Roskilde University

Master of Science
Mathematical Bioscience

Master's Programme

Mathematical Bioscience

Do you want to work with mathematical modelling of health and disease development? In the Master's programme in Mathematical Bioscience, we teach you to apply mathematics to physical, biological, and chemical processes, finding the key to better treatments and practices.

Illnesses, pollutants, viruses – all spread and develop in patterns of cause and effect, that can be detected with mathematical models. In the Master's programme in Mathematical Bioscience, we combine biology and mathematics to address challenges to our health, environment, and society as a whole.

Our profile

In the interdisciplinary programme, you will learn to apply mathematical modelling to societal challenges within health and disease development or the environment. You will train to analyse datasets of physical, biological, and chemical processes – be it the development of a pandemic disease, the growth of a cancer tumour or the spreading of microplastic in the environment – and develop mathematical models describing these processes. With the use of mathematics, you will learn to uncover patterns, generate new knowledge, and thus contribute to predict, optimise, and control diseases and pollution.

Computer programming and simulations are integrated parts of the programme. We often work with datasets generated in labs, which we model using mathematics and computer simulations. You will train in scientific computing and data science as well as in dynamic systems analysis, and through these learn to describe biological systems and processes using mathematic models.

Among our research areas are optimisation of cancer and diabetes treatments, prevention of epidemic outbreaks, design of environmental solutions, modelling of processes and development and implementation of efficient parameter estimation methods based on health care data. The department hosts two major research centres: PandemiX, specialising in the spreading of pandemics, and Cancitis, specialising in cancer treatment. You will work closely with researchers and fellow students, pursuing your own academic interests through problem-oriented project learning and interdisciplinary problem solving.

Study environment

You will be studying in a relatively small active research environment and work side by side with PhD-students and experienced researchers, and you will be invited to participate in research projects all throughout the programme. We have an informal tone and an open-door policy, so academic, practical, and technical support is always close by. We are all driven by a genuine love of mathematics and an interest in applying its many aspects to real world problems.

We are part of the department of Science and Environment, which also holds the Master's programme in Physics and Scientific Modelling, and you will meet many students from here through our joint social and extracurricular activities. These include academic seminars, student run events as the Natcafé, boardgames nights and alumni events, where you can meet former students. Once a year, we hold a two-day overnight seminar with all students and staff, where we debate issues pertaining to student life.

Example of a study programme

1st year		2nd year	
1ST SEMESTER	2ND SEMESTER	3RD SEMESTER	4th SEMESTER
Modelling of Biological Systems 10 ECTS	Dynamical Systems Analysis 5 ECTS	Paramater Estimation 5 ECTS	Master Thesis 30 ECTS
	Probability & Statistics 5 ECTS	Differential Geometry 5 ECTS	
General Molecular and Medical Biology 5 ECTS	Elective/thematic course *) 5 ECTS	Elective/thematic course *) 5 ECTS	
Modelling Project 15 ECTS	Elective/thematic course *) 5 ECTS	Specialization project / project-oriented Internship 15 ECTS	
	Scientific Computing and Data Science / Advanced Topics in Mathematics 10 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 and thematic courses

2ND SEMESTER				
Bioinformatics 5 ECTS	Applied Data Science and Visualisation 5 ECTS	Biodiversity and Conservation 5 ECTS	Methods in Ecology 5 ECTS	Advanced Eukaryotic Cell Biology I 5 ECTS

3RD SEMESTER		
Seminar course in Molecular Health Science 5 ECTS	Pharmacology 5 ECTS	Sustainable Use of Biological Systems 5 ECTS

Each semester the study board may approve additional elective courses which are available to students.

1st 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.

2nd SEMESTER

The overall objective in this semester is to give the student an understanding of the different methodologies used in biology and in mathematics. Through various courses and '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.
In the second semester the student can choose a variety of elective and thematic courses to profile and specialise their education. The thematic profiles are "Mathematical Bioscience with Scientific Computing", "Mathematical Environmental Bioscience" and "Mathematical Bioscience of Diseases".

3rd SEMESTER

The overall objective in this semester is student specialisation. This is realised 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.

4th SEMESTER

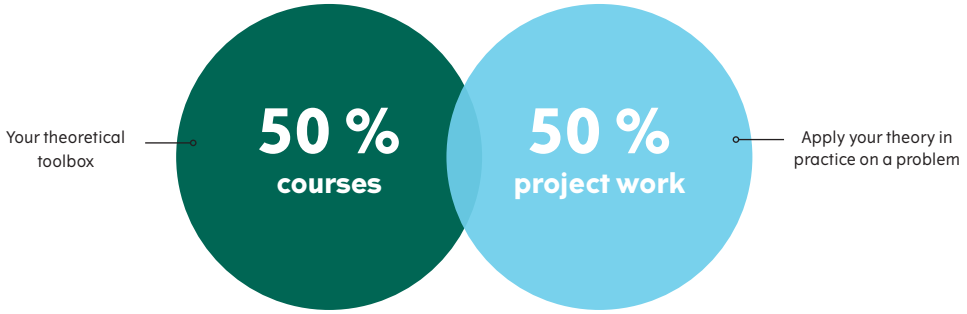
In the master's thesis the objective is that the student shows the ability to apply the skills, knowledge, and competencies obtained in the programme to independently formulate a current research question/hypothesis in the field of mathematical bioscience. The student can investigate the problem by, 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.


Photo: Lisbeth Holten

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

Examples of student projects include:

- 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 do comorbidities develop and why are they so hard to treat?

Career

Our candidates are highly sought-after in sectors and businesses, which uses mathematical modelling and computational methods to describe and understand complex, real-world challenges. These include the bio-chemical and biotech industry, the healthcare sector, financial sector, public research institutions and administration as well as consultancy companies within the environmental area. Thus, this programme gives you a wide range of job opportunities and also qualifies you to enter a PhD-programme.

Examples of employment include

- **Director at Denmark´s Export and Investment Fund,** supporting Danish export
- **Senior Software Developer at Edlund,** developing it-solutions for the insurance business
- **Professor at DTU Aqua, National Institute of Aquatic Resources,** researching management of aquatic resources

You should study Mathematical Bioscience, if:

You want to apply mathematics to solve real world problems in health and environment

You want to study in an interdisciplinary environment, preparing you for the future job market

You want to pursue your own academic interests during your studies

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
E-mail: **vejledning@ruc.dk**
Telephone hours:
Monday - Friday 10.00 - 11.30
Telephone number: (+45) 4674 2424

Published by
Roskilde University
Department of Science and Environment

Layout
RUC Communication & Press

Print
LaserTryk

JANUARY 2025

SVANEMÆRKET
Tryksag
5041 0826
LaserTryk.dk