and interactions between e.g., ecosystems and human activities, which it is not possible to investigate with traditional methods such as experiments and field studies.

My competencies are used both for research and to advise authorities on the effects of various policy initiatives.

Karen Timmermann, Professor, DTU

Project Examples

- What are the governing bio-physical mechanisms behind avascular tumors growth?
- How do cells communicate so fast?
- What strategies should we impose if we vaccinate for COVID-19?
- How can mathematical modelling estimate the burden of pollution in an ecosystem?
- Can we understand complex biological pathways through just a few mathematical equations – and what is the benefit?
- When should treatment start for patients developing cancer?
- How can normal and impaired glucose-stimulated insulin secretion be described mathematically?
- How can we use mathematical models to predict fluctuations in product quality and quantity during biological production?
- Why does immuno-therapy work for some patients but not for others?
- How can anti-bodies be used to treat stress-induced mental disorders?
- How does comorbidities develop and why are they so hard to treat?

Competences

The master's programme in Mathematical Bioscience gives you a strong professional position in the private sector and a solid starting point also for academic research. The programme will enable you to:

- Analyse, structure, and categorize large and complex biological data sets statistically and using computational tools.
- Design new mathematical models and test biological hypotheses in order to gain fundamental new knowledge about biological systems and processes, both within health care, but also with industrial biological processes.
- Apply models to predict, optimize and control dynamic systems.
- Independently develop code and revise programs to numerically solve complex mathematical models.

Career

The use of mathematical modeling and computational methods to describe and understand complex, real-world challenges are strongly required skills by bio-medical and high-tech companies, hospitals, and governments.

The programme is project oriented and through interdisciplinary work and in cooperation with fellow students and a professor, it provides a realistic work situation, which prepares you for the future job market. More specifically, the programme gives you a wide range of job opportunities in, for example:

Biochemistry and biotech-industries

The health sector (hospitals)

Consultancy companies within the environmental area

The research and development sector

Further information



You can find admission requirements, application deadlines and other information about Mathematical Bioscience at Roskilde University here:

ruc.dk/en/master/mathematical-bioscience

Contact us if you have questions about Mathematical Bioscience:

RUC Study & Career Guidance

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