



**BACHELOR AND MASTER PROGRAMMES AND COURSE CATALOGUE**  
**NORWEGIAN UNIVERSITY OF LIFE SCIENCES (UMB)**



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## UMB'S VISION STATEMENT IS

The Norwegian University of Life Sciences will be an internationally renowned and innovative university for life sciences, environment and sustainable development.

## UMB'S MAIN OBJECTIVES ARE:

- to be a major player in the field of life sciences, focusing on the core disciplines: biology, food and environmental science, land use and natural resource management, as well as associated and technical subjects;
- to actively contribute to business development and continue to strengthen the scientific basis for agriculture, aquaculture and other industries based on the utilisation of natural resources.

## EDUCATION

High quality, frequent teacher-student interaction and a pleasant social and physical environment characterise education at UMB.

About 240 of the 650 courses at the Bachelor and Master levels are taught in English, as well as many PhD level courses. One Bachelor and 11 Master programmes are conducted fully in

English. Besides theoretical and scientific education, emphasis is placed on practical training. Studying abroad is encouraged in most programmes. For the public and private sector, the Continuing Education Programme offers relevant on-line, research-based courses.

Accommodation on campus is possible. Please send an early application if you need a residence. Students can participate in 70 different associations and clubs, a student welfare organisation and the excellent student facilities include sports centre, floodlit skiing track and access to the national rowing facility nearby. Since the Norwegian government subsidizes tuition at the Bachelor and Master levels, students need only to cover their own cost of living expenses.

## ABOUT NORWAY

- Norway has been ranked the best place in the world to live (for the past four years), according to the United Nations Human Development Index which measures quality of life

- Public universities in Norway do not charge tuition fees, this also applies to international students.

- Norway is a safe, tranquil and politically stable country

## ADMISSION

**APPLICATION FORMS** Application forms for all Bachelor's, Master's and non-degree study programmes at UMB can be found at [www.umb.no/applications](http://www.umb.no/applications)

**APPLICANTS** must document knowledge of English at a level equivalent to the requirements set by the TOEFL test, with results approved by the Admission Office at UMB

**ACADEMIC REQUIREMENTS** Minimum requirements for admission to higher education in Norway are set by The Norwegian Agency for Quality Assurance in Education (NOKUT): [www.nokut.no/en](http://www.nokut.no/en)

**BACHELOR'S** programme applicants must meet the minimum requirements for admission to higher education in Norway.

**MASTER'S** programme applicants must normally have obtained a First Degree / Bachelor's degree of at least 3 years duration, or its equivalent, including courses equalling 2 years of full-time studies in a subject relevant to that of the programme applied for. The requirements vary by country, as applicants must have completed 3 years of higher education in addition to the minimum

requirements for admission to higher education in Norway.

**PROSPECTIVE PHD** students are requested to visit the following webpage for further information:  
<http://www.umb.no/phd-studies>

**NON-DEGREE** applicants must meet the minimum requirements for admission to higher education in Norway.

Exchange applicants from institutions with which UMB has exchange agreements are not required to meet any specific academic requirements other than those which were required for entrance to their home university. However there may be an English requirement that must be fulfilled. This is normally specified in the agreement. Please check with your home institution.

**LANGUAGE REQUIREMENTS** All applicants must document that they have met the language requirements set by NOKUT:  
[www.nokut.no/en](http://www.nokut.no/en)

However, the language requirement for bilateral, Nordplus and Erasmus students is regulated by the exchange agreement.

## REQUIRED DOCUMENTATION

*Certified copies of:*

- the applicant's passport
- official higher secondary education / university transcripts to document that the applicant has met the academic requirements
- official documentation of English language proficiency

## COST OF LIVING

The following estimated costs are for a single student for one semester of 5 months. We would like to point out that this is a minimum budget.

Accommodation NOK 12,500

Food/household NOK 15,000

Books NOK 4,000

Clothing NOK 3,500

Phone NOK 2,000

Local transport NOK 1,000

Semester fee NOK 340

Sports club NOK 450

Student society NOK 250

Leisure NOK 2,500

Total/semester NOK 43,800

If you are staying for a full academic year you should expect to spend

NOK 87,600 on a minimum budget.

According to government statistics the average student in Norway spends

approx 8.000 - 10.000, - pr. month while studying.

## STUDENT SERVICES

UMB is committed to helping students to take full advantage of the opportunities the university and Norway have to offer:

- An extensive orientation programme is offered in the beginning of August, follow-up gathering in November.
- Counselling services including private and confidential consultations provided by qualified professionals to deal with personal or academic issues.
- Accommodation on campus is possible. Please send an early application if you need a residence.

## RESEARCH

**RESEARCH AT UMB** includes basic research and applied research, providing a foundation for education, research training and research geared towards the private sector. Research is focused mainly on Environmental Sciences, Food Science, Biotechnology, Aquaculture and Business Development and has a strong interdisciplinary and international approach. There is a strong link between research and the above-mentioned study programmes; students at the Master and PhD levels are often actively involved in many of UMB's research activities.

**RESEARCH IS ALSO** carried out in cooperation with the research institutes established in Ås. Together, the university and the institutes represent the largest research environment within life sciences in Norway. UMB is also active through national alliances with other institutions and through institutional partnerships with universities in developing countries. UMB's health-related research is linked to healthy food, clean water and the environment, and the many related challenges in developing countries.

## INTERNATIONAL ACTIVITIES

**UMB HAS EXCHANGE** agreements with more than 80 universities worldwide, including eight Nordic, 44 European and eight North American institutions. The objectives of UMB's cooperation with universities abroad include building strong academic networks, facilitating international exchange and contributing to competence building with universities in the South.

## UMB DEPARTMENTS AND CENTRES

### DEPARTMENTS

- Department of Animal and Aquacultural Sciences
- Department of Chemistry, Biotechnology and Food Science
- Department of Ecology and Natural Resource Management
- Department of Economics and Resource Management
- Department of Landscape Architecture and Spatial Planning
- Department of Mathematical Sciences and Technology
- Department of Plant and Environmental Sciences
- Department of International Environment and Development Studies, Noragric

### CENTRES

- Aquaculture Protein Centre
- Animal Production Experimental Centre
- Centre for Plant Research in Controlled Climate
- Centre for Continuing Education
- Centre for Integrative Genetics

## LOCATION

The Norwegian University of Life Sciences is located in Ås, approximately 35 km south of Oslo. The campus park is one of the largest neoclassic parks in Norway and covers some 150 acres. It is used for educational and research purposes as well as for recreation. Easy and fast public transportation from Oslo and Gardermoen International airport is available by train or bus.











## BACHELOR DEVELOPMENT STUDIES

### WHY STUDY DEVELOPMENT?

- Because you are interested in poverty and injustice.
- Because you want to understand how environment, culture, trade and politics influence development.
- Because you want knowledge to contribute towards finding local and global solutions.

**WHAT CAN YOU USE THIS QUALIFICATION FOR?** Graduates find employment in a wide range of national and international institutions, such as government agencies, and non-governmental development organizations. With additional pedagogic training you may work in teaching institutions. The bachelor degree is a good basis for further studies.

**WHAT WILL I LEARN?** Development Studies is an interdisciplinary field where academic depth is achieved through insight into different but complementary fields. The study programme seeks first to develop basic knowledge within different disciplines, such as social anthropology, sociology, ecology, economics, resource management and earth science, and then to analyze development issues in an interdisciplinary way.

You will have an opportunity to study at one of our partner universities in for example Costa Rica, Tanzania, India, Canada or England..

**STRUCTURE OF THE PROGRAMME** The programme consists of mandatory and elective courses. The elective courses may be within areas such as economics, international relations, ecology, organizational theory and resource management. All mandatory courses are taught in English, and it is possible to compose a study plan with all courses in English. We recommend that you take one semester abroad where you may take courses that are not offered at UMB.

With a bachelor degree in Development Studies you can seek admission to a master programme in Development Studies, International Environmental Studies or Agroecology at UMB or to similar programmes in Norway and abroad.

### REQUIREMENTS

Applicants must meet the minimum requirements for entrance into higher education in Norway (GSK) and fulfill the university's English language requirement.

### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Department of International Environment and Development Studies,  
P.O. Box 5003, 1432 Aas, Norway  
phone: +47 64 96 52 00  
e-mail: [studieveileder-noragric@umb.no](mailto:studieveileder-noragric@umb.no)  
[www.umb.no/noragric](http://www.umb.no/noragric)

## STUDY PROGRAMME STRUCTURE\*

### DEVELOPMENT STUDIES- 180 CREDITS

#### MANDATORY COURSES

INTRO. TO ENVIRONMENT, DEVELOPMENT AND GLOBALIZATION

DEVELOPMENT SEMINAR

SOCIAL ANTHROPOLOGY

SOCIOLOGY

ECONOMICS FOR ENVIRONMENT AND DEVELOPMENT

WRITING SEMINAR

LINKING ECOLOGICAL AND SOCIAL RESILIENCE

DEVELOPMENT AID AND POLITICS

DEVELOPMENT CLASSICS

TROPICAL ECOLOGY AND DEVELOPMENT

BACHELOR THESIS

#### ONE OF:

SOCIAL SCIENCE STATISTICS AND METHODS

STATISTIKK (IN NORWEGIAN)

#### ONE OF:

EXAMEN PHILOSOPHICUM

EXAMEN PHILOSOPHICUM – SEMINAR VERSION (NORSK OR  
ENGELSK)

#### ELECTIVE COURSES

FOURTH SEMESTER EXCHANGE AT A UNIVERSITY ABROAD

#### RECOMMENDED ELECTIVE COURSES

SUSTAINABLE AGRICULTURE AND THE ENVIRONMENT

ENVIRONMENTAL ECONOMICS

HUMAN RIGHTS BASED DEVELOPMENT

HEALTH AND DEVELOPMENT

GLOBAL ENVIRONMENTAL CHANGE

ANTHROPOLOGY OF DEVELOPMENT

LAND RIGHTS: AN INTRODUCTION

INTERNATIONAL RELATIONS, POLITICS AND DEVELOPMENT

#### LANGUAGE COURSES

FRENCH BASIC

SPANISH BASIC

URDU

SWAHILI

\* WE RESERVE THE RIGHT TO MAKE CHANGES







## MASTER AGROECOLOGY

### WHY STUDY AGROECOLOGY?

- You are concerned about long-term sustainability of agriculture and food systems.
- You want to link knowledge with action to make a difference.
- You want to work in international teams solving complex problems.

**HOW DO AGROECOLOGISTS USE WHAT THEY LEARN?** The programme prepares students for a wide range of positions concerning conventional and organic agriculture and food systems, including advisory services and extension, development projects, management of agricultural and natural resources, environmental protection, and further education and research.



**CONTENTS OF THE PROGRAMME** In the first semester (30 credits) there is a holistic and transdisciplinary approach to ecological, economic and social issues in farming and food systems. The focus is on agroecosystems, on holistic methodology for their study, evaluation and improvement, on attitudes, ethics and values, and on individual and group-based learning.

Learning is based on exploring real-life farm and food systems cases. The casework experience is supported by lectures, seminars and supervision, and the goal is to develop competency for responsible action by linking theory and practice.

After the first semester, you can develop an area of concentration on various topics constituting 30 or 60 credits. The programme offers many options for individual tailoring of the students' subject profiles and for studying abroad at universities that cooperate with UMB.

The programme concludes with a master degree thesis constituting 30 or 60 credits. A 60 credits thesis must include a special syllabus of 5 credits. The MSc degree requires 120 credits in a programme approved by the advisors.

**THE WAY FORWARD** With real-life experiences as starting point, the programme provides knowledge and methods transferrable

to a wide range of situations, as well as the personal skills to become a life-long learning agroecologist.

#### REQUIREMENTS

Applicants must demonstrate English language ability in accordance with the UMB regulations for programmes taught in English.

Applicants must hold a Bachelor's degree or equivalent qualification from university-level studies in agriculture, ecology, biology or a relevant social science

#### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Study coordinator Ingrid F. Bugge  
tlf.: +47 64 96 55 25  
e-mail: [ingrid.bugge@umb.no](mailto:ingrid.bugge@umb.no)

## STUDY PROGRAMME STRUCTURE\*

### AGROECOLOGY - 120 CREDITS

#### CORE COURSES

AGROECOLOGY AND FARMING SYSTEMS

AGROECOLOGY AND FOOD SYSTEMS

#### ELECTIVE COURSES

MASTER THESIS

MASTER THESIS

\* WE RESERVE THE RIGHT TO MAKE CHANGES

\*\*WRITING A 60 CREDIT THESIS, YOU MUST TAKE A SPECIAL SYLLABUS  
CONSISTING OF AT LEAST 5 CREDITS

THE MASTER'S DEGREE STUDY PROGRAMME IS PLANNED IN CONJUNCTION  
WITH THE RELEVANT STUDY COORDINATOR.

FURTHER INFORMATION ON THE STRUCTURE OF THE  
PROGRAMME: [www.umb.no/studies](http://www.umb.no/studies)

## FORMER STUDENT



**BASTIAN EDI HOFFMAN**  
Higher Executive Officer  
County Governor of Hordaland,  
Dept. of Agriculture

*Through the Agroecology classwork, I gained access to the world you meet as a project leader, researcher or consultant. The curriculum provided a close connection between real-life cases and theory and an opportunity to apply the tools of analysis taught in class. During my project work, I contacted the agricultural authority and the Ministry of Agriculture and Food. We later collaborated for my master thesis, called "Success factors for organic agriculture in Norway".*

*Today I'm working as the leader of a project that promotes the intensification of animal grazing to control scrub/vegetation encroachment in Hordaland County. Connecting different actors like producers, processors, local groups, tourist entrepreneurs and the local inhabitants goes hand in hand with product development, farm consultation and networking for the county. I am also responsible for organic agriculture in Hordaland, which entails devising action plans, networking and consulting with farmers. In my job, agroecological competence is needed every day to face production challenges and the differing perspectives of the stakeholders that I work with.*



EUROPEAN MASTER

# ANIMAL BREEDING AND GENETICS

## WHY STUDY ANIMAL BREEDING AND GENETICS?

- The programme provides scholarships for third-country and EU students.
- The programme supports European top-quality Masters Courses and enhances the global image of European higher education.
- Six excellent universities which offer high quality courses.

**WHAT CAN YOU USE THIS QUALIFICATION FOR?** It is an increased need for candidates with a MSc degree in Animal Breeding. Highly qualified graduates in the internationally operating area of animal breeding and genetics are needed. The programme is highly relevant for students who wish to work in organizations focused in the field of sustainable animal breeding.

**WHAT WILL I LEARN?** You will bridge the gap between quantitative and molecular genetics which are needed competence in the future. You can compose your own study plan with several courses in quantitative and molecular genetics. Some recommended courses are: Molecular Biology, Genetic Basis of Biodiversity, Models and Algorithms in Bioinformatics, Genome Analysis - Methodology, Molecular Genomics, Animal Breeding Plans, Theory and Application of Inbreeding Management

**CONTENTS OF THE PROGRAMME** After the introduction period in Wageningen (The Netherlands), students conduct the major part of their training at two of the participating universities of their choice. This gives them access to a broad range of subjects and experience abroad. Students are awarded two nationally recognized Master degrees (double degree) after successful completion of the two-year programme.

**UNIVERSITIES INVOLVED:**

- Wageningen University (WU) (the Netherlands) as co-ordinator
- University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria
- Christian-Albrechts-Universität (CAU), Kiel, Germany
- Agro ParisTech, France

- Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden
- The Norwegian University of Life Sciences (UMB), Aas, Norway.

**STUDY PROGRAMME STRUCTURE** No compulsory courses are required, but students have to fulfil at least 60 ects at UMB, minimum 30 ects for thesis under (joint) supervision of UMB.

**ADMISSION REQUIREMENTS**

Information about application, admission and selection please see this webpage: [www.emabg.eu/](http://www.emabg.eu/)  
e-mail: [emabg@wur.nl](mailto:emabg@wur.nl)

**FOR MORE INFORMATION?**

- Information about application and general questions about the study: Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internet: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the study programme:  
Study Coordinator:  
phone: +47 64 96 51 54  
e-mail: [megumi.fog@umb.no](mailto:megumi.fog@umb.no)

## STUDY PROGRAMME STRUCTURE\*

### ANIMAL BREEDING AND GENETICS

#### SOME RECOMMENDED COURSES

AQUACULTURE BREEDING AND GENETIC THEORY

MOLECULAR BIOLOGY (LECTURE SPOKEN IN NORWEGIAN)

LABORATORY COURSE IN MOLECULAR BIOLOGY

EUCARYOT MOLECULAR BIOLOGY

POPULATION GENETICS AND MOLECULAR EVOLUTION

MOLECULAR GENOMICS

STATISTICAL GENOMICS

MODELS AND ALGORITHMS IN BIOINFORMATICS

GENOME ANALYSIS, METHODOLOGY

STATISTICAL ANALYSIS

ANIMAL BREEDING PLANS

THEORY AND APPLICATION OF INBREEDING MANAGEMENT

GENETIC BASIS OF BIODIVERSITY

\*WE RESERVE THE RIGHT TO MAKE CHANGES.

FURTHER INFORMATION ON THE STRUCTURE OF THE PROGRAMME: [www.umb.no/studies](http://www.umb.no/studies)

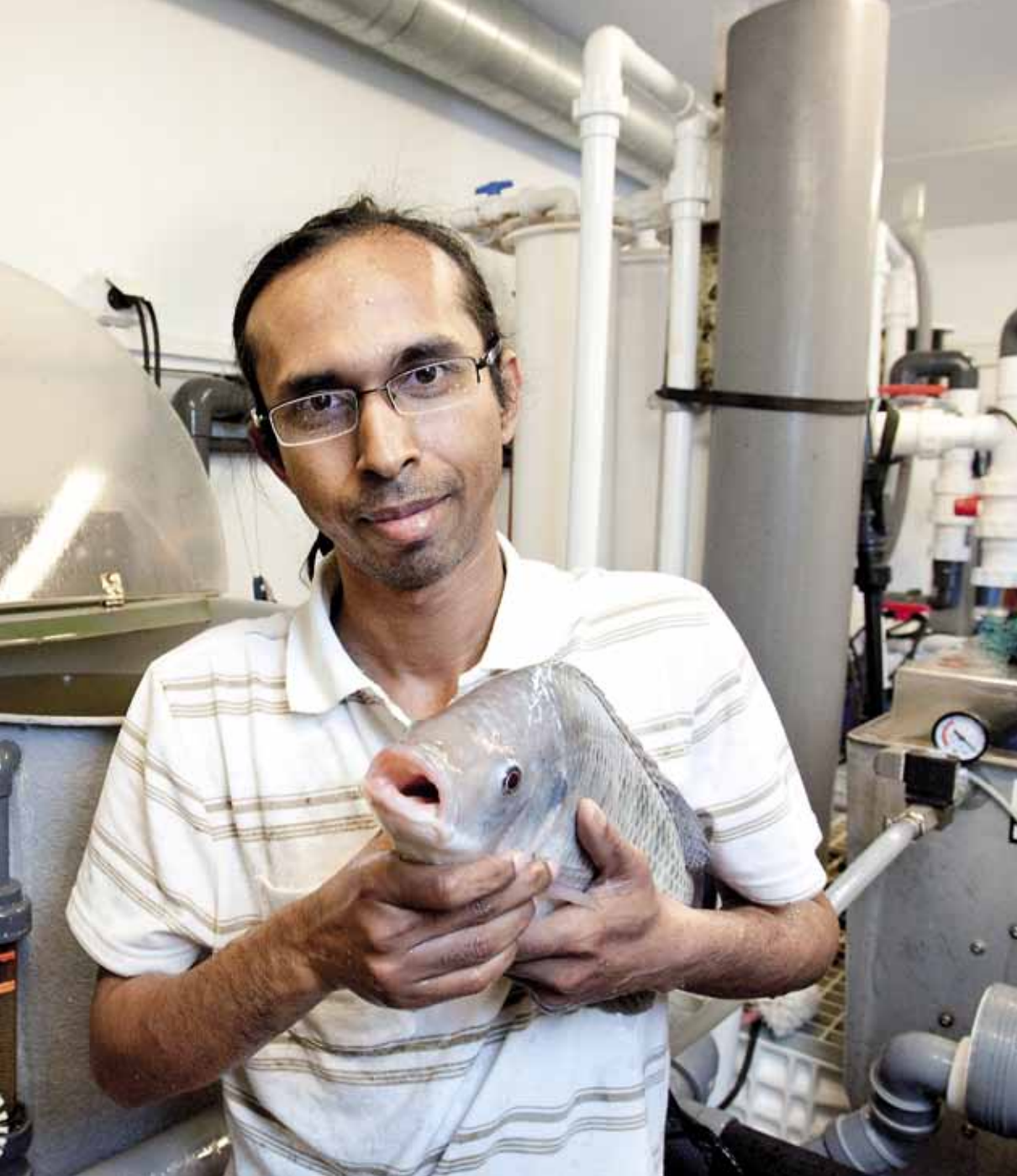
## FORMER STUDENT



**BINYAM S. DAGNACHEW**  
PhD student, Quantitative  
genetics, Department of Animal  
and Aquacultural Sciences

*I am working as a PhD student in the Department of Animal and Aquacultural Sciences, UMB with title "Multivariate analysis in Animal breeding and genetics". The knowledge and skills I have gained through the study are key parts of my day to day work. My involvement in EM-ABG also provided me opportunities and network to work with credited professionals in the field which has been very inspiring for me. Few years ago, Animal Breeding and Genetics (ABG) evolve in new way with the merge of molecular techniques and the need for trained professionals in the field has grown. During my stay in UMB, I have found the student and academic environment very interesting and it is one of my reasons for considering UMB as a place for my PhD study. Since participating in EM-ABG could lead to different specializations, I advise prospective students to figure out what they want to do as early as possible which will simplify their choice of course combination.*







## MASTER AQUACULTURE

### WHY STUDY AQUACULTURE?

- The aquaculture industry develops fast with an annual increase of 5-10%.
- Productions are estimated to be doubled within 2020-2030.
- New industry with great potential and innovation.

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**WHAT CAN YOU USE THIS QUALIFICATION FOR?** Different of existing positions; manager in the fish farming industry, quality control, governmental or extension positions, establishing new aquaculture species, managing breeding programs, sales or administration. The Master degree is also a stepping stone to an academic career.

**WHAT WILL I LEARN?** The programme can give you broad and interdisciplinary strengths or specialisation in a subject that you are particularly interested in. From courses we offer in fish breeding, fish nutrition, product quality and planning and design of aquacultural plants, you will get insight and knowledge about how those components/factors affects the effectiveness of production and influence the economical yield.

**CONTENTS OF THE PROGRAMME** The study starts with an introduction course in diseases and health in farmed fish, genetics and breeding, and in fish nutrition. A practical and theoretical course in fish production, product quality is also included. Courses like statistics and experimental design and analysis are recommended. The aim of the study programme in master in Aquaculture is that students get broad practical and theoretical knowledge in different fields, before they complete their master thesis within a focus area which can be chosen from fish breeding, fish nutrition or production technology.

#### **STUDY PROGRAMME STRUCTURE:**

The Master programme is planned in

conjunction with the relevant study coordinator.

Further information on the structure of the programme: [www.umb.no/studies](http://www.umb.no/studies)

#### **REQUIREMENTS**

A Bachelor or equivalent degree, including minimum 10 credits mathematics, 10 credits in chemistry/physics, 10 credits in statistics and 60 credits in biology. Applicants must demonstrate English language ability in accordance with the UMB regulations for programmes taught in English.

#### **FOR MORE INFORMATION?**

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Study coordinator  
Marit Ensby  
tlf.: +47 64 96 51 26  
e-post: [marit.ensby@umb.no](mailto:marit.ensby@umb.no)  
Megumi Ohta Fog  
tlf.: +47 64 96 51 54  
e-post: [megumi.fog@umb.no](mailto:megumi.fog@umb.no)

## STUDY PROGRAMME STRUCTURE\*

### AQUACULTURE - 120 CREDITS

#### COMPULSORY COURSES

GENERAL AQUACULTURE –  
DISEASES AND HEALTH IN FARMED FISH

GENERAL AQUACULTURE – BREEDING AND GENETICS

GENERAL AQUACULTURE – NUTRITION

AQUACULTURE PRODUCTION

PRODUCTION TECHNOLOGY IN AQUACULTURE

AQUACULTURE BREEDING AND GENETICS THEORY

AQUACULTURE – SPECIAL COURSE

#### MASTER THESIS

\* WE RESERVE THE RIGHT TO MAKE CHANGES

FURTHER INFORMATION ON THE STRUCTURE OF THE  
PROGRAMME: [www.umb.no/studies](http://www.umb.no/studies)

## FORMER STUDENT



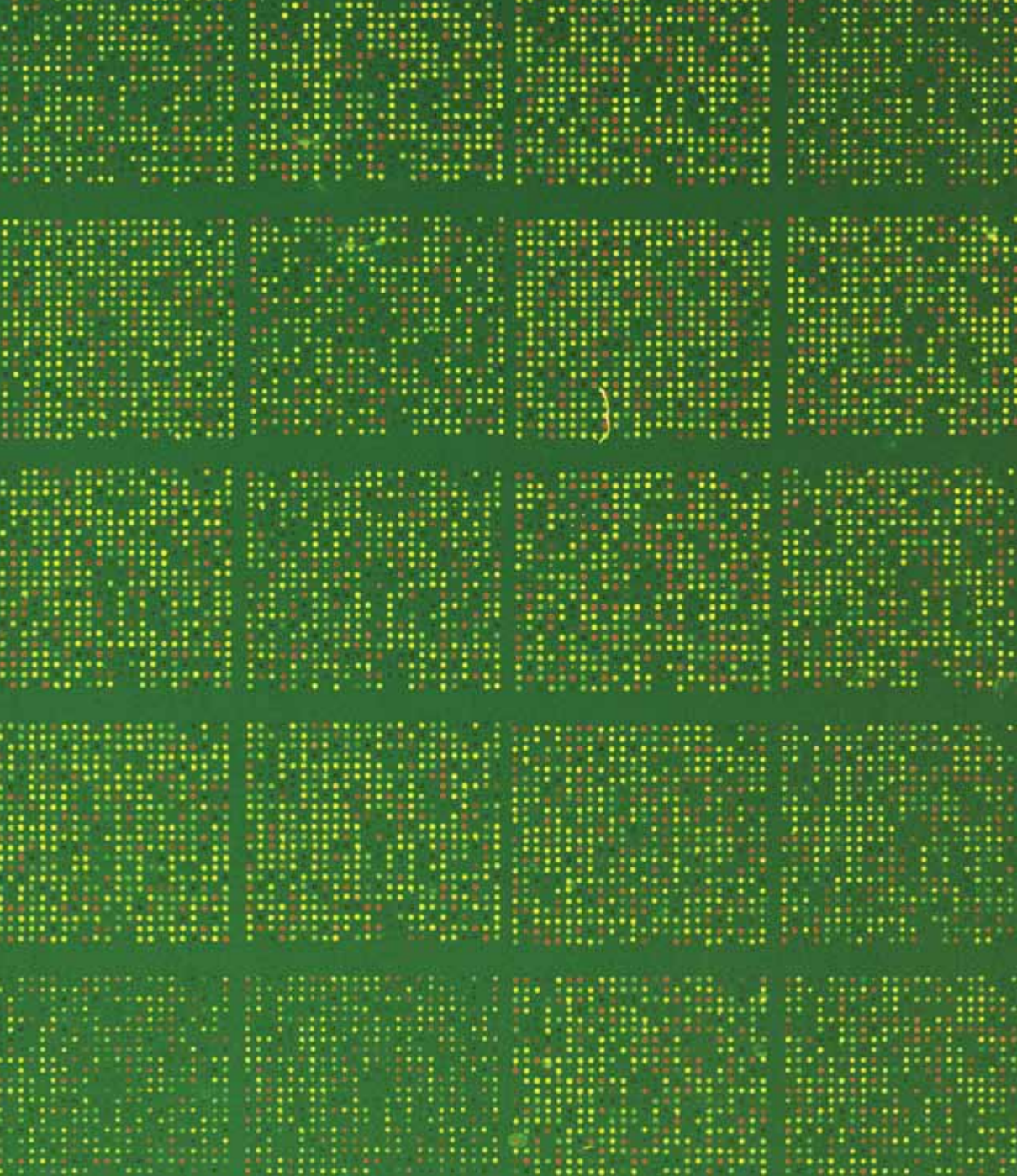
**JON ØVRUR HANSEN**  
PhD student  
Aquaculture Protein Centre (APC)

*I am working as a PhD student in the Aquaculture Protein Centre (APC). This is one of the first Norwegian Centres of Excellence to be established, and the only one at UMB at present.*

*My research topic is to investigate different aspects of feed uptake and growth for salmonid fishes.*

*I have always been interested in fish, and have been keen to work in this area. I therefore found the study programme in Aquaculture appealing. People I knew also recommended UMB, because of the positive student environment. And I certainly had great classmates!*

*I would recommend everyone to travel as an exchange student during their study period! I had the chance to spend half a year at Nova Scotia Agricultural College in Canada while I was a master student, and it was a very rewarding time!*



MASTER

# BIOINFORMATICS AND APPLIED STATISTICS

## WHY STUDY BIOINFORMATICS AND APPLIED STATISTICS?

- Modern biotechnology depends on bioinformatics for the analysis and categorisation of data.
- There is a great demand for bioinformatical and statistical knowledge.
- Campus Ås has some of Norway's best experts in applied statistics.

A study program of a high quality, according to an international evaluation in 2008.

**PROSPECTIVE EMPLOYMENT:** Employment in medical and pharmaceutical science or industry. Work as an analyst in e.g. animal or plant breeding, climate surveillance, or in managing, bank or insurance. You will learn how to develop models and prognoses in economics and environmental issues, e. g. stocks, populations or epidemics. The Master degree is also a stepping stone to an academic career.

**LEARNING OUTCOME:** Bioinformatics combines mathematical and biological subjects. Applied statistics focuses more on mathematical subjects as such.

Master projects are available within genetics (e. g. domestic animal breeding, aquaculture, plant breeding) or microbiology (e. g. genomics, proteomics, microbial ecology, human pathogens and plant pathogens). Within applied statistics one can also perform methodical studies of chemometry, ecology and economy.

At campus Ås you will find modern biotechnology platforms, generating large amounts of data. Bioinformatics and applied statistics are essential for the categorisation, interpretation and analyses of results, and will give us new knowledge about biology. In bioinformatics you focus on the *results* from these types of analyses, whereas you in applied statistics focus on the *methods* of analysis.

**STUDY STRUCTURE:** The Master program has two independent specialisations:

*Bioinformatics:* Mandatory courses within bioinformatics, genome analysis and statistics. You write a master thesis of 60 credits (ECTS), alternatively 30 credits (ECTS) if you lack essential courses.

*Applied statistics:* A course in theoretical statistics is mandatory, in addition to mathematical and statistical subjects related to your master thesis. You write a

master thesis of 60 credits (ECTS).

A special syllabus related to the master thesis is mandatory.

Modern software and computer science are necessary and often used tools during the whole study.

#### **FUTURE:**

With a Master of Science degree in Bioinformatics and Applied statistics you qualify for employment in both public and private institutions, as described under “Prospective employment”. You are also qualified for PhD-studies. Additional pedagogic education will enable you to teach at high-school level.

#### **ADMITTANCE:**

*Bioinformatics specialisation:* A Bachelor of Science degree or equivalent, consisting of both mathematical and biological subjects. A Bachelor’s degree in biotechnology with a specialisation in bioinformatics qualifies.

*Applied statistics specialisation:* A Bachelor’s degree in mathematical science, containing at least 70 credits (ECTS) of mathematics and statistics, in addition to at least 10 credits (ECTS) of programming.

Admittance requires a mean level of grade C (ECTS) or better in your Bachelor’s degree.



#### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Study Coordinator Janne Beate Utåker,  
phone: +47 64 96 58 25  
e-mail: [studieveileder-ikbm@umb.no](mailto:studieveileder-ikbm@umb.no)







MASTER

# DEVELOPMENT AND NATURAL RESOURCE ECONOMICS

## WHY STUDY DEVELOPMENT AND NATURAL RESOURCE ECONOMICS?

- You obtain a solid knowledge of economic theory with a specialisation in development and natural resource economics.
- You can study one semester in Africa or do fieldwork in a developing country.
- Your degree can be used outside the development field.

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**WHAT CAN YOU USE THIS QUALIFICATION FOR?** You may work in teaching and research institutions, in national ministries, regional departments or in international organizations and development/environment NGOs. You may also continue with a PhD.

**WHAT WILL I LEARN?** The programme is targeted at students who are interested in the interaction between development, environment and economy, and want to study in an international environment. You get skills and experience in economic analysis, as a bridge between theories and real-world problems. A special emphasis is put on

- Management of natural resources, poverty and rural development
- National policies and trade.
- The wellbeing of rural people, their natural resource base, and the underlying causes of poverty and environmental degradation.

**CONTENTS OF THE PROGRAMME** This master programme is an economics programme at a high academic level. The focus is on economic theory, resource and environmental economics. You can choose to take the second semester at a university in Africa or do field work in a developing country. The last semester is dedicated to writing a thesis, that might be based on research in a developing country.

UMB has a strong teaching and research record both within development and resource economics.

**CONTINUING EDUCATION** This programme is a Master of Science programme that meets the academic requirements for PhD studies within Economics.

#### REQUIREMENTS

A Bachelor or equivalent degree with a major or concentration in economics (minimum of 60 ECTS). The maximum annual number of students for enrolment is 25.

#### FOR FURTHER INFORMATION

- Application and general questions about studies at UMB:  
Student Information Office,  
P.O. Box 5003, 1432 Aas, Norway,  
phone: +47 66 59 61 00,  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)
- Academic questions and detailed questions about the programme:  
Student Advisor Lise Thoen,  
tlf: +47 64 96 56 82 / +47 64 96 57 00  
e-post: [studieveileder-ior@umb.no](mailto:studieveileder-ior@umb.no)  
[www.umb.no/ior](http://www.umb.no/ior)

## STUDY PROGRAMME STRUCTURE\*

### DEVELOPMENT AND NATURAL RESOURCE ECONOMIC - 120 CREDITS

#### MANDATORY COURSES

RESOURCE AND ENVIRONMENTAL ECONOMICS

ECONOMETRIC METHODS

MATHEMATICS FOR ECONOMISTS

MICROECONOMICS

DECISION MODELLING - FUNDAMENTALS

MACROECONOMICS III

RESEARCH IN DEVELOPMENT ECONOMICS/ OR

RESEARCH IN DEVELOPMENT ECONOMICS + FIELD WORK

DEVELOPMENT ECONOMICS - MICRO

ISSUES IN DEVELOPMENT ECONOMICS

DEVELOPMENT AND ENVIRONMENT ECONOMICS

MASTER THESIS INCLUDING SEMINAR

#### OPTIONAL COURSES

PROJECT EVALUATION AND ENVIRONMENTAL VALUATION

INDUSTRIAL ORGANIZATION

ECONOMIC INTEGRATION AND TRADE LIBERALIZATION

INTERNATIONAL ECONOMICS AND FINANCE

ENVIRONMENTAL ACCOUNTING AND MANAGEMENT

\* WE RESERVE THE RIGHT TO MAKE CHANGES

FURTHER INFORMATION ON THE STRUCTURE OF THE PROGRAMME:

[www.umb.no/studies](http://www.umb.no/studies)

## FORMER STUDENT



**DANIELA ORGE FUENTES**  
Researcher  
Norwegian Institute for Urban  
and Regional Research (NIBR)

- I currently work as a researcher at a Norwegian research centre, working on a research project on land issues in Latin America. I started my PhD degree in 2010.

- My Master degree in Economics has been highly relevant for all jobs I've had since I graduated in 2008. It has provided me with valuable tools for understanding and analyzing highly complex social contexts. Working with research, my education has proved to be a necessary theoretical background.

- I chose UMB because I had an impression that the Master degree in Economics was of a much more applied type than the one they offer at other Norwegian universities. I was right about that and I have never regretted my choice.

- I think that good academic achievements come as a result of interest and engagement in the subjects you are studying. I do not believe in choosing education based on other people's choices or wishes for you. You should follow your heart, but keep in mind that some degrees might make it more or less easy for you in terms of getting a job later on.



MASTER  
**ECOLOGY**  
GENERAL ECOLOGY

**WHY STUDY GENERAL ECOLOGY?**

- It is a key component in understanding global environmental challenges.
- There is a growing concern over the human impact on the environment.
- The need for ecologists has never been greater.

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**WHAT CAN YOU USE THIS QUALIFICATION FOR?** You will be qualified for tasks related to environmental monitoring, research and education, sustainable forestry and agriculture, biological conservation, bioethics, journalism, and a range of technical professions. It can also be basis for a PhD position.



**WHAT WILL I LEARN?** Mandatory courses in genetic basis of biodiversity, ecological methodology, and global change ecology and conservation biology will give you a thorough understanding of central elements of ecology. In addition you can choose from a wide range of courses depending on interest, for instance bird ecology, forest ecology and forest history, insect ecology, lichen ecology, molecular evolution, plant-animal interactions, plant ecophysiology, pollination biology, vertebrate population dynamics, and wetland ecology. The programme has strong research emphasis.

**CONTENTS OF THE PROGRAMME** During the first year you will tailor your personal study profile by selecting your favorite courses. The course work will require interactive participation by the students through presentations, short thematic reviews, term papers and discussion sections. An individual research project, i.e. the Master thesis, is the main focus the second year.

#### REQUIREMENTS

The applicants must have obtained a Bachelor's degree, or its equivalent, in natural sciences (e.g. biology, ecology, natural resource management, agricultural or environmental sciences) with basic knowledge in statistics/research methods. Applicants must demonstrate English language ability in accordance with the UMB regulations for programmes taught in English.

#### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the study programme:  
Study Coordinator  
Espen Arestøl  
phone: +47 64 96 57 25 / +47 64 96 58 00  
e-mail: [studieveileder-ina@umb.no](mailto:studieveileder-ina@umb.no)



## STUDY PROGRAMME STRUCTURE\*

### ECOLOGY – GENERAL ECOLOGY - 120 CREDITS

#### MANDATORY COURSES:

CONSERVATION BIOLOGY

GENETIC BASIS OF BIODIVERSITY

GLOBAL CHANGE ECOLOGY

SCIENTIFIC METHODOLOGY IN ECOLOGY AND MANAGEMENT OF NATURAL RESOURCES

SPECIAL CYLLABUS

MASTER'S THESIS

#### AT LEAST ONE OF THE FOLLOWING COURSES:

BEHAVIORAL AND POPULATION ECOLOGY

ECOLOGICAL ENTOMOLOGY

ENVIRONMENTAL POLLUTANTS AND ECOTOXICOLOGY

LANDSCAPE ECOLOGY

MOLECULAR EVOLUTION

PHOTOBIOLOGY

POLLINATION AND REPRODUCTIVE ECOLOGY OF PLANTS

RESTORATION ECOLOGY

THE ECOLOGY AND MANAGEMENT OF RIVERS AND LAKES

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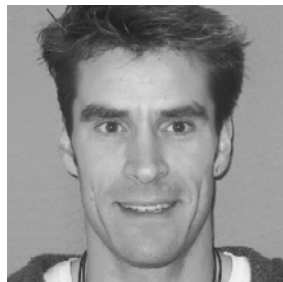
COMMENT: YOU HAVE TO MEET THE PREREQUISITES FOR THE CHOSEN 300-LEVEL COURSE TO OBTAIN THE MASTER'S DEGREE IN ECOLOGY.

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\*WE RESERVE THE RIGHT TO MAKE CHANGES.

FURTHER INFORMATION ON THE STRUCTURE OF THE PROGRAMME: [www.umb.no/studies](http://www.umb.no/studies)

## FORMER STUDENT



**JOHN WIRKOLA DIRKSEN**  
PhD-Student, UMB.  
Department of Ecology and  
Natural Resource Management,

- I am working to find indicators of forest biodiversity through data yielded from airborne laser scanning (ALS). I am going to compare ALS data to ecological field data.

- My master's degree was a natural stepping stone for this PhD-position. It has given me a good foundation for the work I am doing now.

- I chose UMB because it is a small university where it is easy to get to know the staff. In addition, UMB offers extraordinary many courses within natural sciences.

- Decide on the topic for your master's thesis and start working on it as soon as possible. Do not hesitate to choose a topic you have never worked with before.



MASTER

# ECOLOGY

## TROPICAL ECOLOGY AND MANAGEMENT OF NATURAL RESOURCES

### WHY STUDY TROPICAL ECOLOGY AND MANAGEMENT OF NATURAL RESOURCES?

- Tropical areas include some of the most spectacular ecosystems on earth.
- You learn how to manage the vanishing tropical ecosystems.
- You will collect field data in Africa, Asia or Latin America.

### WHAT CAN YOU USE THIS QUALIFICATION FOR?

In Europe you can work in advisory or managerial positions. In developing nations the opportunities include jobs in protected areas, positions in ministries and regional and local offices, NGOs, consultancies or teaching. It can also be basis for a PhD position.

**WHAT WILL I LEARN?** The programme provides a thorough knowledge of the biology and ecology of the tropics. It addresses many of the current challenges in tropical ecology like threats to biodiversity and destruction of important biomes. It also focuses on the links between poverty and conservation and management of natural resources. Methods to ecosystem restoration are thoroughly covered as well as principles of conservation biology. You will also get an understanding of tools for species extractions, field methodologies and analytic techniques.

**CONTENTS OF THE PROGRAMME** The first year consists of course work where you will obtain a thorough knowledge of the scientific basis for the degree. The course work will require interactive participation by the students through presentations, short thematic reviews, term papers and discussion sections. The second year is set aside for individual research projects. The programme has a strong research emphasis.

### REQUIREMENTS

The applicants must have obtained a Bachelor's degree, or its equivalent, in natural sciences (e.g. biology, ecology, natural resource management, agricultural or environmental sciences) with basic knowledge in statistics/research methods. Applicants must demonstrate English language ability in accordance with the UMB regulations for programmes taught in English.

### FOR MORE INFORMATION?

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Student Information Centre (SiT)  
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tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the study programme:  
Study Coordinator: Espen Arestøl  
tlf.: +47 64 96 57 25 / +47 64 96 58 00  
e-mail: [studieveileder-ina@umb.no](mailto:studieveileder-ina@umb.no)

## STUDY PROGRAMME STRUCTURE\*

### ECOLOGY – TROPICAL ECOLOGY AND MANAGEMENT OF NATURAL RESOURCES - 120 CREDITS

#### MANDATORY COURSES:

COMMUNITY BASED NATURAL RESOURCE  
MANAGEMENT

CONSERVATION BIOLOGY

ECOLOGY AND MANAGEMENT OF NATURAL RESOURCES  
IN THE TROPICS

RESTORATION ECOLOGY

SCIENTIFIC METHODOLOGY IN ECOLOGY AND  
MANAGEMENT OF NATURAL RESOURCES

#### SPECIAL SYLLABUS

TROPICAL ECOSYSTEMS AND BIODIVERSITY

#### MASTER'S THESIS

\*WE RESERVE THE RIGHT TO MAKE CHANGES.

FURTHER INFORMATION ON THE STRUCTURE OF THE  
PROGRAMME: [www.umb.no/studies](http://www.umb.no/studies)

## FORMER STUDENT



**HARTVIG VELUND**  
Trainee  
Green Resources

*I am working with various environmental issues in forest projects in East Africa. This implies for instance biodiversity monitoring and FSC certification.*

*I chose to study at UMB because of its reputation. In addition, I saw that an education from UMB could give challenging and interesting job opportunities. The training and skills acquired at UMB are fundamental for what I'm doing now.*

*My advice to prospective students: dare to keep your big goals, but don't make the plans too tight. Think strategic, but take courses you find interesting. Study hard, but remember to have fun!*







MASTER

# FEED MANUFACTURING TECHNOLOGY

FÔRTEKNOLOGI

## WHY STUDY FEED MANUFACTURING TECHNOLOGY?

- The study gives you unique knowledge about nutrition and processing technology.
- The competence is strongly needed in the feed industry.
- Your expert knowledge within animal feed production gives you many career opportunities.

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**WHAT CAN YOU USE THIS QUALIFICATION FOR?** You will acquire skills needed for higher level management in the feed milling industry and related industries. This Master study is also an excellent background for further scientific research activity in feed technology.

**WHAT WILL I LEARN?** The curriculum consists of a combination of nutritional, technological, chemical and physics topics, which combined will represent a unique approach to this topic.

**CONTENTS OF THE PROGRAMME** You will get hands-on experience with the various types of equipment and production lines by fully integrating the possibilities offered by the Centre for Feed Technology in the programme. Teaching and training will partly be based on lectures, but a considerable part will be offered as demonstrations and training in groups. The courses are mainly taught by staff from UMB but external experts from the feed industry and international companies and institutions will also be called in when appropriate.

#### **REQUIREMENTS:**

A bachelor's degree or its equivalent, with at least: 10 credits mathematics, 10 credits chemistry/ physics, 10 credits statistics and 60 credits biological subjects, preferably including nutrition.

#### **FOR MORE INFORMATION?**

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Study Coordinators  
Marit Ensby,  
Phone.: +47 64 94 51 26  
E-mail: [marit.ensby@umb.no](mailto:marit.ensby@umb.no)  
Megumi Ota Fog,  
Phone.: +47 64 96 51 54  
E-mail: [megumi.fog@umb.no](mailto:megumi.fog@umb.no)

## STUDY PROGRAMME STRUCTURE\*

### FEED MANUFACTURING TECHNOLOGY - 120 CREDITS

#### COMPULSORY COURSES

FEED MANUFACTURING TECHNOLOGY

ADVANCED FEED MANUFACTURING TECHNOLOGY

FEED PRODUCTION PLANNING AND MANAGEMENT

FEED OPTIMALISATION FOR DIFFERENT SPECIES

HEAT ENGINEERING

PROTEINS, POLYSACCHARIDES AND FATS/OILS

THE REST WILL BE OPTIONAL COURSES AND  
MASTER THESIS

\*WE RESERVE THE RIGHT TO MAKE CHANGES.

FURTHER INFORMATION ON THE STRUCTURE OF THE  
PROGRAMME: [www.umb.no/studies](http://www.umb.no/studies)

## FORMER STUDENT



**VUKASIN DRAGANOVIC**

Researcher,  
Skretting ARC Stavanger

*- I work as a researcher in Skretting Aquaculture Research Centre, Stavanger. I work in Feed Production department. My area of responsibility is evaluation of feed ingredients and new product development.*

*- I find my education at UMB very relevant to my current position, especially when it comes to experimental work.*

*- I was interested in feed technology and UMB is one of the few places in the world that offers this education*

*- To work hard and get as much knowledge as possible*



MASTER

# INTERNATIONAL DEVELOPMENT STUDIES

## WHY INTERNATIONAL DEVELOPMENT STUDIES?

- You want to learn about the challenges facing developing countries
- You want to study in an international environment and experience a developing country
- You want to contribute towards poverty reduction and a sustainable world

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**WHAT CAN YOU USE THIS QUALIFICATION FOR?** Graduates find employment in a wide range of national and international institutions, such as government agencies, non-governmental development organisations, multi-lateral and bilateral aid organisations, and research and teaching institutions.

**WHAT WILL I LEARN?** You will learn about conditions for human development at the local and global levels as well as relationships between development and ecological processes. After graduation, you will be able to:

- Understand and analyse policy issues related to poverty, human development, wealth creation, social justice, equality and environmental protection
- Formulate and assess development policies and project interventions
- Undertake studies that link theories to practical development projects

**CONTENTS OF THE PROGRAMME** The first year consists of course work covering development theory and policy, research methodology plus elective subjects. A two-month field course in rural development and project management at Makerere University, Uganda, and possibly in Tanzania, will give you valuable field experience. The field course is normally followed by field research for the master thesis. Most students do their research in a developing country. You will write your thesis in the final spring semester at UMB.

**INTERNATIONAL SETTING** The students attending the programme each year typically represent around twenty nations from all continents. The teaching staff has also been recruited internationally.

**STUDY PROGRAMME STRUCTURE:** Further information on the structure of the programme: [www.umb.no/studies](http://www.umb.no/studies)

### REQUIREMENTS

Admission requires a bachelor's degree, a Norwegian cand. mag. degree, or an equivalent background in a relevant field, e.g., political science, education, anthropology, sociology, resource management, or economics. Applicants must meet the university's requirement for English language proficiency.

### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Department of International Environment and Development Studies,  
P.O. Box 5003, 1432 Aas, Norway  
phone: +47 64 96 52 00  
e-mail: [studieveileder-noragric@umb.no](mailto:studieveileder-noragric@umb.no)  
[www.umb.no/noragric](http://www.umb.no/noragric)



## STUDY PROGRAMME STRUCTURE\*

### INTERNATIONAL DEVELOPMENT STUDIES - 120 CREDITS

#### COMPULSORY COURSES

INTRODUCTION TO DEVELOPMENT STUDIES  
DEVELOPMENT THEORY AND POLICY  
RESEARCH METHODS  
DEVELOPMENT CLASSIC  
METHODS IN ENVIRONMENT AND DEVELOPMENT RESEARCH  
RURAL DEVELOPMENT AND PROJECT MANAGEMENT (FIELD COURSE)

#### RECOMMENDED 300-LEVEL COURSES

POLITICAL ECOLOGY  
ADVANCED READINGS IN DEVELOPMENT STUDIES  
CONFLICT AND DEVELOPMENT  
GENDER AND DEVELOPMENT  
INTERNATIONAL RELATIONS THEORY  
STATE FORMATION: HISTORICAL ISSUES AND CONTEMPORARY DEBATES

#### ADDITIONAL ELECTIVE COURSES

SUSTAINABLE AGRICULTURE AND THE ENVIRONMENT  
POLITICAL STRUCTURES AND PROCESSES  
LINKING ECOLOGICAL AND SOCIAL RESILIENCE  
HEALTH AND DEVELOPMENT  
GLOBAL ENVIRONMENTAL CHANGE  
ANTHROPOLOGY OF DEVELOPMENT  
DEVELOPMENT AID AND POLITICS  
LAND RIGHTS: AN INTRODUCTION TO THEORY, APPLICATIONS AND POLICY  
MANAGEMENT OF GENETIC RESOURCES: LAW AND POLICY  
GLOBAL POLITICAL ECONOMY  
MANAGEMENT OF DRYLAND RESOURCE SYSTEMS  
GLOBAL CHANGE AND DEVELOPMENT  
RESEARCH ETHICS AND PHILOSOPHY OF SCIENCE I  
RESEARCH ETHICS AND PHILOSOPHY OF SCIENCE II

\* STUDENTS WILL DESIGN INDIVIDUAL STUDY PLANS DURING THE FIRST SEMESTER. COMPULSORY COURSES CAN BE WAIVED FOR STUDENTS WITH A STRONG BACKGROUND IN THE SUBJECT.

## FORMER STUDENT



**OMAR DRAMMEH**

Regional Consultant  
Save the Children, Norway

*My job is to motivate and inspire others to take on voluntary work. I spread information on the Child and the Human Rights Declaration.*

*"I chose to study at UMB because I am very concerned about international politics. I am particularly interested in the North/South question and human rights. At UMB you have the possibility of practising what you have learned during fieldwork. The combination of knowledge and practice was important for Save the Children Norway.*

*The student environment was very good. I have good contact with friends all over the world since my study period. I miss As and the good environment.*

*It is important to get involved and to show interest. Being active in the organisations and the student environment counts a great deal."*



MASTER

# INTERNATIONAL ENVIRONMENTAL STUDIES

## WHY STUDY INTERNATIONAL ENVIRONMENTAL STUDIES?

- You are concerned about environmental challenges of our time
- You believe environmental solutions require combining natural and social sciences
- You want qualifications to contribute to sustainable development internationally

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**WHAT CAN YOU USE THIS QUALIFICATION FOR?** The programme qualifies for work in national and international agencies, ministries and environmental organisations. It also qualifies for jobs in development aid agencies, education, research institutions, media, consulting companies and international firms.

**WHAT WILL I LEARN?** Students will learn about causes and effects of global environmental problems related foremost to climate change, loss of biodiversity, desertification, water availability and land degradation. The programme gives an in-depth understanding of how governance structures and power relations influence current trends. Roles of international political bodies, national states and state policies, markets and civil society are emphasized. Poverty alleviation and health issues are also core aspects of sustainable development with strong links to environmental qualities.

**CONTENTS OF THE PROGRAMME** The first year consists of course work covering natural and social issues, research methodology plus elective subjects. A two-month field course in local environmental management and project management is given by Makerere University, Uganda, and Tribhuvan University, Nepal. The field course is normally followed by field research for the master thesis. Most students do their research in a developing country. Students will write their thesis in the final spring semester at UMB.

**INTERNATIONAL SETTING** The students attending the programme each year typi-

cally represent around twenty nations from all continents. The teaching staff has also been recruited internationally.

#### REQUIREMENTS

A bachelor's degree or equivalent education in a relevant field is required for admission. Depending on your planned specialisation, your background may be from environmental sciences, ecology, resource management, agriculture, forestry, geography, economics, political science or social science.

#### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
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e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Department of International Environment and Development Studies,  
P.O. Box 5003, 1432 Ås, Norway  
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e-mail: [studieveileder-noragric@umb.no](mailto:studieveileder-noragric@umb.no)  
[www.umb.no/noragric](http://www.umb.no/noragric)

## STUDY PROGRAMME STRUCTURE\*

### INTERNATIONAL ENVIRONMENTAL STUDIES - 120 CREDITS

#### COMPULSORY COURSES

INTRODUCTION TO ENVIRONMENTAL STUDIES  
GLOBAL ENVIRONMENTAL CHANGE  
POLITICAL ECONOMY - INSTITUTIONS AND THE ENVIRONMENT  
RESEARCH METHODS  
METHODS IN ENVIRONMENT AND DEVELOPMENT RESEARCH  
ENVIRONMENTAL MANAGEMENT IN THE FIELD (FIELD COURSE)

#### RECOMMENDED ELECTIVE COURSES

ECONOMICS FOR ENVIRONMENT AND DEVELOPMENT  
SUSTAINABLE AGRICULTURE AND THE ENVIRONMENT  
STATISTICAL ANALYSIS  
LINKING ECOLOGICAL AND SOCIAL RESILIENCE  
AGRICULTURAL AND DEVELOPMENT  
DEVELOPMENT AID AND POLITICS  
LAND RIGHTS: AN INTRODUCTION TO THEORY, APPLICATIONS, AND POLICY  
MANAGEMENT OF GENETIC RESOURCES: LAW AND POLICY  
POLITICAL ECOLOGY  
NATIONAL ENVIRONMENTAL GOVERNANCE  
INTERNATIONAL ENVIRONMENTAL GOVERNANCE  
MANAGEMENT OF DRYLAND RESOURCE SYSTEMS  
CLIMATE CHANGE AND DEVELOPMENT  
CONFLICT AND DEVELOPMENT  
COASTAL AND AQUATIC RESOURCE MANAGEMENT  
ECOLOGY  
TROPICAL ECOSYSTEMS AND BIODIVERSITY  
GLOBAL CHANGE ECOLOGY  
TROPICAL FIELD ECOLOGY  
PROJECT EVALUATION AND ENVIRONMENTAL VALUATION  
GLOBAL AND LOCAL POLLUTION  
BIOGEOCHEMISTRY, GLOBAL CHANGE  
APPROPRIATE SANITATION FOR THE DEVELOPING WORLD  
ECOTECHNOLOGY

\* STUDENTS WILL DESIGN INDIVIDUAL STUDY PLANS DURING THE FIRST SEMESTER. COMPULSORY COURSES CAN BE WAIVED FOR STUDENTS WITH A STRONG BACKGROUND IN THE SUBJECT.

## FORMER STUDENT



**MARTE QVENILD**

Forsker 3  
Norsk institutt for naturforskning  
(NINA)

**WHAT ARE YOU DOING AT THE MOMENT?** *I work at NINA's department of Natural Resource Use at Lillehammer with projects related to biodiversity, conservation ecology, and nature-based tourism. Part of my job will be to carry out an interdisciplinary PhD study within the field of biodiversity.*

**WHY DID YOU CHOOSE UMB FOR YOUR STUDIES?** *The programme was chosen as I could carry out the whole programme in English, in an international environment. Also, in a small university like UMB it is easy to have interaction with lecturers and scientific staff. UMB has good connections with universities in the south, which made it possible for me to have an exiting semester in Nepal.*







## MASTER INTERNATIONAL RELATIONS

### WHY STUDY INTERNATIONAL RELATIONS?

- You are interested in international solutions to current global challenges.
- You want a theoretical and practical understanding of international interaction.
- You want to become qualified to work for international organizations.

**WHAT CAN YOU USE THIS QUALIFICATION FOR?** Candidates holding a Master's degree in International Relations from UMB will be able to compete for jobs within civil administration, international organizations, research and education institutions, and within private sector working in international environments. The students graduating from the programme will be the only candidates with education from Norway with a degree in International Relations.

**WHAT WILL I LEARN?** The programme gives a theoretical understanding of international interaction and relevant fields such as environment, development and poverty. The programme aims to increase the practical understanding of international interaction through placement schemes both in organizations and other universities, particularly universities abroad. International relations deepens the understanding of the political nature of why and how bilateral and multilateral institutions promote certain development policies spatially and temporally.

**CONTENTS OF THE PROGRAMME** The programme is a collaboration between Norwegian Institute of International Affairs (NUPI) and UMB. The first year consists of course work covering natural and social issues, research methodology plus elective subjects. Students may do their research in any parts of the world. Students will write their thesis in the final spring semester at UMB. The programme has a duration of two years, consisting of a total of 120 credits (ETCS), of which the master thesis constitutes either 30 or 60 credits. The student has 50 or 20 credits for elective courses, respectively.

**INTERNATIONAL SETTING** The students attending the programme each year typically represent around twenty nations from all continents. The teaching staff has also been recruited internationally.

#### REQUIREMENTS

A Bachelor's degree or equivalent education in a relevant field is required for admission. Depending on your planned specialization, your background may be from political science, environmental sciences, ecology, resource management, geography, economics, or social science.

#### FOR MORE INFORMATION?

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web: [www.umb.no/noragric](http://www.umb.no/noragric)

## STUDY PROGRAMME STRUCTURE\*

### INTERNATIONAL RELATIONS - 120 CREDITS

#### COMPULSORY COURSES

INTERNATIONAL RELATIONS THEORY

CONFLICT AND DEVELOPMENT

GLOBAL POLITICAL ECONOMY

RESEARCH METHODS I

RESEARCH METHODS II

#### SELECTED ELECTIVE COURSES

STATE FORMATION: HISTORICAL ISSUES AND  
CONTEMPORARY DEBATES

INTERNATIONAL ENVIRONMENTAL GOVERNANCE

POLITICAL STRUCTURES AND PROCESSES

POLITICAL ECONOMY – INSTITUTIONS AND THE  
ENVIRONMENT

DEVELOPMENT AID AND POLITICS

RESEARCH ETHICS AND PHILOSOPHY OF SCI. I

RESEARCH ETHICS AND PHILOSOPHY OF SCI. II

INTRODUCTION TO DEVELOPMENT STUDIES

INTRODUCTION TO ENVIRONMENTAL STUDIES

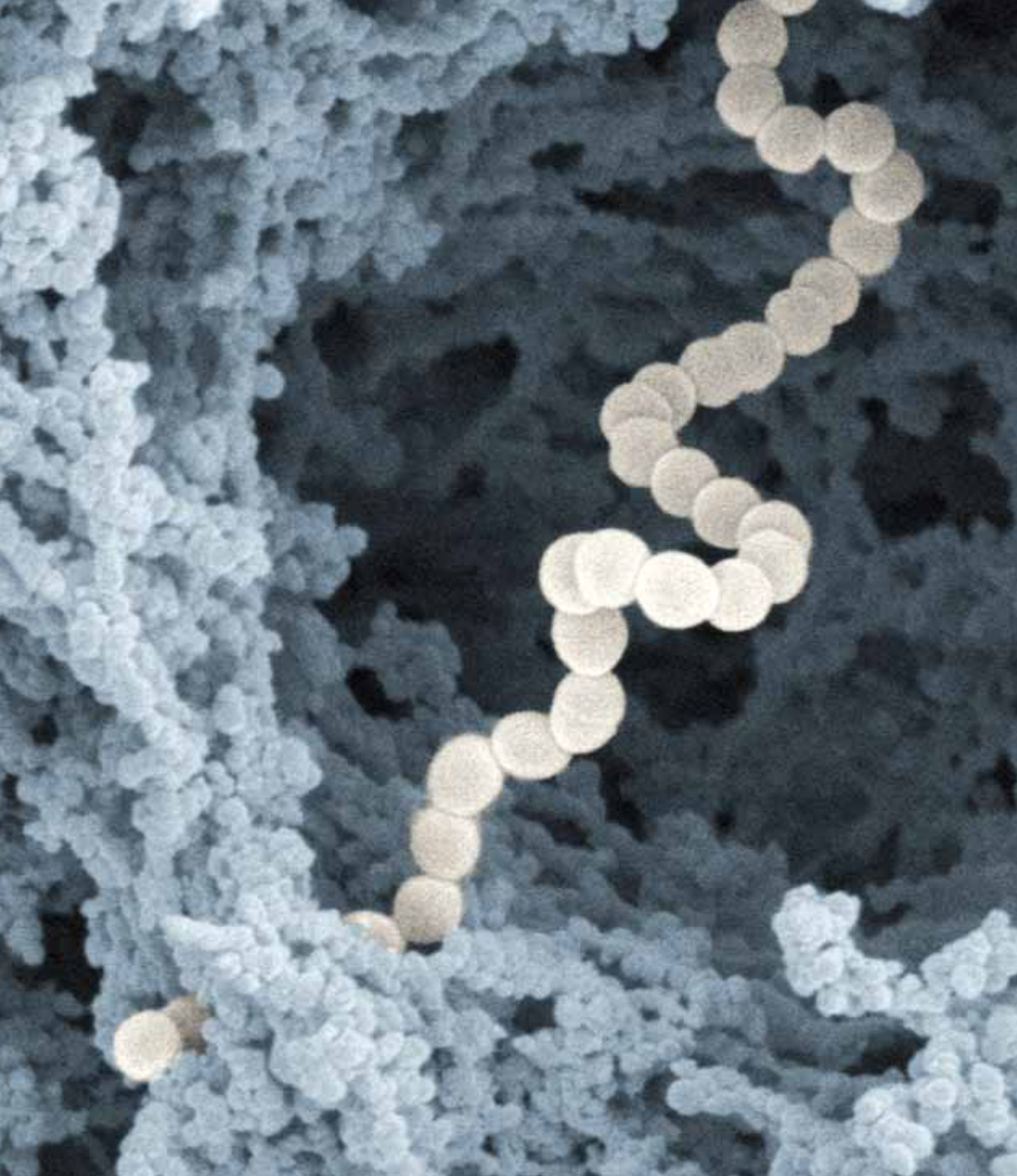
DEVELOPMENT CLASSICS

POLITICAL ECOLOGY

ADVANCED READINGS IN DEVELOPMENT STUDIES

\* STUDENTS WILL DESIGN INDIVIDUAL STUDY PLANS DURING THE FIRST SEMESTER. COMPULSORY COURSES CAN BE WAIVED FOR STUDENTS WITH A STRONG BACKGROUND IN THE SUBJECT.





## MASTER MICROBIOLOGY

### WHY STUDY MICROBIOLOGY?

- Microbiological knowledge is important in medicine, industry, biotechnology and environmental issues as well as for control authorities.
- Microorganisms are essential for human beings, and for the turnover of nutrients in nature.
- In biotechnological industry and the food industry microorganisms may be both useful and problematic.

A study program of a high quality, according to an international evaluation in 2008.

### PROSPECTIVE EMPLOYMENT:

Employment in biotechnological, medical and food industry. In private or public research and development. Microbiologists are in demand as consultants in public communities and in private institutions. The MSc degree in Microbiology qualifies for PhD-studies.

**LEARNING OUTCOME:** Your MSc degree may be in areas of basic or applied microbial research. At campus Ås there are internationally recognised research groups with expertise in microbial gene technology, enzyme function, horizontal gene transfer and quorum sensing. There is also focus on applied food microbiology concerning pathogens, hygiene, probiotics and food production. In environmental microbiology, the biogeochemical processes are important, e. g. the formation of climate gases, and combustion of organic components. It is possible to use microorganisms for bioremediation and for the conversion of waste to useful compounds.

**STUDY STRUCTURE:** The first year of the study program ensures a broad theoretical basis for the master thesis. A course in experimental molecular microbiology is mandatory, in addition to at least one course in environmental microbiology, mycology or pathogenic microorganisms. You can also select courses in microscopy, and molecular, biochemical or chemical methods.

You do a master thesis of 60 credits (ECTS), alternatively 30 credits (ECTS). A special syllabus related to the master thesis is mandatory.

#### **FUTURE:**

With a Master of Science degree in Microbiology you qualify for employment in both public and private institutions, as described under “Prospective employment”. You are also qualified for PhD-studies. Additional pedagogic education will enable you to teach at high school level.

#### **ADMITTANCE:**

A Bachelor's degree in biotechnology or equivalent qualifies. To a certain extent lacking and essential bachelor courses are allowed as a part of the Master's degree. The study coordinator performs this assessment. Admittance requires a mean level of grade C (ECTS) or better in your Bachelor's degree.



#### FOR MORE INFORMATION?

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P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Study Coordinator Janne Beate Utåker,  
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## MASTER PLANT SCIENCE

### WHY STUDY PLANT SCIENCE?

- You are interested in agriculture and horticulture
- Ecological agriculture
- Effect of climate and environment on growth and quality
- Health aspects of plants and food
- You can use the basic knowledge gained during the bachelor's study programme to solve many challenges in agriculture, nationally and internationally.

**WHAT CAN YOU USE THIS QUALIFICATION FOR?** Work opportunities include managerial positions in environment or agriculture.

You will be qualified for governmental, communal or private sectors as a manager, adviser/consultant, PhD-student, researcher, lecturer (with pedagogic). You can work internationally, in UN organisations like FAO, and NORAD.

**PROGRAMME OBJECTIVES** The programme provides specialisation in agriculture, horticulture, plant biology or plant pathology. You can choose between three study options:

1) Agriculture and horticulture, focusing on:

- Flowers, fruits, berries and vegetables
- Cereal, fibre and oil plants and diverse fodder plants
- Environmentally sustainable growing methods
- Physiological processes in plants, affected by external conditions (nutrients, temperature, light and daylength)

- How plant breeding are used to meet the market

2) Plant Biotechnology, focusing on:

- Understanding of plants function, and how the environment and climate effects on their functions
- Genetics and molecular methods

3) The specialisation in Plant Pathology is a cooperation between the Nordic countries and is focusing on plant health and plant protection. Choice of electives provides the possibility for

individual adjustments in the study programme. NOVA-University

**REQUIREMENTS** Bachelor's degree in plant science, biology, biotechnology or equivalent education that includes basic knowledge in mathematics, chemistry, plant physiology, and natural sciences.

#### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Study Coordinator Ingrid Bugge,  
phone: +47 64 96 55 25  
e-mail: [ingrid.bugge@umb.no](mailto:ingrid.bugge@umb.no)









## MASTER RADIOECOLOGY

### WHY STUDY RADIOECOLOGY?

- There is an urgent need of university trained candidates within nuclear sciences, including radioecology.
- Radioecology is a key research area ranging from nuclear sources to impact and risk assessments and radiation protection.
- Interested in solving environmental challengers due to the nuclear industry and waste management.

**WHAT CAN YOU USE THIS QUALIFICATION FOR?** A wide range of positions related to authorities responsible for the national legislation and the nuclear energy industry e.g., within ministries, directories, governments, services, development projects, technical support and consultancy, management, environmental protection, as well as within institutions responsible for research and education.

**CONTENTS OF THE PROGRAMME?** In a diverse learning process, you will gain knowledge about radioecology; behaviour of radionuclides in the environment, as well as impact and risk assessment based on radiochemistry and radiation protection, the nuclear industry and waste management, project management and research methods. Skills in these areas are required not only to deal with currently installed nuclear capacity and decommissioned facilities, but also to meet the needs presented by likely new build nuclear installations.

**THE TEACHING** Your learning will be based on lectures, laboratory work, group work, real-life case studies and thematic thesis with interdisciplinary approach, and through reflection on links between real-life situations and theory.

**STUDY PROGRAMME STRUCTURE** The first year provides basic course modules as well as the initiating of the research project; the second year is dedicated to experiments, data, collection and analysis, i.e. finalizing the thesis. The course modules will be held at UMB with support from collaborating European universities. Course modules will be presented by highly competent Norwegian and European teachers.

#### REQUIREMENTS

Bachelor's degree (BSc) or equivalent education in any field relevant to the environment (e.g. chemistry, ecology, biology, resource management, agriculture, environmental sciences, environmental engineering, geography etc.).

Applicants must demonstrate English language ability in accordance with UMB regulations for programmes taught in English.

#### FOR MORE INFORMATION?

- Information about application and general questions about the study:  
Student Information Centre (SiT)  
P.O.Box 5003, 1432 Ås, Norway  
tlf.: +47 94 96 61 00  
e-mail: [opptak@umb.no](mailto:opptak@umb.no)  
internett: [www.umb.no/sit](http://www.umb.no/sit)
- More information about the courses:  
Study Coordinator Ingrid Bugge,  
phone: +47 64 96 55 25  
e-mail: [ingrid.bugge@umb.no](mailto:ingrid.bugge@umb.no)

## STUDYPLAN

### EUROPEAN MASTER IN RADIOECOLOGY, COURSE MODULES AND TIME SCHEDULE

TITLES OF COURSE MODULES	YEAR/SEMESTER AND TIME
RESEARCH PROJECT + SPECIAL SYLLABUS (MINIMUM 5 ECTS)	YEAR 2/ AUTUMN AND SPRING
RADIATION PROTECTION AND WASTE MANAGEMENT	YEAR 1/ FEBR – MAY IN FRANCE
RISK MANAGEMENT AND EMERGENCY PLANNING	YEAR 1/ FEBR – MAY IN FRANCE
ACCESSING RISK TO MAN AND ENVIRONMENT, ETHICS	YEAR 1/ JANUARY
PROJECT MANAGEMENT AND RESEARCH METHODS	YEAR 1/ SEPT – NOV WITH EXAM IN DEC
RADIOECOLOGY -BEHAVIOUR OF RADIONUCLIDES IN THE ENVIRONMENT	YEAR 1/ SEPT – NOV WITH EXAM IN DEC
RADIATION AND RADIOCHEMISTRY	YEAR 1/ AUG-SEPT WITH EXAM IN DEC

FURTHER INFORMATION ON THE STRUCTURE OF THE PROGRAMME: [www.umb.no/studies](http://www.umb.no/studies)



# COURSES AVAILABLE IN ENGLISH

[www.umb.no/courses](http://www.umb.no/courses)

<http://www.umb.no/study-options>

## **AKA251 General Aquaculture Breeding and Genetics**

**Credits:** 5 **Language:** English

**Learning outcomes:** Students will learn the basic aquaculture genetics and breeding, in addition to some major aquaculture breeding programmes.

## **AKA260 Aquaculture - Breeding and Genetics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students are to acquire sound knowledge in the use of traditional and modern fish breeding methods. The students are to gain skills in the evaluation of various strategies and methods and be able to understand the principles of estimating various breeding parameters. As a conclusion of the course, the students will be able to suggest a breeding program for a fish breeding company with given breeding goals and restrictions.

## **AKA350 Optimisation of Fish Breeding Programs**

**Credits:** 10 **Language:** English

**Learning outcomes:** The student will be able to understand and make sensible use of various simulation software for optimisation of breeding schemes for aquaculture species.

## **AKE251 General Aquaculture - Nutrition**

**Credits:** 10 **Language:** English

**Learning outcomes:** The aim of the course is to provide students with a basic understanding of nutrition with emphasis on monogastric animals and in particular fish. The student should gain an understanding of the main components of the diet and their interrelationships and importance for the animal. The student will be



brought up to date in the area of aquafeeds and in addition be given an introduction to feed composition, feed evaluation and calculation of feed rations for fish.

## **AKE310 Aquaculture Nutrition**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students will gain both theoretical and practical experience of feed formulation and biological feed evaluation. The student will also obtain a theoretical understanding of the principles behind feed formulation and nutrition physiology, thus allowing an understanding of the economical, technical and biological challenges of today's and tomorrow's aquaculture industry from a feed management perspective.

## **AKX251 General Aquaculture - Anatomy and Health in Farmed Fish**

**Credits:** 10 **Language:** English

**Learning outcomes:** The first aim of the course is to give the student a theoretical base in fish physiology, anatomy and health. The second aim is to give the student a practical experience of this knowledge. The final aim is to create a situation allowing the student an insight in to the consequences of implementing biological knowledge in a production situation.

## **AKX253 Product Quality in Aquaculture**

**Credits:** 5 **Language:** English

**Learning outcomes:** The student will during the course have gained a solid theoretical understanding of quality and the components responsible for quality of aquaculture products. The student will also gain insight into different analytical methods and possibilities for influencing/improving important quality parameters. The student is presented to the basic principles of quality, definitions and the

needs for appropriate analytical methods and ways of influencing quality. The students are further expected to gain detailed knowledge related to central sensory, nutritionally and processing related quality parameters, as well as the importance of ethical and hygienically safe products. Insight into the factors regulating quality in practical production will be gained through the excursion and visit to applied research institutions.

### **AKX300 Aquaculture, Special Course**

**Credits:** 5 **Language:** English

**Learning outcomes:** Students will acquire an interdisciplinary understanding and technical independence in the area of aquaculture.

### **AOS233 Strategiske prosessar og avgjerdetaking**

**Credits:** 10 **Language:** English

**Learning outcomes:** The objectives in this course are threefold. First, we review the impact of the cognitive dimension on strategic diagnosis and decision-making. We investigate how this dimension influences the activities that affect the organisation in developing strategy. The second objective is to provide a conceptual framework for understanding complex organisational structures as systems. This involves a review of different perspectives on strategic decision-making and the factors that influence the process. The two theoretical platforms that support this second objective are information feedback theory and behavioural decision theory. These theories provide insights into the different possible perceptions of the strategic development problem and serve as valuable learning and communication tools. These views are combined into the unified approach called systems thinking. This perspective gives the decision maker a powerful method for investigating and communicating the long-term consequences of strategic planning activities.

## **APL405 Framing the PhD**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The two main objectives of the course is to become conscious of the scientific and personal challenges involved in doing a PhD and to facilitate and boost the work with the education plan and the design of the thesis project through constructive guidance and thinking tools to understand, structure and demarcate the thesis topic in the crucial initial stages of the PhD. The students will get training in communicating their own project and give feedback to others.

## **BIN300 Statistical Genomics**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students should be able to judge the pros and cons of: - alternative mapping methods for genes and QTL, - alternative designs and methods of analysis for the fine scale mapping of genes, - alternative methods for the analysis of sequence data and gene detection. The students should acquire sufficient knowledge to follow more advanced courses in these fields.

## **BIN310 Models and Algorithms in Bioinformatics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students must be able to explain the theory behind central scoring models for sequence alignments, and thereby understand the basis of statistically based conclusions. The students will understand the optimal algorithms for sequence alignments, and implement variants of them in a high-level language. Students will know the principles behind commonly used heuristic algorithms for pairwise and multiple sequence alignments. Markov models, and other probabilistic models, and how these are used for sequence analysis, are central to the course. Students will process large data sets in a modern scripting language, and retrieve

relevant information from searches in international databases. The student should also be able to present subject-relevant material both orally and in writing.

## **BIN350 Genome Analysis, Methodology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Students shall be able to give an overview of important genome resources, explain how these are organised in information databases, and on an individual basis be able to evaluate which of these resources are most relevant in real-life cases.

## **BIO220 Eucaryot Molecular Biology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Here, we will guide the students from a genetic understanding to application of their genetic knowledge (theory and practical experience from laboratory experiments) and analysis. The knowledge they are to gain is on eucaryote genetics and on the understanding of genes and genomes. This course provides a basis for further studies in biotechnology, livestock breeding, food, plant breeding, bioinformatics and medicine. Students should also learn how to use literature for solving problems, with elements of problem-based learning in colloquia. This is to repeat the basis of molecular biology as well as opening up for increased current learning. Optionally, a term paper can be written for 5 extra credits individual work in addition to BIO220. This requires a thoroughly written paper using primary literature according to scientific standards for publications.

## **BIO243 Biotechnology in Plants**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** The course will introduce the students to the different biotechnological methods used in plants and their role in modern research in

biology as well as in the production of food, feed and other plant products. The students should be able to understand how biotechnology may supplement or replace traditional methods in propagation and breeding. The course consists of both lectures and laboratory exercises, the themes covered are: A: DNA extractions, PCR, interpretation of gels, genetic markers used for marker assisted breeding (MAS). The plant genome: construction, polyploid plants, mutations, alternative methods of mutation (TILLING), genetic maps, quantitative and qualitative characters, theory on selection based on geno- and phenotype, the genetic foundation for resistance, quality etc B: Cell- and tissue culture: In vitro propagation through adventitious and axillary propagation (different tissues), disease elimination through meristem cultures, chimeras and their importance in propagation, somatic embryogenesis, double haploids, gene modifications, reverse genetics, gene expression. C: Genetically modified crops: Current and potential role in plant production, potential and limitations of different types of transgenes, risk assessments, laws and regulations in Norway (and EU), internationally related to genetically modified (GM)crops.

## **BIO300 Microscopy Techniques**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students will acquire theoretical and practical knowledge in optics, sample treatment and image formation to be able to: 1) explain central optical terms. 2) describe ray paths and image formation in various microscope types. 3) make rational choices concerning sample treatment and imaging methods based on sample type and the problem to be solved. 4) evaluate and interpret micrographs. Students should be able to: A) Diagnose, adjust and use the following microscopes: 1) Light microscopes - LM, with various types of optics (bright fields, dark fields, polarisation, phase, DIC and fluorescence). 2) Confocal Laser Scanning Microscope - CLSM. 3) Scanning Electron Microscope - SEM, in various imaging modes (SEI and BEI) and for element determination (X-ray analysis). 4)

Transmission electron Microscopy - TEM. B using the following equipment for sample treatment: 1) Ultramicrotome for cutting in LM and TEM. 2) Cryostate for cutting in LM and SEM. 3) Coating-units (Sputter and High vacuum) in SEM. 4) Critical point drying (CPD) in SEM. C) Using a selection of methods in connection with sample treatment, colouring/markings and simple image treatment (will vary somewhat from one year to the next).

## **BIO301 Advanced cell biology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After completing the course, students should have a thorough understanding of molecular mechanisms of eukaryotic cell biology and important concepts of stem cell biology. Understanding the principles of cell communication, cell interaction and intracellular signal transduction will be given priority. The students should acquire knowledge about central signaling pathways controlling cell growth and differentiation processes, how these signaling pathways are regulated and which transcription factors that are affected. These learning aims should contribute to the students' development of skills, enabling them to acquire relevant literature on the subject and to formulate scientific problems within cell biology.

## **BIO320 Development Biology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Understanding advanced gene regulation underlying the specification of different cell types in multicellular organisms. Students are to gain insight into recent research in the field of model organisms such as the fruit fly and Arabidopsis. The students are to gain a deeper understanding of one topic in development biology through the title/topic for the semester assignments. Another aim is for students to be able to develop an understanding of choice of methods



and research approaches used to solve problems and questions in developmental biology.

## **BIO321 Population Genetics and Molecular Evolution**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students should be able to understand the dynamics of the evolutionary changes that happen at the molecular level, the evolutionary forces behind such changes and the evolutionary effects of different molecular mechanisms on genomes, genes and gene products. The students should also gain theoretical insight and practical skills in methods used in comparative and phylogenetic analyses based on molecular data. The students should develop a critical approach towards the interpretation of this type of data, and a level of knowledge sufficient to understand cutting edge research articles on the subject. The students should be able to plan their own research on the subject and apply relevant methods in order to analyse and present the results.

## **BIO322 Molecular Genomics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After completing the course, students are to have established a good understanding of how higher-level eucaryote genomes are built up and regulated. The students are to be able to describe and explain the most important methods used to study genomes, transcriptomes and proteomes, including the evaluation of the strengths and weaknesses of the methods. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **BIO323 Evolution in Host-Pathogen Systems; Plant Breeding for Resistance**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students shall understand the evolutionary genetics of host-pathogen interactions and how these may be affected/manipulated through breeding of resistant cultivars. Sustainable use of resistance genes in plants as part of IPM strategies. Inoculation and disease-assessment techniques, analysis of resistance in plant populations. To understand that (1) pathogens can rarely be exterminated, (2) that low levels may be acceptable and (3) plant protection strategies based on resistance that expose the pathogen to extreme selection pressures are not sustainable.

## **BIO330 Environmental Microbiology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The main aim is to give students: -A basic insight into microbial processes and interactions that play central roles in the functioning of ecosystems. -The theoretical foundation necessary for acquiring knowledge in the subject field by reading primary scientific literature. -An understanding of methods, with main emphasis on the role of molecular biology in microbial ecology. - Intellectual skills that may be used for solving environmental problems.

## **BIO332 Experimental Molecular Microbiology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students will become familiar with techniques used in microbiological research, with emphasis on molecular methods. Students will become aware of the contexts in which the different methods are used, and the strong and weak points of the various methods will be discussed. In addition, they will learn how to interpret and evaluate biological data, and gain experience in

reading and using scientific primary literature. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

### **BIO333 Mycology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students will have an overview over basic fungal systematics, -genetics, -physiology and -ecology. Students will have acquired knowledge of industrial uses of fungi, their applications in the biological control of plant diseases. The students should be able to consider possible positive and negative effects of fungi, suggest actions to limit any possible risks, and be able to classify fungi using morphological techniques.

### **BIO340 Bioethics**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Students should get acquainted with the legislation in the field and know the central participants that researchers work with. Since the legislation requires consequence and risk evaluation as well as ethical argumentation, this must also be known to the students. Students are to be capable of holding a discussion on the ethical and social consequences of the use of modern biotechnology in the way it is required in cases of applications for exposing or performing field experiments on genetically modified organisms or for conducting clinical research on genetic engineering.

### **BIO350 In Situ RNA Hybridisation Techniques**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students shall be able to harvest their plant or animal material, fix it, wax-embed it, section it in a microtome, transfer to a pre-coated slide, make probes of potentially interesting gene sequences, hybridise with the probes, develop and examine under the microscope. One is able to see which genes are active (expressed) at any given time in a developmental process. The students should be able to see the potential and the limitations for the technique in plant sciences.

## **BIO351 Genetically Modified Plants - Case Study**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students shall learn something about the techniques used to create genetically modified plants. Through groupwise case studies, they are to consider all aspects of GMOs; how will it affect health and environment?, is this a product/project that is useful for society?, will it lead to a more sustainable development?, is it ethically justifiable? By going through these case studies, they will acquire knowledge and qualifications to enable them to participate in the public debate on GMOs. They will also be aware of Norwegian and international law within the field and the international agreements and conventions applicable.

## **BIO420 Advanced Developmental Biology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Understanding of the advanced gene regulation which determines the specification of different types of cells in multicelled organisms. The students are to gain insight into recent research in the field of model organisms such as the fruit fly and the Arabidopsis. The students will achieve this depth by being assigned a broad field in which to conduct a project and a smaller field of their own choosing in developmental biology (may well be connected with own research). This depth is designed to lead students to an analysis of material and synthesis by drawing their own conclusions based on the syllabus. It is great if the

course can help students to consider the application of developmental biology in research. It is also a goal for the students to be given an introduction to bioethics and thereby develop a certain understanding of different fundamental views so that they are able to argue for or against these and draw conclusions for instance on how to view research on genetic engineering.

## **BIO421 Population Genetics and Molecular Evolution**

**Credits:** 15 **Language:** English

**Learning outcomes:** The students should be able to understand the dynamics of the evolutionary changes that happen at the molecular level, the evolutionary forces behind such changes and the evolutionary effects of different molecular mechanisms on genomes, genes and gene products. The students should also gain theoretical insight and practical skills in methods used in comparative and phylogenetic analyses based on molecular data. The students should develop a critical approach towards the interpretation of this type of data, and a level of knowledge sufficient to understand cutting edge research articles on the subject. The students should be able to plan their own research on the subject and apply relevant methods in order to analyse and present the results.

## **BIO422 Nordic Postgraduate Course in Plant Breeding**

**Credits:** 5 **Language:** English

**Learning outcomes:** To get an understanding of the role of molecular genetics and genomics in plant production. To be able to present and discuss professional scientific topics in English.

## **BOT200 Plant Physiology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The course gives knowledge and understanding of the structure and functions of plants. The course also gives the students knowledge of the responses of plants to environmental and climatic conditions and how these interact with the metabolism and mechanisms of plant growth regulation. The course provides experience in the conduction of practical experiments and the presentation and discussion of experimental results. The course also provides practice in the application of methods and terminology of the field as well as cooperation in groups.

## **BOT201 Crop Physiology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:**

## **BOT230 Plant Ecology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The course is based on the fact that plants, as opposed to most animals, cannot move. The plants must therefore handle biotic and abiotic environmental conditions where they grow. The course focuses on the consequences this has for the reproduction, nutrient uptake, life-history strategies, anti-herbivore defence, population dynamics and distribution of plants, and for the structure of plant communities. The main part of the course takes place in the field and gives students good insight into the integration between ecological theory and field methodology. The course gives students a solid foundation of knowledge which is useful in further studies in ecology and nature management and also relevant to students in other plant-related disciplines.

## **BOT320 Advanced Course in Plant Developmental Physiology**



**Credits:** 15 **Language:** English

**Learning outcomes:** The course provides opportunities to develop insight into the growth and internal organisation of plants, and into their responses to spontaneously generated or climate-induced signals. The course stimulates the development of skills in presenting and discussing scientific material.

## **BOT340 Photobiology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The aim is for the students to achieve a good understanding of the photobiology of plants. This includes a thorough introduction to photosynthesis. In addition, great emphasis will be put on plants\' adaptation to UV-radiation. The students will learn to use different methods for measuring photosynthesis (chlorophyll fluorescence, measurement with oxygen electrodes and infrared gas analysis) and in addition learn to measure the spectral composition and light strength for both daylight and artificial light (spectrometers, sensors, data loggers etc. will be used). The contents of the course can, to a certain extent, be adapted to the students\' interests and requirements.

## **BOT350 Pollination and Reproductive Ecology of Plants**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The course gives advanced knowledge of the pollination and reproductive ecology of plants. There will be special focus on: adaptations to various pollen vectors, pollinator behaviour, pollination limitation to reproduction, natural selection of pollination traits, evolution of pollination adaptations, the connection between pollination and reproductive strategies, the evolution of reproductive strategies, and management. The course makes students capable of doing Master\'s and PhD degrees on the pollination and reproductive ecology of plants, and gives students with Master\'s degrees in other plant sciences useful

additional knowledge for their projects. The course is problem-based and provides the students with critical attitudes towards the existing knowledge within the field.

## **BUS230 Management Science - Principles**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** To give students a solid basis for using quantitative decision-making methods, where linear programming will be central, in solving economic problems. The main focus of the course will be on formulating and solving different problems. As well, the economic significance of the results will be central. There will be focus on discussing the strengths and weaknesses of the different methods and the fact that models will always be a simplification of reality. The course will to a certain degree focus on issues connected to agriculture and resource management.

## **BUS231 Management Science - Principles**

**Credits:** 10 **Language:** English

**Learning outcomes:** The course shall give the students a solid basis for the use of important quantitative decision methods, where linear programming is the most important, to analyse economic and business problems. The main emphasis will be on formulating and solving different types of problems. Furthermore, the economic interpretations of the results are central. The importance of the strengths and weaknesses of the different methods will be discussed, as well as the fact that a model will always be a limited representation of reality. The course will to a certain degree be aimed towards agriculture and resource management problems.

## **BUS233 Management Information Systems**

**Credits:** 5 **Language:** English

**Learning outcomes:** Today, information systems are an integral part of all business activities and careers. This course is designed to introduce students to contemporary information systems and demonstrate how these systems are used throughout organizations. Most notably, the course will extensively examine how information systems are fueling globalization making the world smaller and more competitive in virtually every industry and at an ever-increasing pace. We will focus on the key components of information systems; people, software, hardware, data, and telecommunications, and how these components can be integrated and managed to create competitive advantage.

## **BUS314 Corporate Governance**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** There are numerous laws and regulations related to corporate governance/risk management/internal control in Norwegian companies. The course will deal with important concepts, rules and regulations, and also highlight the roles of different agents such as the board, auditing board, administrative leadership, auditor, risk management and compliance functions.

## **BUS320 Empirical Analyses of Financial and Commodity Markets II**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The aim of the course is to develop the students ability to conduct econometric analyses of financial and commodity markets.

## **ECN150 Introduction to Development Economics**

**Credits:** 5 **Language:** English

**Learning outcomes:** After completing the course, the students should have an overview of: 1) Typical distinctive characteristics of developing countries. 2)

Important theories and models for economic development and reduced poverty. 3)  
Relevant development problems and possible means for solving these.

## **ECN201 Econometrics**

**Credits:** 10 **Language:** English

**Learning outcomes:** ECN201 gives an introduction to econometric methods. The focus is on applied and not theoretical econometrics. There are two specific goals. First, the course aims at giving the students practice in reading and understanding empirical works in economics and other social sciences. That includes knowledge of ordinary least squares (OLS) and its assumptions, the consequences of violating these assumptions, and how to detect and correct misspecification in econometric models. Second, the students will do their own econometric analysis, which includes formulating the problem to be investigated, developing an econometric model based on economic theory, obtaining the required data, estimating the econometric model, testing and correcting for misspecification in the estimated model, describing the empirical findings, and discussing their relevance for the investigated problem. The second specific goal also includes learning to use an econometric program such as SHAZAM.

## **ECN230 International Economics**

**Credits:** 5 **Language:** English

**Learning outcomes:** The student is expected to develop: an understanding of why nations trade and under which conditions trade occurs; knowledge of the role of supply and demand factors in determining the gains from trade; the ability to evaluate the welfare effects of protectionist trade policies, free trade, managed trade, and the economic implications of other forms of government intervention to foster development; a conceptual framework for evaluating international competitiveness, comparative advantage, and foreign investment and strategic behaviour.

## **ECN270 Resource and Environmental Economics**

**Credits:** 5 **Language:** English

**Learning outcomes:** Candidates should be able to apply economic theory to analyse environmental and natural resource management issues. These issues include: economy - ecology interactions, sustainable development, optimal management of renewable and non-renewable resources, optimal pollution, biodiversity conservation, land degradation and deforestation, valuation of environmental resources and accounting for the environment, and international environmental agreements.

## **ECN271 Project Evaluation and Environmental Valuation**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After the course, students should be able to carry out, interpret and critically evaluate Cost-Benefit Analyses (CBAs) of projects and policies, including the treatment and economic valuation of environmental impacts, health impacts and impacts on cultural heritage.

## **ECN301 Econometric Methods**

**Credits:** 10 **Language:** English

**Learning outcomes:** The successful student should be able to conduct independent econometric analysis of economic data, and to critically evaluate econometric analysis with respect to choice of model, method and interpretation of results. The analysis should be performed using a computer and appropriate software. The econometric analysis should be in accordance with current standards for scientific documentation within economics.

## **ECN302 Mathematics for Economists**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course will introduce the matrix algebra required in courses in econometrics and the tools required for solving optimization problems in economics. The focus is on applying the mathematical tools rather than proving them. An important part of the course is to solve problem sets.

## **ECN303 Impact Assessment Methods**

**Credits:** 5 **Language:** English

**Learning outcomes:** An introduction to modern impact assessment methods for quantitative assessment of impacts of changes in policies, projects, shocks and other changes. An overview of the most relevant methods, their strengths, weaknesses and areas of application. An exercise is given for each of the main methods to give students as experience with their application.

## **ECN311 Microeconomics**

**Credits:** 10 **Language:** English

**Learning outcomes:** The theory introduced in intermediate courses in microeconomics is further developed in ECN311. The course will give the students basic training in solving economic problems related to supply, demand, and input demand. The focus is on applying rather than proving theory. The course gives a basis for further studies in, for example, development, resource, and environmental economics.

## **ECN312 Industrial Organisation**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course aims at providing the students with economic concepts and analytical tools required for understanding, explaining and analyzing

market behavior, market structure and market power; and the interplay between the market conditions and strategic behavior. The use of game theory is emphasized.

### **ECN320 Macroeconomics III**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students should be able to use economic models to analyze current concerns related to macroeconomic stabilization, economic growth and development. The course should also stimulate interest in current social issues and an analytical attitude.

### **ECN330 Economic Integration and Trade Liberalization**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students are expected to develop: · a conceptual framework for understanding the legal, political and economic implications of economic integration versus trade liberalization through a study of the development of the European Union and the multilateral trading system under the WTO; and · the ability to assess trade policies and domestic regulations affecting trade in goods, services and intellectual property (special attention is paid to agricultural programs of a country to determine whether such policy is compliant with a country's commitments under the WTO Agreements).

### **ECN331 International Economics and Finance**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course is designed to complete the students' understanding of the basic economics of trade through a formal treatment of the international macroeconomy and its relation to foreign exchange, foreign exchange regimes, capital movements, exchange rates and macroeconomic policy. Specifically, the student is expected to develop: 1) an understanding of the



relation of the microeconomics of international trade with the macroeconomics of international transactions; (2) an appreciation for the complex relationships between macroeconomic indicators and the foreign exchange markets, and the interrelationships among assets, goods, and foreign exchange markets; and (3) an understanding of the implications of a government's (and central bank's) macroeconomic policy/objectives under fixed, flexible and managed foreign exchange regimes and the economic implications of the policy choices from each.

## **ECN350 Development and Environment Economics**

**Credits:** 10 **Language:** English

**Learning outcomes:** To give the students deeper insights in economic theory and methodology and how to use these for the analysis of development and environment policy issues in developing countries. - Advancement of theoretical and methodological skills. - Combine theory and methodology to do applied policy analysis. - Policy analysis for poverty reduction, food security and natural resource management.

## **ECN351 Research in Development Economics**

**Credits:** 5 **Language:** English

**Learning outcomes:** In this course, students should be able to find and present a researchable topic within development economics and to write a research proposal for their thesis. In order to write a research proposal they need to be able to: - demonstrate command of existing knowledge within their research topic; - use existing knowledge to explore the issue of interest; formulate researchable research questions and/or hypotheses; - locate economic data and/or plan how to collect their own field data; and understand the methods used to compile and analyse the data.

## **ECN353 Development Economics, Micro**

**Credits:** 5 **Language:** English

**Learning outcomes:** The students should understand and be able to elaborate on:  
- how rural households and rural institutions adapt in developing countries; - why the behaviour of rural households and rural institutions in developing countries are different from the behaviour of firms and markets in developed countries.

### **ECN354 Issues in Development Economics; Poverty Analysis**

**Credits:** 5 **Language:** English

**Learning outcomes:** Give insights into key issues in poverty analysis: definition, methods and main results.

### **ECN355 Research in Development Economics II**

**Credits:** 10 **Language:** English

**Learning outcomes:** In this course, students should be able to find and present a researchable topic within development economics and to write a research proposal for their thesis. In order to write a research proposal they need to be able to: - demonstrate command of existing knowledge within their research topic; - use existing knowledge to explore the issue of interest; formulate researchable research questions and/or hypotheses; - locate economic data and/or plan how to collect their own field data; and understand the methods used to compile and analyse the data. Students will generate an original data set on which their Master's thesis can be based.

### **ECN371 Environmental Economics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students shall acquire an understanding of how to create more environmentally friendly behavior among individuals and firms. The main focus is on the use of various policy instruments in environmental policy

formulation. The course offers knowledge about the causes behind environmental problems and the various interactions between ecological processes and economic activity. Concerning economic behavior, the students will be educated in game theory and institutional behavioral theory. Within game theory (principal-agent models) the concept of resource allocation mechanisms and uncertainty will be emphasized. In the institutional part cooperative behavior, preference changes, and the importance of transaction costs and rights are core issues. The students shall learn to evaluate under which conditions the various theories are relevant. They shall, moreover, acquire knowledge about the effect of different policy instruments - economic, legal and informational - under different conditions.

## **ECN372 Climate and Environmental Economics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The course will give the students a theoretical overview, using environmental economics and game theory, and learn them to apply this to current international negotiations and national policy discussions. The aim is to show how economic tools yield insights into the current debate, and can also be used to assess different options being discussed. While the combination of theoretical overview and application is focussed on the climate issues, the integrative part of the course will also be useful to many other environmental issues.

## **ECN373 Environmental Accounting and Management**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students should be able to explain system-based management methods and practical tools for developing environmental strategies and environmental accounting systems for private and public enterprises, and be able to evaluate existing environmental accounting and management systems.

## **ECN374 Dynamic Optimisation**

**Credits:** 5 **Language:** English

**Learning outcomes:** The students should state, solve and interpret common dynamic optimization problems encountered in economics; and apply this knowledge and skills to independent economic analysis.

## **ECN380 Energy Markets and Regulation**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students shall acquire knowledge about and experience with the use of economic analysis tools as applied to economic and political issues in the energy sector.

## **ECN450 Development Economics: Methods and Policy Analysis**

**Credits:** 20 **Language:** English

**Learning outcomes:** Application of economic theory and methodology on development policy issues in developing countries. Combination of theory and methodology. Tools for policy analysis. Training in scientific writing.

## **ECN452 Topics in Development Economics I**

**Credits:** 5 **Language:** English

**Learning outcomes:** Topics vary from year to year, but will generally be within applied microeconomics for development analysis.

## **ECN454 Topics in Development Economics II**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Course content will vary from year to year, depending on demand and supply.

## **ECOL110 Tropical Ecology and Biology**

**Credits:** 10 **Language:** English

**Learning outcomes:** The course should provide the students with a basic understanding of ecological theory and animal and plant diversity within a tropical context. Students will acquire knowledge of the taxonomy of significant plants and animals in tropical ecology, their environmental dependencies, and how evolutionary forces have resulted in adaptations to various ecological conditions. The course also provides an overview of tropical biomes and ecosystems. The course builds an essential basis for further studies in ecology, biology, and nature management and conservation, especially related to tropical environments.

## **ECOL200 General Ecology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** An understanding of empirical and theoretical ecology. Good knowledge of various life-history strategies. Knowledge of the history of science in ecology and an understanding of the problems in the science of ecology, for instance to understand why ecology is a difficult subject. The candidate should acquire good skills in the application of ideas and methodology in the subject field of ecology. The candidate should become skilled in critical thinking and in gathering and analysing information. The course seeks to develop the candidate's ability to understand and evaluate the structure and functions of ecosystems. The ethical aims are to show that ecology as an academic subject is value-neutral, as well as give an understanding of the diversity of life forms that represent different solutions to the challenges of life.

## **ECOL201 Ecology Essay**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Comprehensive knowledge of a self-elected topic in ecology. The course offers a large amount of freedom of choice when it comes to topic and scientific profile, and the student will be given a good opportunity to write an essay with his or her own personal preferences as basis. The course will give an understanding of empirical and theoretical ecology. The candidate should gain skills related to literature search, the reading of original scientific works and written scientific presentation. The candidate should also acquire good skills in the application of ideas and methodology in the subject field of ecology. The course seeks to develop the candidate's ability to understand and evaluate the structure and functions of ecosystems. Ethical aims are to show that ecology is value-neutral as an academic subject, as well as to give an understanding of the diversity of life forms that represent various solutions to life's challenges.

## **ECOL250 Tropical Ecosystems and Biodiversity**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course provides the students with an understanding of key biological characteristics of tropical ecosystems, and establishes a foundation for higher-level studies in tropical ecology and natural resource management. The students should learn to identify unique characteristics of tropical biomes (e.g., desert, arid, grasslands, forests, mountain, coastal and aquatic systems). The systems are studied in view of seasonal variations, population dynamics, the adaptation of organisms and species interaction.

## **ECOL300 Scientific Methodology in Ecology and Management of Natural Resources**

**Credits:** 5 **Language:** English

**Learning outcomes:** After completing the course, students should have knowledge of how scientific studies are conducted, including all phases from planning up to publishing, and they should be able to start the work on their own Master's thesis. The course will give students a basic understanding on how to plan a scientific study, of the collection, processing and analysis of data and of the presentation of results in a Master's degree. This will be documented by working out a plan and a description of the student's own future Master's degree work. Ecology and natural resource management use a wide range of different scientific methods. The students will focus on methods used either in ecological science or social science, depending on study programme and topic for the Master's thesis. After completing the course, students should have the skills needed to choose problems suitable for scientific studies, gather relevant information on the problem, formulate scientific questions and hypotheses to investigate, deduce predictions that are to be tested, plan how the data should be collected in a representative and effective way, plan and conduct laboratory or field studies/experiments, process and insert data into computer programs, choose statistical analyses suitable for the data, interpret the statistical analyses, present the results in figures and tables, present, in a written form, the scientific study in the form of a Master's thesis with a summary, introduction, methods, results, discussion and references, present the material using precise, scientific formulation including scientific English, publish and distribute the Master's thesis. The course will also touch upon ethical questions related to research and give students advice on how to handle ethical problems in research.

## **ECOL310 Global Change Ecology**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students will have good knowledge of cutting-edge research on global changes and their influence on various organisms and ecosystems. In addition, the students will have an understanding of the complexity and functions



of ecosystems. The course will also provide the students with good knowledge of the scientific publishing process and ability to study original scientific publications. The candidate will be able to synthesise and acquire information from scientific publications and be able to communicate this material orally. The candidate should have good skills in the application of the subjects, ideas and methods, as well as in analysis and interpretation of results. The course seeks to develop the candidate's ability to understand and evaluate the complexity and diversity of nature. Special emphasis will be placed on illuminating the significance of interaction between organisms, and between organisms and their environments. Ethical aims are to convey humility towards organisms' ability to survive and reproduce under harsh environmental conditions.

## **ECOL320 Tropical Field Ecology**

**Credits:** 10 **Language:** English

**Learning outcomes:** The main goal is to give the students an understanding of how the complex connection between ecology, resource management and culture both limits and gives possibilities for management of tropical areas. The students will get experience in data collection and analysis from field investigations by performing their own projects and by learning about ongoing projects. The students will get experience from cooperating in multicultural groups, in giving presentations for each other, and from developing their project report.

## **ECOL350 Restoration Ecology**

**Credits:** 5 **Language:** English

**Learning outcomes:** The goal of the course is to teach how degraded ecosystems may be developed into self-functioning systems once again.

## **ECOL380 The Ecology and Management of Rivers and Lakes**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students should acquire good insight with the ecological processes in rivers and lakes, in addition to an understanding of relevant topics in present day watercourse management.

## **EDS201 Introduction to Development Studies**

**Credits:** 5 **Language:** English

**Learning outcomes:** Students will be introduced to current development issues. They will become motivated for further studies through exposure to a range of literature. They will acquire skills in group work, presentation, computer work and the learning platform ClassFronter. Students will get an understanding of what is expected of them as a master student at UMB. They will learn about UMB libraries and the use of English as a language of study. Students will meet with advisors and develop an individual plan of study.

## **EDS203 Introduction to International Relations**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course provide a very simple introduction to international relations, as well as contemporary history. It also functions as an introduction to accademic writing skills.

## **EDS215 Sustainable Agriculture and the Environment**

**Credits:** 5 **Language:** English

**Learning outcomes:** The students shall understand essential features of agricultural systems in developing countries, how different systems have evolved,

and how agricultural practices influence environment and development in low-income countries.

## **EDS220 Statistical Analysis**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students will acquire knowledge of basic statistical models and methods that are used in applied research.

## **EDS234 Environmental economics - the role of institutions**

**Credits:** 5 **Language:** English

**Learning outcomes:** This course covers the theoretical part of EDS235. Students shall acquire insight into core aspects of the functioning of the economy as a system of institutions, social relations and power. The students will learn how economic and social institutions and the political environment are structured and influence each other. Students shall also acquire insights about how the economy and other institutional structures influence the use of environmental resources. They shall specifically acquire insight into the institutional conditions for human behavior and learn to apply this knowledge to understand behavior related to use and preservation of environmental resources. The aim is finally to support the students in their understanding of important ethical questions linked to the use and protection of environmental resources.

## **EDS235 Political economy - institutions and the environment**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students shall acquire insight into core aspects of the functioning of the economy as a system of institutions, social relations and power. The students will learn how economic and social institutions and the political environment are structured and influence each other. Students shall also acquire

insights about how the economy and other institutional structures influence the use of environmental resources. They shall specifically acquire insight into the institutional conditions for human behavior. Students shall moreover acquire the capacity to use the theory to study concrete cases concerning management of environmental resources. Political economy is an interdisciplinary field drawing on economics, sociology, anthropology, law and political science. Students shall develop the ability to critically evaluate the assumptions underlying the various theories and perspectives. The aim is finally to support the students in their understanding of important ethical questions connected to the use and protection of environmental resources.

## **EDS250 Agriculture and Development**

**Credits:** 10 **Language:** English

**Learning outcomes:** Understanding the farm as a system with emphasis on ecological principles (agro-ecosystems), and analysing agricultural systems with respect to environmental objectives (sustainability), productive objectives (increased food production) and social objectives (equity).

## **EDS255 Health, Environment and Development**

**Credits:** 10 **Language:** English

**Learning outcomes:** The course provides an introduction to the emerging inter-disciplinary field of 'Health and Development'. Students will develop competency to use central concepts in a couple of alternative frameworks currently under development by leading development agencies. In addition to use of these frameworks, emphasis is put on understanding the differing values, beliefs and interests underlying them. This provides a basis for recognizing differing ethical positions inherent in the analyzing tools. Groups will work on cases (such as poverty and health, HIV/Aids, biosafety/GMOs, and provision of clean water and sanitation) that will be presented and discussed in both oral and written forms.

Students are expected to demonstrate their knowledge of concepts, their ability to collectively apply knowledge and understanding to particular problems and to explain their weighed decision for using a particular approach.

### **EDS315 Management of Genetic Resources: Law and Policy**

**Credits:** 5 **Language:** English

**Learning outcomes:** Knowledge about and ability to interpret conventions, laws and policies on agricultural genetic resources, including property rights, access, exchange and sharing of benefits arising from commercial use of such resources.

### **EDS330 Political Ecology**

**Credits:** 10 **Language:** English

**Learning outcomes:** The chief aim of this course is to strengthen the students' interdisciplinary understanding by exposing the students to the different theoretical trends in the emerging field of political ecology and to empirical studies on resource and environmental management that are based on political ecological approaches. The course will investigate the links between local, national, and global levels of environmental management. It will further seek to develop among students a capacity of critical thinking.

### **EDS335 Advanced Readings in Development Studies**

**Credits:** 5 **Language:** English

**Learning outcomes:** The main aims of the course are to introduce students to some key texts in development studies and to train students in analyzing, discussion and contrasting these readings.

### **EDS347 International Environmental Governance**

**Credits: 5 Language:** English

**Learning outcomes:** Theoretical goals: Students shall acquire deeper insights into theories of environmental governance and resource regimes at international governance levels. Students shall develop the capacity to undertake interdisciplinary analyses. They shall further learn about the historical evolution of the international governance regimes and core international agreements, conventions and protocols and how these function and interact. Key fields or themes include climate change, biodiversity, pollution desertification, fisheries, global forest politics and trade/environment linkages. They should also be conversant with important globalization trends. Skills goals: Students shall acquire the capacity to use the theory to study concrete cases concerning environmental governance at the global level within the context of international agreements. In relation to this, the role of the state will also be emphasized. Students shall, finally, be able to evaluate strengths and weaknesses of existing governance structures, and develop and evaluate ideas for alternative solutions. Attitude goals: The students should develop their skills in critical thinking, in understanding both own and other peoples attitudes, values and norms and develop their self-reflection around the topics focused in the course.

## **EDS360 Conflict and Development**

**Credits: 10 Language:** English

**Learning outcomes:** General objectives: Students should acquire an interdisciplinary understanding of international conflict and development problems and an understanding of the links between natural, technical, and social dynamics of conflicts and development. Specific knowledge and understanding: Students should, upon completion of the course, be able to: - identify and elaborate causal links within different types of conflicts over natural resources - identify critical aspects of a conflict and locate it within an historical context Specific skills: graduates of the course should be capable of: - quickly gathering relevant



information about, and building an outline of, different types of conflicts - using methods from different disciplines to generate useful and lucid information about a given conflict - knowing where additional information is available and how such information can be used Ethics and attitudes: a central objective is that students should learn to understand and appreciate the foundations and nature of individual, social, and ethnic differentiation, and their implications for conflict origins, paths and resolutions.

## **EDS410 Doctoral Course in Environment and Development Studies**

**Credits:** 15 **Language:** English

**Learning outcomes:** International environment and development studies is an evolving multi- and inter-disciplinary field of study. Characterised by normative and policy concerns, this field of study examines processes of development and change in ways that illuminate the dynamics of power relations and states of human well-being and the environment in particular contexts from different perspectives. The PhD course is aimed at providing the students with a sound interdisciplinary understanding of environment-development relations and a critical knowledge of development theories, policies and practices with due regard to the diversity and complexity of the real world. Given its multi- and inter- disciplinary nature, the course draws on knowledge from social and natural sciences and present approaches that integrate the political economic, cultural and ecological aspects of change at macro, meso and micro levels.

## **EDS415 Research Methodology in Development Studies**

**Credits:** 5 **Language:** English

**Learning outcomes:** Course participants should get a better understanding of the relationship between theoretical perspectives and research methodology in

development studies, and a clearer idea of how to develop their own research design for a PhD project. Course participants will be challenged to think more systematically on how they choose and define units of data collection and analysis. Participants will also have the opportunity to discuss basic elements in their own research design in smaller groups.

## **FMI310 Environmental Pollutants and Ecotoxicology**

**Credits:** 15 **Language:** English

**Learning outcomes:** The students will have knowledge of different sources of contamination and be able to evaluate the long-term effects of contamination of different ecosystems. The students will understand the links between concentration levels including the speciation of contaminants, and mobility and ecosystem transfer, biological uptake and bio-accumulation and bio-magnification of environmental contaminants in living organisms, and the ecotoxicological effects on cell, organ, organism and population. Students will be able to assess the short and long-term impact on man and the environment from contamination, and for some pollutants evaluate alternative countermeasures to reduce the impact in different ecosystems. Students will also be introduced to modern analytical techniques applied within the field. The students will understand that nature is fragile and that we need to consider the long term effects of pollutants to prevent negative ecotoxicological effects.

## **FMI312 Environmental Exposures and Human Health**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students shall understand how pollution in air and water, exposure to unhealthy environmental factors at work, contaminants in nutrients and industrial discharges affect human health.

## **FORN310 Bioenergy -Resources, Profitability and Solutions**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course shall provide an in-depth understanding of technological, environmental and economic consequences related to bioenergy. Students shall be able to work with cross-cutting problems and planning processes linked to the establishment of bioenergy facilities (generation of both heat and electricity). This implies being able to analyse, synthesise and present knowledge from different disciplines. Students are to be trained in written and oral communication of interdisciplinary issues and research results.

## **FYS381 Biological Physics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Gain a comprehensive understanding of how the properties of biological systems are determined by basic physical laws, have an understanding of and be able to do mathematical calculations on some models for molecular and cellular processes, and be able to orient oneself further within the scientific literature on biological physics. The student should also be able to write a scientific report and put forward the results in an oral presentation. Know and understand i) how cells are built, ii) how a diffusive transport process is the result of random movements on the microscopic level and how the equation of diffusion may be deduced, iii) hydrodynamics at small spatial scales (cellular level), iv) what entropic forces are and how they work, v) chemical forces, vi) cooperative transitions in macromolecules, vii) enzymes and molecular machines, and viii) basic properties of electrically excitable cells. Be able to orient oneself and gain knowledge from scientific books on biological physics and ordinary scientific articles. Understand that the divisions between the natural sciences - physics, chemistry and biology - are made by man and that natural science is actually one continuous science.

## **FYS385 Project in Biological Physics**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students should acquire in-depth knowledge of a specific topic in biological physics or be introduced to doing research within the field.

Learn to write and orally present a scientific project report.

## **FYS386 Mathematical Neuroscience**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Gain a comprehensive understanding of how the properties of neurobiological systems can be modelled mathematically and be able to navigate in the academic literature on mathematical neuroscience. Be able to formulate and solve simple models from mathematical neuroscience. Be able to navigate in and acquire knowledge from scientific literature in the subject field in order to be able to develop more complicated models. Understand that mathematical models are necessary in order to understand complex neurobiological processes.

## **GEN220 Genetic Basis of Biodiversity**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students should understand that all (today\'s and extinct) biodiversity is the outcome of Darwinian selection and other genetic mechanisms. The enormous number of gene/allele combinations in the genomes of most living species is beyond imagination; yet, we have to learn genetic approaches to understand the above-mentioned adaptation processes.

## **GEN320 Molecular Markers for Genomics**

**Credits:** 5 **Language:** English

**Learning outcomes:** The students will learn DNA marker-based approaches for understanding genome organisation and evolution. The lab part will provide the

students with hands-on experience to do DNA-based work for their MSc/ PhD work.

## **GEN401 Research School Genetics A**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** - To give an overview of genetics and methods used in genetics. The overview shall be up to date concerning topics and techniques in molecular genetics and breeding. - To strengthen the cooperation of genetics and breeding workers. - After having completed the course students should be able to point out relevant methods to solve specific research tasks in the genetic fields covered.

## **GEN402 Research School Genetics S**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** - To give an overview of genetics and methods used in genetics. The overview shall be up to date concerning topics and techniques in molecular genetics and breeding. - To strengthen the cooperation of genetics and breeding workers. - After having completed the course students should be able to point out relevant methods to solve specific research tasks in the genetic fields covered.

## **GEO220 Groundwater**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** In the course, the students will learn about the properties of normal groundwater supplies and how they can be utilised and protected against pollution. The main emphasis of the teaching is on the connections between soil-forming rock, surficial deposits and groundwater. The student should understand how groundwater behaves and moves. The student will become familiar with

the most important properties of groundwater as compared to surface water. The student will get an overview over global questions related to groundwater. After completing the course, the student should be able to conduct a practical evaluation of the utilisation of groundwater as drinking water and as an ecological resource. The student should have obtained an understanding for groundwater as an important resource that must be managed in a justifiable way. The course will also give an understanding of the fact that groundwater not always is a renewable resource.

## **GEO222 Geology Project**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Use the knowledge acquired from the courses in geology to solve applied problems or problems related to geological research projects. Through the course, the students will acquire knowledge of the practical conduction of geological investigations. He/she will have the opportunity to come into direct contact with employers and researchers in geology. The student will learn to write a report addressing the needs of the client.

## **GEO300 Hydrogeology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The student will get insight into quantitative methods to describe properties of groundwater, including the flow of water and spreading of pollutants. Quantitative analysis of the transport of water and dissolved substances in porous media under saturated conditions. Use of quantitative methods, including large-scale groundwater models as predictive tools. The ability to evaluate the risk of irreversible changes in groundwater resources both in quantity and quality as a result of human encroachments is important in order to achieve good resource management. Clean groundwater is an important natural resource.

## **GEO310 Paleoenvironment and Climate Change**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The student will obtain an understanding of the natural changes in the Earth's physical and biological environments in the recent geological past.

## **GEO311 Geological Excursion**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The course is intended to give the students broad and in-depth knowledge of field geology focused on their Master's degree. The course is based on participation in recent Norwegian or foreign geological excursions on Master's degree or research level.

## **GMGD210 Geodetic Measurements**

**Credits:** 5 **Language:** English

**Learning outcomes:** Master the planning, field work and analysis of geodetic measurements. There will be great emphasis on quality assurance and connections to relevant standards.

## **GMGD300 Geodesy Graduate Course**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** Students are to understand the theoretical basis for calculation methods and techniques. They should be able to apply this in problem solving in several topics in geodesy (e.g. topical list of the course).

## **GMGI300 Geographical Database Systems**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After completing the course, the student should be capable of building models for geographical information, evaluating different solutions for geographical database handling and implementing storage and services for geographical information in centralised and distributed systems.

## **GMLM211 Marine Geodesy**

**Credits:** 5 **Language:** English

**Learning outcomes:** Students should understand the role of the ocean in the Earth system and understand the basic principles of geodetic measurement techniques related to oceanography as well as surveying on sea and under water.

## **GMSG200 Satellite Geodesy**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students must know reference systems used in space geodesy and understand the theoretical foundation for satellite motion in space. They must be updated on the individual space geodetic observing techniques and satellite systems and be familiar with international organisations and their services (IERS, IGS etc.).

## **HET401 Individual Ph.D. course in Ethology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The course shall give PhD students competence in ethology that goes beyond the master level courses in ethology. The topic is chosen in discussions between the student, the supervisors or other teachers. Individual learning goals are set up for the chosen topic.



### **HFA300 Animal Breeding Plans**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students will learn about the importance of biological, technical and economic conditions within the different animal species, and evaluate this in alternative breeding plans.

### **HFA301 Calculation of Breeding Values**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students will learn what breeding values calculated as blup-values are, and will be able to calculate these values for example data sets. They will also be acquainted with the estimation of variance components that are required to find blup-values.

### **HFA304 Theory and Application of Inbreeding Management**

**Credits:** 10 **Language:** English

**Learning outcomes:** To present a unified approach to the management of inbreeding, providing supporting concepts with practical tools.

### **HFA400 Quantitative Genetics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students should acquire a solid understanding of quantitative genetics.

### **HFA401 Biometrical Methods in Animal Breeding**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Successful candidates will be able to calculate breeding values for breeding companies, understand the underlying theory and be able to work with and publish papers using special mixed models (e.g. maternal effect, dominance).

## **HFA404 Statistical Problems in Quantitative Genetics and Animal Breeding**

**Credits:** 5 **Language:** English

**Learning outcomes:**

## **HFE200 General Animal- and Fish nutrition**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Main aims: To acquire fundamental knowledge of the macro and micro nutrients, their chemical structure, characteristics, nutrient value, digestion and main functions in the body. The student will also acquire fundamental knowledge of feed types, main feed sources and principles for their evaluation.

## **HFE305 Feed Manufacturing Technology**

**Credits:** 10 **Language:** English

**Learning outcomes:** After this course, the student should be familiar with most of the processes that are used in the feed industry, and they should have gained knowledge of the causes and the justification for the use of the processes by taking into consideration knowledge about nutritional requirements, ingredient characteristics and cost of the processes.

## **HFE306 Advanced Feed Manufacturing Technology**

**Credits:** 5 **Language:** English

**Learning outcomes:** The purpose of this course will be to gain in-depth knowledge of how and why different key processes and equipments are installed and used in feed production plants. The objective is that the students after this course will be able to not only understand the principles used for key processes, but also to optimise these processes through discussions with factory personnel and equipment producers.

## **HFE307 Feed Production Planning and Management**

**Credits:** 15 **Language:** English

**Learning outcomes:** The goal is to gain insight into all the key processes of feed production management.

## **HFE308 Optimalization of Feed Processing for Different Animal Species**

**Credits:** 10 **Language:** English

**Learning outcomes:** The purpose of this course is to gain knowledge about special needs of different species when it comes to feed composition and physical quality, and special needs when it comes to ingredients used. In addition, the interactions between feed components and processing will be studied.

## **HFE400 Lipid Metabolism**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Provide students with advanced up-to-date knowledge of major areas in the fields of lipid, lipoprotein and membrane biochemistry. With emphasis on lipid metabolism in the major metabolic tissues liver, adipose tissue and muscle.

## **HFX206 Product Quality, Meat and Fish**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Through the course, students will have acquired a basic theoretical understanding of quality characteristics and the factors that control the quality of meat and fish raw products, plus a basic overview of the significance of these commodities in the Norwegian diet. Students will also be able to explain how quality can be influenced by different ante- and early post-mortem factors, and can explain the main principles for some frequently used measuring methods.

## **HFX207 Introduction to Animal Production and Fish Farming in Developing Countries**

**Credits:** 5 **Language:** English

**Learning outcomes:** The objective of this course is to give students basic knowledge about important production systems for livestock and fish. Breeding, nutrition, veterinary and other management aspects are lectured in theatre presentations by specialists in various fields. In addition to the broader system approach, students will also obtain in-depth knowledge in a limited area by writing and presenting a semester assignment. In this process the student will also acquire experience in writing and presenting a scientific paper. After completing the course, students will have a broader understanding of potentials and challenges of animal production and fish farming in the tropics. The students will be introduced to experts at UMB and partner institutions, and to projects in the South in which they can do research for their Master thesis. In their lectures, specialists from different fields and cultural backgrounds will focus on ethical aspects and increased awareness of other cultures.

## **HFX209 Evolutionary Biology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students will gain insight in the following main topics:

1. A history of life on earth. 2. Conceptual structure of evolutionary theory with emphasis on genetic variation, natural selection and adaptation. 3. Speciation 4. Life history evolution 5. Sexual selection 6. Senescence in an evolutionary context. 7. Pattern and process in macro evolution. After completion, the students will be able to use the conceptual apparatus of evolutionary biology to interpret and understand biological processes.

## **HFX300 Experimental Design and Analysis in Animal Science and Aquaculture**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course shall increase the practical understanding and application of statistical techniques, that were taught in earlier statistics courses, to the practical situations in animal science and aquaculture. The students shall be able to use, understand, and know the pros and cons of various statistical methods and designs that are used as part of their main master thesis. Also, the students should be able to critically judge the statistical methods used in research reports.

## **HFX306 Feeding and Production Diseases in Cattle**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The aim of the course is to give students basic knowledge in feeding-related production diseases in cattle and how to diagnose these. The students are to gain skills in the evaluation of different strategies to prevent feed-related production diseases by using a new analytical and feed planning tool. The course is arranged in collaboration with The Norwegian Veterinary College, and the students at the two institutions will learn to utilize the comparative competence.

## **HFX400 PhD Course in Nutritional Biochemistry and Physiology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Upon completion of the course, students will be able to explain, employ and analyse how organisms react to varying levels of energy supply, protein, fat and carbohydrate supply, liquid supply and supply of different vitamins and minerals. Further, students will be able to explain and evaluate the significance of different physiological regulatory mechanisms under various metabolic conditions. The student will be able to conduct experiments that include sample collection, laboratory analyses, and data evaluation. The students will be able to form their own opinion on main scientific issues under debate in the research field.

## **INF200 Advanced Programming**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After completing the course, students will be able to: - develop programs based on object-oriented and generic programming; - read and understand programs at an equivalent level of complexity; - analyse tasks and implement algorithms to solve them; - use the functionality delivered by standard libraries; - localise errors in programs; - use advanced programming tools such as debuggers, profilers, and version control. The student will have acquired deeper knowledge about the higher-level programming language that is used in the course. The student is able to evaluate the applicability of more complex programs and be able to assert their quality. The student will have developed an insight into the programmer's responsibility for the correct and reliable functioning of his or her own programs, their quality and documentation.

## **INN310 Intellectual Property Rights**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The course aims at giving the students the ability to read, analyse and practise the fundamental principles of intellectual property rights, IPR. The students should be able to handle the fundamental theory of trademarks, design, patents and business agreements (but also copyright and geographical rights). The skills should be demonstrated as essential elements in the development of new products and services.

## **JORD201 Process Modelling in Soil Water and Plant Systems**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students shall be able to formulate, solve, apply and present simple models for major processes in the soil, water and plant system. Insight into quantitative causal connections in soil, water and plant systems is important for sustainable use and management of different ecosystems. Quantitative understanding of connections between processes in soil, water and plant systems. Evaluation of quantitative effects of different interventions. Construction of mathematical models to describe important processes in soil, water and plant systems. Evaluation of quantitative effects of different interventions in soil, water and plant systems through mathematical models. Implementation and interpretation of sensitivity and Monte Carlo analyses. Implementation and interpretation of scenario analyses. Presentation of the model and model results. The knowledge is important for sustainable use and management of different ecosystems.

## **JORD220 Soil Physics and Soil Cultivation**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Insight into the physical properties and processes of soil. Understand the connection between soil structure and plant growth. Be able to evaluate the effects of various ways of cultivating the soil on soil quality and environment. Understand how the physical properties of soil are affected by the composition and use of the soil. Knowledge of how the different physical properties of soil (soil structure) form the basis for different growth conditions for plants. Select the appropriate cultivation method based on the properties of the soil, terrain conditions, environmental consequences and plant selection. Calculate important physical parameters in soil. Understand that our cultivated areas are limited and that we therefore must protect them carefully for generations to come, by avoiding erosion, soil compaction and loss of organic material.

## **JORD221 Soil Physics, Laboratory Course**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Insight into: - measurement and calculation of various physical soil parameters, - relations between different physical soil parameters, - the use of physical soil measurements to describe the soil and what kind of environment it provides for the growing of plants.

## **JORD251 Soil Classification**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** After completing the course, students will be able to: - give an account of the regional distribution, formation, characteristics and use of the important soil types in the world, - describe principles for the formation and classification of soil in reference to the soil classification system Soil Taxonomy (1999), FAO/Unesco system (1975/1990) and WRB (2006), - from the classification nomenclature be able to express the important characteristics of soil that is classified, - classify soil in reference to one of the mentioned international soil classification systems.



## **JORD260 Tropical Soils, Their Properties and Management**

**Credits:** 5 **Language:** English

**Learning outcomes:** Provide basic knowledge of tropical soils and their role in the ecosystems, both natural and man-made. Soil genesis in relation to the present and past environment and land use patterns. General understanding of the management of soil resources for sustainable production. Knowledge of the most important tropical soils (according to modern soil classification) and their relation to the present landscape, climate and vegetation. Physical and chemical degradation; soil erosion, soil mining, salinity, alkalinity, pollution, etc. The student should be able to evaluate the most important soil resources in the tropics and sub-tropics, and be able to read and understand soil maps, understand the most used land capability and land use classification systems. The students shall learn about the consequences of different land use for the individual farmer and for the national land resources.

## **JORD310 Global and Local Pollution**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** To understand how soils functions as reactors in biogeochemical cycles. In-depth understanding of how the terrestrial ecosystem reacts to anthropogenic impacts on soils, such as pollution (organic compounds and trace metals), nutrients (NPK), land use change and warming. This necessitates a deep understanding of soil as an ecosystem, with particular emphasis on its robustness and resilience.

## **JORD315 Biogeochemistry, Global Change**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Knowledge of the processes and organisms which dominate and regulate the biogeochemical system. Understanding how and why the system

is about to change, and the uncertainties involved. The students are trained in acquainting themselves with scientific debates/discussions of biogeochemistry and global change, and to be active in such debates by reading and using primary scientific literature in the seminars and semester assignments.

## **JORD340 Soil Fertility and Soil Management**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** To understand current issues regarding plant nutrition, fertilisation, soil tillage and management in the light of newer research results while at the same time to gain an insight into the significance of these production factors for the quality of our production area and the pollution of our water systems. Insight in selected topics of plant nutrition for their current significance for crop production. To understand the effects of fertilisation and soil tillage on plant growth, sustainable production and environmental conditions. Insight into other pollution sources such as heavy metals in soil and plant systems. Students should be in a position to evaluate the effects of different cultivation practices on plant growth and the environment. He/she should be able to put them in perspective of total management of our soil and water resources. To understand sustainable use of soil resources for maintaining crop production and minimising the pollution risks of terrestrial environment.

## **KJB310 Protein Chemistry**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Give an understanding of the significance of a protein's structure for its stability and biological activity and of how the structure of a protein may be determined. Give an understanding of the most common bioinformatics relevant to protein structures. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve

complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **KJB320 Proteomics I**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students will acquire the training and understanding necessary to perform the methods independently in a research project. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **KJB420 Proteomics II**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students will acquire the training and understanding necessary to perform the methods independently in a research project.

## **KJM310 Chromatography**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The student should be able to evaluate the use of various methods of separation (for instance HPLC, GC) and conduct separation of organic/biochemical molecules using GCA, LC, various columns/pillars and evaluate other alternative detectors and interpret the results. The student should have in-depth knowledge of and insight into chromatographic theory, and knowledge of chromatographical practices and the theory behind the various separation principles. Through independent study in the laboratory and a theoretical study of the subject, the students will achieve competence in comparing different analysis methods, and gain a basic understanding for quantitative results that, for instance,

are related to the pollution of food and environment. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

### **KJM311 Organic Spectroscopy**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Gain comprehensive knowledge of organic spectroscopic methods, especially UV/visible, IR, NMR (especially  $^1\text{H}$  and  $^{13}\text{C}$ ) and MS. Gain a good understanding of how and when the methods are used, and be able to use the methods in an independent way for determining the structure of unknown organic compounds. Special emphasis will be placed on natural products.

### **KJM312 Natural Product Chemistry**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Gain advanced knowledge of the most important classes of substances within the natural products. Especially hydrocarbons, fatty acids, terpenes, phenols and alkaloids. Students should be familiar with structures, characteristic properties of the product classes, the most important sources, biosynthetic principles. Basic principles of isolation, characterisation and some examples of syntheses will be given.

### **KJM313 Mass Spectrometry**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Give knowledge of both the practical and theoretical background for using mass spectrometry, such as GC-MS, MALDI-MS and LC-MS. The candidates should be able to use mass spectrometry for identifying organic

and biological compounds. Candidates are to have knowledge of, and be familiar with, the various techniques used to separate the ions in a mass spectrometer, such as for instance quadrupole, sector instruments (magnets and ESA), TOF, ion traps and FT-ICR. Spectrum interpretation is a central topic in the course, and candidates will spend time interpreting structures. Students will become familiar with the theory behind the different fragmentations of various compounds in different mass spectrometers. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **KJM350 Radiation and Radiochemistry**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students will have an understanding of the properties of radionuclides and emitted ionising radiation, the use of radioactive tracers and simple measurement methods as well as radiation protection. The course will provide the students with working permission related to the use of open, ionising radiation sources in their future work. The students will after the course: Understand the properties of radionuclides including half life, radiation types and radiotoxicity. Have insight into the biological effects of radiation and effective radiation protection. Be able to use simple tracer methods and simple measurement methods for alpha radiation, beta radiation and gamma radiation for qualitative and quantitative analysis applied to research projects. Have sufficient knowledge of radioactive substances and radiation protection for students to be approved as users of ionising sources that they can use in their research projects. Understand that radioactivity is a phenomenon that humans have always been exposed to, and that radioactivity can be used for good purposes (cancer therapy) and that measures can be implemented for reducing the unwanted effects of radioactive radiation.

Knowledge is important in reducing unnecessary fears and anxiety related to radioactivity among the population. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **KJM351 Radioecology/Behaviour of radionuclides in the Environment**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students are expected to have an overview over radioecology and be able to conduct experimental radio-ecological studies. The course gives a thorough introduction to radiochemistry including tracer techniques, radiochemical separation techniques as well as advanced measurement methods that are used in radioecology. In addition to radioactive sources, the course also focuses on species (speciation), transport, mobility, biological uptake and the effect of radiation as well as assessment of environmental impact and risks related to radioactive contamination. The students will have knowledge of radioactive sources and understand the transport of radioactive substances in various ecosystems, understand the basis for environmental impact and risk assessments and be able to conduct radioecological studies using tracer techniques, radiochemical separation techniques and advanced measurement methods. The students will have insight in environmental impact and risk assessments and the use of effective countermeasures, i.e. competence that is needed within national preparedness associated with radioactive contamination. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **KJM360 Assessing Risk to Man and Environment**

**Credits:** 10 **Language:** English

**Learning outcomes:** Understand the basis for evaluations of the ecological impact of pollutants on man and the environment. Understand the links between science and policy in the management of pollutants. The course will use ionising radiation as a case study to illustrate the various methods and approaches for assessing the effects and impacts of environmental stressors. But the approaches and methods are generic, and can apply to any environmental pollutant, and students can choose their own stressor for their case study. Thus the course will be relevant for students within both radioecology and environmental chemistry and ecotoxicology. For radioecologies it will enable them to put the models and approaches for assessing radiation in to context with other environmental stressors as well as the protection of man from ionising radiation.

## **KJM410 Organic Mass Spectrometry (MS)**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Give knowledge of both the practical and theoretical background for using mass spectrometry, such as for instance GC-MS, MALDI-MS and LC-MS. The candidates should be able to use mass spectrometry for identifying organic and biological compounds. Candidates are to have knowledge of, and be familiar with, the various techniques used to separate the ions in a mass spectrometer, such as quadrupole, sector instruments (magnets and ESA), TOF, ion traps and FT-ICR. Spectrum interpretation is a central topic in the course and candidates will spend time interpreting structures. Students will become familiar with the theory behind the different fragmentations of various compounds in different mass spectrometers.

## **LAD100**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Students will get a brief introduction of digital visualization and design tools for landscape planners, as well as some training in digital techniques for use in planning, analysis, design, presentation and drawing.

## **LAD202 3D Computer Modelling for Landscape Architecture**

**Credits:** 5 **Language:** English

**Learning outcomes:** In order to be able to create and visualize three-dimensional (3D) illustrations that support a design concept, one should be able to model in 3D using the right techniques. This course will provide a hands-on experience of basic 3D modelling, using standard modelling packages such as AutoCAD and SketchUp for landscape designers. Students will gain knowledge of basic modelling techniques with materials and textures, virtual lights/sunlight and cameras, and rendering stills. The techniques learned in the course will then be applied to a landscape design project. The final output from each student will be a 3D model illustration of a design project.

## **LAD302 3D in Design**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course will function as an arena to investigate and work with various topics connected to the use of 3D modelling and visualizations in design and planning. After introducing the main topic through planned lectures, students will work individually with supervision on a selected case study.

## **LAFT201 Form, colour and drawing IV**



**Credits:** 5 **Language:** English upon request

**Learning outcomes:** From a point of departure achieved through their participation in LAA115, LAA116, LAA250, students shall now further develop their abilities within form, drawing, colour and digital techniques in order to strengthen their basic capabilities with regard to their future activities within landscape architecture.

## **LAFT202 Form, colour and drawing. Advanced**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** It will be expected that students develop their previously gained knowledge from LAFT courses to achieve a deeper understanding of form, colour, drawing and digital techniques to solve the given tasks. It is expected that students will achieve an independent stand towards task solving, be capable of developing clear powers of conceptualisation, and articulate, both verbally and visually, about their working processes to both teachers and students alike.

## **LAØ370 Landscape Ecology**

**Credits:** 10 **Language:** English

**Learning outcomes:** - be able to undertake computer-based landscape-ecological analysis of mapped data or aerial photographs, - be able to identify the types of habitat and species that are vulnerable to habitat fragmentation, - be able to evaluate landscapes, to identify potential corridors and barriers to the movement of people and wildlife, - be able to create solutions for landscape planning problems based on landscape ecological principles, - be able to demonstrate an awareness of the limitations of generalising management solutions from one landscape to another.

## **LNG130 Norwegian as a Foreign Language**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The course will give the students basic knowledge of spoken Norwegian, with the aim of understanding and using the language in everyday situations. Pronunciation and oral exercises are given priority. It is expected that students will work on their own with the CD and grammar exercises on the Internet (<http://pavei.cappelen.no>) In addition to the language course some lectures on Norwegian culture and society will be given in English.

## **LNG135 Norwegian as a foreign language II**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course builds on Norwegian for foreigners I, giving more extensive knowledge of Norwegian with more sophisticated texts. Pronunciation and oral exercises are given priority. It is expected that the students will work on their own with the CD and grammar exercises on the Internet (<http://pavei.cappelen.no>).

## **LNG150 Swahili Intensive Course**

**Credits:** 5 **Language:** English

**Learning outcomes:** Engelsk: The aim is for the students to be able to understand and use everyday language in a simple communication setting. The course will give them basic knowledge in Swahili and elementary insight in intercultural communication as preparation for fieldwork in the autumn semester.

## **LAA308 Landscape Design**

**Credits:** 20 **Language:** English upon request

**Learning outcomes:** Students should acquire thorough knowledge of current architecture and landscape architecture. They will be able to solve complex problems connected to projects related to parks or green areas at a high level, from analysis and concept development to detailed design. Students will be able

to handle planning and decision-making processes related to complex projects, including construction methods used in landscape areas and visualisation of architecture projects, from concept to detailed building instructions. Through the students' individual work, they will develop independent problem-solving skills, plus the skill of independent work, scientific thinking and reflection.

## **LAA321 Restoration and conservation of historical gardens and landscapes; 3D-visualisation**

**Credits:** 10 **Language:** English

**Learning outcomes:** The aim is to give the students knowledge of central topics in relation to investigation, conservation, restoration and management of historical gardens and landscapes, including the challenges in today's cultural heritage management for both private and public sector. When the course is finished, the students should be able to recognize and investigate an historical garden or garden element, and present an analysis of this according to historical sources. Students will use 3D modelling and visualization techniques as a supportive tool for the analysis. Basic 3D modelling techniques will be introduced for students.

## **MATH250 Partial Differential Equations and Models**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students are to learn the basic theory of partial differential equations. They are to become capable of using this theory for solving problems in biology, geomatics, physics and technology. After completing the course, the students should master the following topics: - conservation laws, - the wave equation, - diffusion equations, - the Laplace equation, - separation of variable techniques, - Sturm-Liouville theory, - difference methods. Students are to be able to use: - relevant methods and techniques with emphasis on practical applications, - the computer programme MATLAB for solving and visualising problems that

are part of the course. They should also be able to make and analyse simple mathematical models.

## **MATH270 Complex Analysis and Transformation Methods**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students shall learn elementary theory for analytical functions and transformation methods. They shall be able to apply this theory to problems in geomatics, physics and technology. After completing the course, the students shall master: - complex numbers, - complex functions, - Cauchy's integral theorem and Cauchy's integral formula, - Taylor series and Laurent series, - residue calculations, - Fourier transformations.

## **MATH280 Numerical linear algebra with applications**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Theoretical understanding of the basic methods in numerical linear algebra, selected optimization problems and insight in selected practical applications, i.e: - Numerical aspects associated with solving Linear Equations - Vector Spaces and Linear Transformations - Diagonalization and change of Change of Coordinate Basis - Inner Products, Length, Orthogonality and Inner Product Spaces - Orthogonal Projections and Least-Squares Problems - The Singular Value Decomposition Some possible applications: - Constrained Optimization - Linear Regression (Principal Component Regression, Ridge Regression, Weighted Least Squares, Partial Least Squares) - Dynamical Systems - Linear Programming - Image Analysis - Economical analysis

## **MATH290 Real Analysis**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students are to learn how to use mathematical ideas precisely. This is a necessary background for understanding mathematical analysis. After completing the course, students are to master: - axiomatic description of the different number systems, - basic topological ideas such as metrical space, completeness, compactness, - convergence and uniform convergence, - the Riemann integral, - selected topics in functional analysis.

## **MATH310 Continuous Dynamical Systems**

**Credits:** 10 **Language:** English

**Learning outcomes:** Students are to learn the theory concerning continuous dynamical systems (ordinary and partial differential equations) and the application of such systems to selected problems in environmental subjects, biology and physics. The course contents may vary from year to year, but will normally consist of the following parts: - dimension analysis, scaling and perturbation methods, - geometrical theory for systems of ordinary differential equations (phase space, Picard's theorem, equilibrium, limit cycles, stability analysis, bifurcation theory and normal forms) and delay- equations. The theory is applied to for instance reaction kinetics, biological oscillations and the propagation of electrical signals in nerve fibres. - selected topics in diffusion equation theory, reaction diffusion equation theory and nonlocal models. The theory is applied to excitable media, the Turing-mechanism and pattern-forming processes.

## **MINA301 Term Paper in Environment and Natural Ressources**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Acquire detailed knowledge of a certain subject field through literature studies (theory) possibly combined with laboratory/field studies (practical experience). Learn to formulate, conduct and present (in written and/or oral form)

a scientific paper according to a well-established outline/routine. If working in groups; learn the advantages and disadvantages of teamwork at a level and in a form that is normal in research environments, in trade and industry etc.

## **MINA310 Project Management and Research Methods**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students will be competent in designing research projects (Master projects), analysing and evaluating data using appropriate statistical techniques, extract literature, and critical evaluated available data for their own use. They will be trained in making oral and written presentations.

## **MINA410 Environmental Radiobiology**

**Credits:** 5 **Language:** English

**Learning outcomes:** The aim of the course is to give students an introduction to the fundamental principles of radiobiology, within the context of research fields on radioecology and the environmental effects of radiation. As such the course will cover both the history and the state-of-the-art of our knowledge on the biological effects of radiation on humans, and how this relates to other effects seen in non-human organisms. Areas covered include fundamental radiobiology, biological responses to ionising radiation, the use of biomarkers and toxicogenomics, factors linked to differences in radiation sensitivity, non-targeted effects (bystander, genomic instability, adaptive response, etc.,) and multiple stressors.

## **MVI261 Heat Engineering I**

**Credits:** 5 **Language:** English

**Learning outcomes:** Students will acquire knowledge of unit operations and machine equipment that are part of processing lines.

## **MVI271 Fish and meat as raw materials**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students should acquire a basic understanding of the quality of raw materials originating from fish, meat and eggs. The nutritional importance of these raw materials is emphasized. The effect of ante-mortem and early post-mortem treatment of the animals for the quality of the raw material is lectured. Raw material quality is defined, and typical, important methods of measuring raw material quality will be elaborated.

## **MVI310 Proteins, Polysaccharides and Fat/oils: Structure and Functionality**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students are to acquire a basic theoretical and analytical understanding of the significance that lipids and polymers of proteins and polysaccharides have for the structure and rheological properties of food, as well as their use in food and fodder products. The students should get basic knowledge of how components from plants, meat and milk can be used as ingredients in the food and feed industry. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **MVI321 Fermentation Microbiology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The student is to have knowledge and laboratory skills on identification, characterisation and maintenance of microbiological cultures for fermentation purposes.

## **MVI322 Pathogenic Microorganisms**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Knowledge about food and waterborne pathogenic microorganisms; their biology, pathogenesis and spreading routes. Know modern methods for detection and identification of these microbes, and preventive safety measures.

## **MVI330 Experimental Design and Data Analyses**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After the course, the student will be able to conduct and analyse statistical experimental designs and data-analytical multivariable calculations related to food science and food production processes.

## **MVI340 Sensory Analysis and Consumers Research**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students will be able to conduct sensory tests and consumer tests and analyse and interpret the results from these tests. The students should also be able to gather, analyse and interpret relevant literature to be able to discuss and answer essential problems/questions on sensory analysis and consumer research.

## **MVI361 Unit Operations and Measurement Methods**

**Credits:** 10 **Language:** English upon request



**Learning outcomes:** Students will acquire deeper knowledge and more skills in relation to unit operations in food engineering. They will also acquire a greater insight into the conditions regarding machinery, instruments and other equipment in the food industry, and further knowledge of measurement methods. The students should be able to use or implement measurement methods into food production.

## **MVI381 Muscle Food Processing Technology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The student will gain an understanding of several of the industrial processes (minced meat technology, salting/smoking, fermentation and similar) that are used for keeping and processing meat products. The student will gain detailed insight into the production process, the choice of raw materials as well as the quality of selected final products. The course covers to some degree the well-being of animals/the slaughter process and its impact on final product quality. In addition, environmental problems related to handling waste materials from slaughterhouses and the insufficient consumption of by-products are touched upon. Oxidative stability of meat through storage and processing as well as the major mechanisms that influence degradation of food components through processing will be lectured. The course is built around 4 larger projects where the students are producing and evaluating different meat products using their own analysis. As a rule, dry fermented sausages, bacon and two heated, comminuted meat products are produced. However, minor changes are made every year. The student should acquire sufficient knowledge to be able to apply their qualifications to the development of meat products and be able to judge the consequences of their choices with regards to final product quality. The student should be able to select raw materials, ingredients and control processes towards the desired final product quality (for selected products). The student must know methods for suggesting an improved process when faults occur.

## **MVI382A Alcoholic Beverages**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Students will learn about the production of cider, beer, wine and spirits.

## **MVI382B Cereal Technology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Cereals, importance in the diet, chemical composition. Starch - energy, synthesizing and degradation of starch. Protein, amino acid composition in cereals, functional properties, quality aspects. Fibre, different qualities, properties and importance in the diet. Minerals and vitamins, antioxidants in cereals. Wheat, rye, oats and barley, tropical cereals, rice, maize, sorghum and millet. Baking technology, niche products from cereals - Spelt - Einkorn, Buck wheat. Extrusion/breakfast cereals, pasta, biscuits and cakes, crisp bread.

## **MVI383A Dairy Technology**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** Knowledge of the composition of milk in relation to the manufacturing of various products is a central goal in the course. In addition, the students shall gain good theoretical knowledge of the various processing steps and processing lines for the manufacturing of dairy products. Knowledge of the key manufacturing of important dairy products and knowledge of key factors influencing the final quality of the products are the ultimate goals of the course. On the basis of theoretical and practical experience, partly gained through exercises and experiments in the pilot plant for food manufacturing, the students shall understand the manufacturing processes for the most important dairy products and the quality properties of the products. Knowledge and understanding of the composition of milk, unit operations when processing milk, as well as the

manufacturing of unfermented and fermented milk products, milk powder, butter, cheese, whey products and ice cream. Through practical exercises in the pilot plant for food manufacturing, the students shall have achieved skills in the production of fermented milk products, butter, cheese, whey products and ice cream. The course emphasises the conveyance of attitudes related to the importance of and possible uses for a food raw material such as milk, in that as much as possible of its components are used as food. Emphasis is placed on an understanding that has significance both for food security and food safety in a world where undernourishment and malnutrition are global problems. We have an international responsibility. The course emphasises therefore conveyance of knowledge of the processing of milk which might be useful in a global food supply situation.

## **MVI383B Fresh Fermented Dairy Products**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students will gain an understanding of the characteristic properties of various fermented dairy products and understand the technology used in making these products. The connection between the metabolism of the starter and the product properties is significant in this context.

## **MVI383C Cheese Technology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students will gain insight into and a deeper understanding of the cheese manufacturing and the cheese ripening process. The students should be able to develop process lines for the manufacture of various cheese types by applying recent technology and equipment. In addition, students should be able to evaluate the connection between factors significant for the cheese ripening and the development of its characteristic properties. The students should learn to write a journal according to internationally accepted forms for scientific publishing. Students are to be able to put cheese production into a historical and cultural

context. The students are to be able to evaluate what effect various production technologies have on the quality and safety of the products, when regarded as foods.

## **MVI384 Functional Foods: Bioactive components in foods**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students will develop a broad knowledge and understanding of how diverse foods and ingredients can affect our health, in areas outside of traditional nutrition. A knowledge-based critical attitude will be encouraged and an understanding of how the national and international regulations affect the development within this area.

## **MVI385 Product Development**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students are to acquire knowledge about cost-effective and market-oriented innovation processes from idea to launching, regarding; 1. Identifying new products. 2. Key requirements for successful product development. 3. Research design and prescription optimisation. 4. Managing and improving product development processes.

## **MVI390 Immunology, Food Allergy and Intolerance.**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** After completing the course, students will have a thorough, general understanding of the development and function of the immune system. It is an asset to be able to understand why the body's defence system against infections also reacts against non-infectious agents and in this way contributes to the development of hypersensitivity reactions such as allergies and auto-immune diseases. The course approach to food allergies and intolerance entails that students

will gain special knowledge of mucosal immunology and, mechanisms behind the development of allergic reactions, plus understanding of the aetiology of other selected immune-mediated diseases in the digestive system. Students will also have a clear understanding of the differences between immune-mediated hypersensitivity reactions and other forms of intolerances. These learning goals assume that the students develop skills that prepare them to access relevant scientific literature, make grounded evaluations and give advice in food production with the goal to avoid allergies and other hypersensitivity reactions. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.

## **MVI390B Immunological techniques**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** After having completed the course, students should have acquired practical and theoretical experience with the most important analytical methods of immunochemistry and cellular immunology. They should be able to select suitable analytical formats for their own problems, evaluate sources of errors, and resolve problems connected to the use of immunological techniques.

## **MVI391 Diet and Health**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Students should be updated on current knowledge about the relationship between diet and reduced or increased risk for health problems or disease.

## **MVI392 Gastrointestinal anatomy and physiology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The lectures aim to provide a basic understanding of the biology and the different elements and processes in the alimentary tract, how they function, interact and how their functions are modified to achieve optimal nutrition and health.

## **MVI480 Food Process Technology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After the course, students will be able to complete evaluations, quality assurance and calculations connected to unit operations such as cooling, freezing, thawing, warming, heat conservation and sorting.

## **MVI481 Fresh meat science and technology**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students should have acquired in-depth knowledge of the conversion of muscle into meat and changes related to cold storage of fresh meat - all based on chosen quality parameters and recent literature. The students should be able to synthesise new knowledge within the narrow area of meat science/technology chosen here. The students should be able to organise new knowledge within the framework of the course topic.

## **MVI482 Processed Meat Technology: Dry-Cured Products**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The students should have acquired an in-depth knowledge in the different biochemical and technological aspects of producing dry-cured intact meat products. The students should be able to synthesize new knowledge within the narrow area of meat science/technology chosen here. The students should be able to organise new knowledge within the framework of the course topic.

## **MVI483 Dairy Technology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Students will gain an in-depth understanding of the selected topics for the course. The knowledge level will be updated with the most recent research documentation. Within the chosen dairy technology topics, students will approach the edge of the discipline's knowledge platform.

## **MVI484 From Milk to Cheese**

**Credits:** 5 **Language:** English

**Learning outcomes:** The students will have a scientific basis to understand the principles of cheesemaking and factors that influences the cheesemaking process. The students should gain an in-depth understanding of the complexity of cheesemaking and various factors influencing the quality of the cheese. The knowledge level will be updated with the most recent research documentation. Within the chosen topics, students will approach the edge of the discipline knowledge platform.

## **NATF210 Environmental Monitoring**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** After the course the students shall: - have an overview of the methods for environmental monitoring; - know major international monitoring activities and treaties; - have some knowledge about the background of environmental monitoring: i.e. the environmental problems; - be able to handle and interpret monitoring data.

## **NATF300 Conservation Biology**

**Credits:** 5 **Language:** English

**Learning outcomes:** Students will gain sufficient knowledge of genetics, demography, ecology, landscape management and social sciences to work for the conservation of biological diversity as an interdisciplinary task.

## **NATF320 Ecology and Management of Natural Resources in the Tropics**

**Credits:** 10 **Language:** English

**Learning outcomes:** The course aims at providing the students with an in-depth understanding of ecological processes that form the basis for advanced conservation and management of natural resources in the Tropics.

## **NATF350 Community Based Natural Resource Management**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course is designed to provide an in-depth understanding of how people and ecosystems interact. The main goal is to explore different conflicts between development and conservation and how these conflicts can be reduced by community involvement in natural resource management.

## **PAE301 Ecology of Farming and Food Systems**

**Credits:** 5 **Language:** English

**Learning outcomes:** After completing the course the student should: 1. Understand key concepts and principles regarding structure and functioning of farming and food systems (agroecosystems). 2. Know how to deal with goals and value bases of such systems. 3. Have become familiar with methodology, methods and tools for describing, analysing and improving farming and food systems. 4. Know how to connect theory to a practical case.



## **PAE302 Agroecology and Farming Systems**

**Credits:** 15 **Language:** English

**Learning outcomes:** After completing the course, the students should know how to: - Describe and analyse farming systems, - link theoretical knowledge and concrete action regarding farming systems, - acquire knowledge about their own learning. Further, the students should acquire: - Knowledge of structure and functioning of conventional and ecological (organic) farming systems, - knowledge of links between disciplinary (sub-system) knowledge and systemic (holistic) approaches, - experience with methods for systems analysis, including assessment of overall system sustainability, - the ability to handle complexity and change, - the ability to link theory to real-life situations, - the ability to communicate and facilitate, - the ability to learn autonomously and life long, - experience in dealing with attitudes as part of the agroecosystem and learning community. Through real-life case studies with focus on change processes, attitudes of both students and actors in the farming system will be made explicit. The students will learn how to deal critically and constructively with attitudes and value-based choices as important system elements. Desirable attitudes of the students: open-minded, critical, spirited, determined, approachable, exploring and communicative.

## **PAE303 Agroecology and Food Systems**

**Credits:** 15 **Language:** English

**Learning outcomes:** After completing the course, the students should know how to: - Describe and analyse food systems, - link theoretical knowledge and concrete action regarding food systems, - acquire knowledge about their own learning. Further, the students should acquire: - knowledge of structure and functioning of conventional and ecological or local food systems, - knowledge of links between disciplinary (sub-system) knowledge and systemic (holistic) approaches, - experience with methods for systems analysis, including assessment of overall

system sustainability, - the ability to handle complexity and change, - the ability to link theory to real-life situations, - the ability to communicate and facilitate, - the ability to learn autonomously and life long, - experience in dealing with attitudes as part of the agroecosystem and learning community. Through real-life case studies with focus on change processes, attitudes of both students and actors in the food system will be made explicit. The students will learn how to deal critically and constructively with attitudes and value-based choices as important system elements. Desirable attitudes of the students: open-minded, critical, spirited, determined, approachable, exploring and communicative.

## **PHA320 Applied Plant Physiology in Controlled Environment**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** After completing the course, the students should be able to use their knowledge of plant physiology and fertilisation planning as a foundation for effective and environmentally friendly production of flower plants of high quality for the local environment. A thorough covering of the following, central topics: 1. Fertilisation planning for greenhouse crops. 2. Growth and development physiology, and growth regulation. 3. Post-harvest physiology. Solving of both theoretical and practical problems in connection with the use of fertilisation planning and climate control in greenhouse cultures for optimal growth and plant quality. Also analyses and interpretations of reasons for irregular growth, damage symptoms, bad plant quality and durability. Several of the topics in the course focus on an environmentally friendly greenhouse production. This contributes to students gaining attitudes that may lead to more attention being paid to this topic when they turn up as teachers, advisors and researchers in the horticulture field.

## **PHA321 Applied Plant and Production Physiology in Controlled Environment, theme paper**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** After completing the course, the student is going to have a deep understanding of applied plant physiology and fertilisation planning as a base for an effective and environmentally friendly production in greenhouse of high quality and beneficial for the local environment. For further information see PHA320. In addition, the student will gain experience in writing a semester assignment of 5 credits in a selected topic.

## **PHA322 Applied Plant Physiology related to Plant Growth in Regulated Climate, Term Paper**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The student is to have theoretical depth on certain topics in applied plant physiology related to greenhouse crops.

## **PHI401 Research Ethics and Philosophy of Science I**

**Credits:** 5 **Language:** English

**Learning outcomes:** The course aims at an increased understanding of science in practice, i. e. science as it is carried out in diverse ways within the natural, social and cultural sphere. The course considers what is specific about scientific practice, rationality and method in diverse fields, what its aims are, how it is influenced by society and what kinds of social and cultural consequences it may be said to have. The objective is to stimulate students to reflect on their own and others research projects and research fields, in particular with a view to increase their ability to see and diagnose philosophical and ethical problems in the sciences as well as their consciousness of their ethical responsibility.

## **PHI402 Research Ethics and Philosophy of Science II**

**Credits:** 10 **Language:** English

**Learning outcomes:** Teaching goals as well as lectures, seminars and syllabus are by far the same as in the course PHI 401 (see \"Teaching goals\" under PHI 401). But the course PHI 402 will, with an extended course in philosophy of science as its point of departure, give the students an opportunity to go deeper into philosophical and/or ethical issues related to their own research projects. Through the work with a term paper related to their own projects, the students will receive a possibility to think through pressing problems of the kind.

## **PJH212 Cropping Systems of Grain Crops and Grasslands**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** After studying this course, the students shall be able to: - Explain plant development of cereals and forage grasses, and how they respond to important edafic and climatic factors - Management practises and cropping systems, and how this may affect plant development, yield and yield components and quality of the harvested products - Management practises and environmental concerns - Optimisations in management practises and cropping systems to meet requirements to production methods, productivity, product quality, sustainability and environmental concerns

## **PJH230 Fruit and berries**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** The students will learn to understand the anatomy of fruit trees and berry species, and how they react to different climate and culture practice. Students will acquire knowledge of field planning, cultivars, cultivation and different field practice as well as care and maintenance of the species to ensure

stable and good yield over years. Students will also acquire knowledge about product quality, from growing in the fields to post-harvest handling and storage.

## **PJH240 Vegetables and potato - biology and cultivation**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** The students should understand factors that influence the food-quality and yield of vegetables and potatoes. These are factors as climate, cultivation, soil types, use of fertilisers, use of pesticides, crop rotation, organic cultivation etc. The student should also acquire knowledge about product quality from growing in the fields to post-harvest handling and storage.

## **PJH250 Production in greenhouses**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** The course aims to give the students knowledge about the production systems of the most common crops produced in greenhouses. The students will gain an understanding of the biological and technical challenges of plant production in controlled climate. The students should be capable of describing the production of different crops and understand the influence of the different climate factors. The students should also be able to measure and understand measurements of climate parameters and interpret plant growth responses.

## **PLV300 Plant Health and Plant Protection**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students shall have the necessary basis to become advisers and to specialize in complex plant protection issues seen in a future-oriented ecological general perspective. The students shall know about integrated plant protection in theory and practice and acquire an understanding of the ecological processes that integrated plant protection is based on. They shall

have knowledge about new and current challenges in plant protection today. Understanding of ecological processes and risks of environmental effects as a basis for integrated measures against pests in crop production. Consider dates for different integrated measures in different cultures based on damage thresholds, prognoses, warnings and indicator models. Make plans for integrated fight strategies with the fewest risks for environmental strain. Consider integrated plant protection measures in a general perspective for crop production and environmental quality. Product quality considered as production quality - an expanded quality concept.

## **PLV320 PLANT PATHOLOGY IN A CHANGING WORLD**

**Credits:** 5 **Language:** English

**Learning outcomes:** The main objective of the course is to both deepen and broaden knowledge in plant pathology from a societal perspective. On completion of the course, students will be able to - give an account of the key concepts of plant pathology, - describe the social impact of plant disease and its relevance for society - be familiar with methods to address plant pathological questions in a scientific manner - discuss plant disease management from different perspectives with respect to international trade, climate change, and sustainable production. This course is an introductory course to the NorPATH programme and additional goals include development of individual study plans, both possibilities for thesis subjects and locations, as well as conveying knowledge about the possible career opportunities in plant pathology

## **PLV420 NOVA PhD-course in Plant Pathology**

**Credits:** 5 **Language:** English

**Learning outcomes:** See description on the NOVA home page

## **PPFO401 Qualitative Method**

**Credits:** 15 **Language:** English

**Learning outcomes:** The course aims at providing the doctoral students with a basis for using qualitative research methodology. The goal is that students shall be able to use qualitative methods in their own research project and reflect upon their own role in the research process.

## **PPUT301 Science and Technology in School and Society - LUN**

**Credits:** 25 **Language:** English upon request

**Learning outcomes:** The students will gain insight into literature on educational theory and principles, and apply this literature to their own problems within educational theory. One part of the literature is common and one part is chosen by the students. The students are to develop the correct use of quotes and be able to discuss and review literature. Literature shall be used actively in the students\' written work and empirical research. Through presentations and discussions, the students should develop their own opinions about educational theories and principles in the natural sciences. The course aims to give the students a basis before embarking on their master\'s theses.

## **PØL300 Agroecosystems**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students will acquire basic understanding of the diversity and complexity of the factors that control an agroecosystem\'s sustainability.

## **REIS300 Nature-based Tourism**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The course should: - Give an overview of nature-based tourism as a business in Norway. - Give a theoretical basis for analysis of nature based tourism projects. - Undertake a concrete analysis of a nature based tourist project.

## **SKOG310 Nordic Forestry and Forest Research**

**Credits:** 10 **Language:** English

**Learning outcomes:** This course is designed for exchange students from outside Norway wishing to learn about forestry and forest research in Norway and the other Nordic countries. Students will learn about - the natural and socio-economic conditions for forestry in the Nordic countries and the forestry practices that are special to that region. - current research results related to forest management from UMB and other Nordic forest research institutes.

## **SKS303 Silviculture**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** Applied silviculture selects treatments to manage forest ecosystems according to given objectives. This activity requires fundamental knowledge of forest ecosystems and their reactions to management (production ecology), local variation of general patterns in forest ecosystems, objectives of forest management and an extensive overview over silvicultural methods. This course on the master level will enable the students to extract knowledge from the international research literature in silviculture. The students will learn technical terms in Norwegian and English, learn to understand and critically interpret research results, learn to see their relevance in the context of other research results, and learn to see the practical use of new knowledge.



## **STAT300 Statistical Data Analysis**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students learn about the assumptions, applications, and theoretical background for the most common methods within multivariate statistical analysis. It will be emphasised that the students, to a given problem in their study or later in their work, will be able to formulate the problem in such a way that it can be analysed by means of suitable multivariate statistical method(s). Furthermore, the students learn to decide which method(s) that can be used to model and analyse the problem, and to do the analysis, (if necessary) by means of suitable software. The students also learn the practical interpretation and to assess the validity of models, methods, and results.

## **STAT310 Design of Experiments and Analysis of Variance II**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students should learn the statistical principles for design of experiments used to compare different groups or treatments and to analyse data from such experiments, first of all by means of analysis of variance. They also learn the mathematical basis so that they will be able to use their knowledge in new situations that they encounter in their studies and later in their working life. By means of exercises and projects with real problems and data, the students should show that they have reached the learning goals.

## **STAT330 Analysis of Categorical Data**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Be able to analyse contingency tables and binary data by chi-square tests, loglinear regression and logistic regression.

## **STAT360 Theoretical Statistics**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students should acquire a basic theoretical understanding of the most important classes of mathematical-statistical models used among other things when analysing biological data and for the statistical methods developed in connection with such models. They should be able to see connections for exponential distribution classes in general and for linear models especially. The should also understand why and when a model reduction produces better result. The student should also be able to present subject-relevant material both orally and in writing.

## **STIN300 Statistical programming in R**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** Upon completion of the course the student should master to perform statistical analyses using a programming approach in R. The course will provide the necessary knowledge to let the students master standard statistical analyses. Additionally the students should be able to make their own functions which utilise/modify available functions in order to solve specific statistical problems which cannot be solved by standard code. The student should also be able to present the output from the statistical analyses in an accessible and scientific form using text and graphics.

## **TAT211 Production Technique in Aquaculture**

**Credits:** 10 **Language:** English

**Learning outcomes:** - Have general knowledge in production of aquatic organisms, with focus of salmonids. - Know how to produce broodstock, juvenile and adult fish - Know how to evaluate and optimize the most important working operations on a juvenile and ongrowing farm. - Knowledge to make a production plan for a juvenile and ongrowing farm. - Know which factors that is important to optimize the production on a juvenile and ongrowing farm. - Know which factors

that affect the production velocity, how can they be changed, and what is the effect of this. - Know procedures for season independent smolt production. - Know how to performe site evaluations and know site selection criteria. - Know how to prepare documents for production control and propose efforts with deviation. - Be able to prepare working plans for smolt production and ongrowing production farms. - Know maintenance routines/plans for smolt production and ongrowing production. - Be able to estimate investment and running cost for main components in smolt and ongrowing farms. -Know laws and regulations that have affect on the production planning.

## **TAT230 Design of Equipment for Norwegian Aquaculture Facilities**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students should be able to clarify key issues with regard to design, function and dimensioning of fish farms. Furthermore, the students will have knowledge about and be able to calculate and plan the most important systems and components in this kind of facility, e.g. vessels, equipment for oxygenising, heating and purification of water (with special emphasis on wastewater), purification, equipment for removal of ammonia, recycling as well as breeding facilities and systems for anchoring. The students will be able to evaluate technical solutions in the mentioned areas.

## **TAT250 Laboratory Course in International Aquaculture**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students shall get practical training and insight in operations used in international fish farming. The focus is on land-based fish farms and production methods.

## **TAT254 Basic Aquaculture Engineering**

**Credits:** 5 **Language:** English

**Learning outcomes:** The aim of the course is to give the student basic knowledge on technical equipment, methods and systems that are necessary for aquaculture production.

## **TAT350 Planning and Design of Intensive Fish Farms**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students should be able to plan and design a land-based facility for intensive fish farming and carry out projects in this area.

## **TBM250 The Finite Element Method**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** Having passed the course, the students will have gained basic understanding of how to use the Finite-Element-Method (FEM) in solving practical problems. This class also provides training in problem solving using commercial FEM- software packages.

## **THT280 On-site wastewater treatment - Planning, design and impact assesment**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students shall have an overview of on-site systems for wastewater treatment and reuse, and have basic knowledge about the design of treatment systems and their impact on health and environment.

## **THT281 Appropriate Sanitation for the Developing World**

**Credits:** 5 **Language:** English

**Learning outcomes:** The students shall have an overview of the challenges of inadequate sanitation in developing countries. Further, knowledge of appropriate technologies for problem remediation and the socioeconomic factors of relevance for successful implementation.

## **THT282 Ecotechnology Basics**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students shall upon completion of the course have an insight into the major water and sanitation challenges of the world and an overview of sustainable water and sanitation options; conventional and alternative (ecological sanitation). The student shall be able to elucidate the connection to nature, society and health in the design of systems for water supply and wastewater handling.

## **THT283 Sustainable sanitation - decentralized, natural and ecological wastewater treatment**

**Credits:** 10 **Language:** English

**Learning outcomes:** The students shall have an overview of the challenges related to inadequate sanitation in developing countries and an overview of potential technical solutions. The students should know limitations and advantages of different treatment systems and the socioeconomic factors of relevance for successful implementation in different parts of the world. The participants should be able to design and implement smaller decentralized, natural and source separating systems.

## **THT299 Environmental Engineering, Project Work**

**Credits:** 5 **Language:** English upon request

**Learning outcomes:** The goal of the project work is to provide the students with experience in solving concrete problems of a scientific, analytical or practical, technical nature. The students also get practice in project planning and in reporting the achieved results.

## **THT310 Applied Water and Wastewater Treatment**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** The students shall upon completion of the course be able to select and design appropriate treatment systems for water and wastewater. Furthermore, the students shall be able to analyse different treatment systems and synthesise knowledge of geology, biology, ecology and technology to design treatment systems that are adapted to local conditions for smaller scale systems. The course will give a deeper understanding of some treatment processes and more emphasis on treatment and practical experience. The students shall understand advanced methods in process control and optimization by use of computerbased tools and modeling. They shall be able to utilize relevant simulation software in process design and planning of treatment plants.

## **TMP261 Heat and flow simulation**

**Credits:** 5 **Language:** English

**Learning outcomes:** Having finished the course, the student shall be able to utilize modern computersimulation tools to simulate and predict heat and flow transfer in process installations.

## **TMPP350 Process Technology II**

**Credits:** 15 **Language:** English upon request

**Learning outcomes:** On completion of this course, the students should be able to lead a development activity related to: analysing, simulation and optimisation

of single unit processes or complete production systems. It is important for the students to gain experience in an analytic way of solving problems, based on science in physics, chemistry and mathematics in relationship to control and process engineering.

## **ZOOL300 Ecological Entomology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** The students should acquire a critical attitude towards published results in ecological entomology and be able to apply the theory in practical situations. They should be familiar with reading, understanding and presenting scientific papers within ecological entomology and be able to discuss the results within a broader ecological frame. Based on the discussions, the student should be able to judge different point of views in environmental questions, included ethical problems. The papers will also give new scientific knowledge within certain topics.

## **ZOOL310 Behavioural and Population Ecology**

**Credits:** 10 **Language:** English upon request

**Learning outcomes:** On completion of the course, the students should be able to understand the content of research articles in international peer-reviewed journals on topics in behavioural ecology and population ecology. The students should also be able to evaluate the scientific value of such articles, and to present such articles critically to a group of professional colleagues.

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