Studiehåndbok 2013/14 Alle programmer og emner

Universitetet for miljø- og biovitenskap

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Bachelor in International Environment and Development Studies

Language of instruction: English.

Credits: 180

For information, contact: Department of International Environment and Development Studies

Admission requirements:

Higher Education Entrance Qualification

Relevance for society:

In an increasingly globalised world there is a growing need for knowledge about challenges related to development and the environment. The problems faced by developing countries are multifaceted, and require solutions that draw on a wide range of approaches. The programme\'s unique interdisciplinary focus is tailored to meet this need.

Degree awarded: Bachelor

The degree qualifies students for (further studies / jobs):

The Bachelor\'s degree builds the academic foundation necessary for those students wishing to pursue a Master\'s degree in International Development Studies (IDS), International Environmental Studies (IES) or International Relations (IR) offered at UMB, and provides a foundation for applying to similar programmes at other higher education institutions in Norway or abroad. Successful candidates are also eligible to apply for the master\'s programmes Agroecology (AE) and Nature-based Tourism (REIS) offered at UMB.

Internationalisation:

Cooperation with other institutions:

Noragric has a broad network of international partners, and one or more field courses in developing countries will be offered.

Possibilities for study abroad:

Students may go for exchange to one of UMB\'s partner institutions in the 5th semester.

Learning outcomes:

A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in knowledge, competence and skills: Knowledge: - Demonstrate knowledge of global environment and development issues and their interlinkages. - Demonstrate knowledge about interdisciplinary approaches to the study of development and the environment. Competence: - Be able to work targeted and independently. - Be able to communicate knowledge, analyses and results in a convincing manner, orally and in writing. Skills: - Be equipped with knowledge and competence to make well- founded assessments of local and global environment and development challenges. - Demonstrate skills in critical and academic thinking.

Learning and teaching methods:

The programme utilises a wide range of teaching methods. Because working with environment and development often involves adapting knowledge to new situations, many courses use case-oriented teaching and group work. This ensures that students take an active interest in their own learning. Teaching methods vary between courses and include lectures, seminar activities, assignments, presentations and discussions. Field exercises and practical experience is also part of the programme through elective field courses.

Student Assessment:

The courses offered utilise a wide range of evaluation forms, such as written sit-in exams, take-home exams, oral exams and term papers, that in different ways evaluate the students skills in academic reading and writing, as well as analytical skills.

Contents:

The programme consists of mandatory and elective courses. The mandatory courses constitute 120 ECT and make up the two first years of the programme. A progression from introductory to more advanced courses within the interdisciplinary field of international environment and development studies provides the specialization of the programme. Students will also be introduced to philosophy, ecology, scientific writing and research methods. A bachelor thesis of 15 ECT in the last semester is also a requirement. Apart from the thesis work, the third year is set aside for elective courses, either at the department, at other departments, or with other universities. Some options for field courses will be provided and in the fifth semester exchange to partner universities abroad will be possible.

Students must have an approved study plan. The student must take a minimum of 80 credits at the 200 level. The Study Coordinator will provide guidance regarding the choice of electives.

Student guidance:

Studyprogrammes Master 2-year English

Master in Agroecology

Language of instruction: English.

Credits: 120

For information, contact: Department of Plant- and Environmental Sciences (IPM), www.umb.no/ipm

Admission requirements:

You can find general information on admission to UMB here: http://www.umb.no/study-options/article/admission Applicants must hold a Bachelor\'s degree or equivalent qualification from university-level studies in agriculture, ecology, biology or a relevant social science. For admission to English-language Master´s programmes, one of the following special admission requirements for English apply: a) foundation/level 1 course in English at upper secondary school (5 weekly periods) with the mark 4 or better (alternatively, a pass in the English Advanced course I and/or II) b) Test of English as a Foreign Language (TOEFL) with a result of at least 550 points for the Paper-based test (PBT), or 80 points for the Internet-based test (IBT) c) International English Language Testing Service (IELTS) with a score of at least 6.0 d) other approved documentation following an individual assessment

Relevance for society:

Farming and food systems are ecologically, economically and socially important in all societies. Worldwide there is a need for graduates who can deal with such systems, which are characterised by complexity, multifunctionality and rapid change. The Master#\'s degree programme in Agroecology provides a scientific and holistic basis for describing, analysing, and improving farming and food systems. Topics include environmental, production-related, economic and social challenges in farming and food systems; interdisciplinary approaches to dealing with complex processes of change; sustainable development in a local and global context; ecological organic agriculture. The programme prepares students for a wide range of positions within conventional and organic agriculture and food systems, e.g., within the advisory service, development projects, industry sales and technical support, management of agricultural and natural resources, environmental protection, and education.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

Graduates may be employed in the agricultural, rural development, resource management or educational sectors.

Internationalisation:

Cooperation with other institutions:

The programme is part of the NOVA University network cooperation and two evaluation- and planning meetings are held annually with Nordic partners.

Possibilities for study abroad:

There are good opportunities for students to study abroad within the normal time frame of the programme. The second and third semester of the programme can be completed in Norway or another country. NOVA and Erasmus offer courses that may be integrated into the elective part of the programme in the second and third semester. The most important cooperating universities are in Sweden, Denmark, Finland, Wales, Italy, Germany, France, Netherlands and the USA.

Learning outcomes:

A candidate who has completed the programme is expected to have achieved the following learning outcomes, defined as knowledge, skills and competence: Knowledge: Describe and analyze structure and function of conventional and alternative farming and food systems. Map and analyze different dimensions of complex farming and food system in case studies. Demonstrate thorough knowledge of systemic methods of analysis of farming and food systems. Skills: Apply methods for systems analysis and improvement on issues related to sustainable development of farming and food system, based on a participatory action research approach. Carry out interdisciplinary analyses of farming and food systems and evaluate solutions related to sustainability in collaboration with colleagues from other academic fields. Analyze existing theories, methods and interpretations within agroecology. Compare different interpretations and methodologies within the field of agroecology. Describe the role of agroecology in relation to sustainable farming in food systems in Norway and globally. Read scientific articles. Access multiple sources of information and use these critically and creatively in analysis of issues related to the development of farming and food systems. Carry out systems oriented action research and reflection in collaboration with academics and stakeholders in farming and food systems. Map and analyze conflicting goals and values in relation to sustainable farming and food systems in the interplay between economic, social and ecological factors. Identify and explain ethical issues related to stakeholder involvement in research and development (action research). Contribute to sustainable development of farming and food system through action research including visioning, rich picturing and action planning. Competence: Direct one\'s own learning by: 1.Exploring and defining learning goals and needs 2.Making a strategy for how to achieve this 3.Continuous reflection on one\'s own learning process and reframing of one\'s own goals and actions. Work independently on practical and theoretical problems, including the linkages between the two. Apply knowledge and skills in new and complex situations in order to carry out advanced assignments and projects. Communicate and collaborate in academic work in an international and multi-cultural class context and also involving diverse stakeholders in an extra-university context. Carry out an independent, limited research or development project under supervision and in accordance with applicable norms for research ethics in collaboration with stakeholders in farming and food systems. Communicate the master\'s thesis work using the language and terminology of agroecology, both orally and in writing. Communicate about academic issues, analyses and conclusions in the field, both with specialists and the general public. Contribute to strategic development related to the complex development of farming and food systems. Take responsibility for contributing professionally in a work or study environment. Review the strategic performance of teams when collaborating with stakeholders in farming and food systems.

Learning and teaching methods:

The programme starts with a semester introducing students to the structures and functions of agroecosystems, methodology for describing, analysing and improving such systems, and individual and group-based learning. The didactic approach is experience-based learning supported by lectures, seminars and supervision related to project work on real-life cases. The instruction methods in later semesters depend on which courses are chosen.

Student Assessment:

The evaluation of students\' learning is treated as an integral part of the learning process. Evaluation emphasises the student#s\' ability to develop action competence by linking theory and practice. In the first semester, this is evaluated on the basis of written group and individual assignments, the student#s\' contribution to the class and oral exams. Evaluation in later semesters depends on the courses chosen.

Contents:

The program consists of the following parts: 1. An elective introduction to agroecology: The ecology of food and farming systems (5 credits) (PAE301), web-based 2. Core courses in agroecology emphasising farming and food systems (30 credits). Five credits at 100 level in foreign language is accepted in the degree for

students at the M-AE program \'European master\'. The master\'s thesis is normally at 30 credits, alternatively 60 credits

Student guidance:

Master in Animal Breeding and Genetics

Language of instruction: English.

Credits: 120

For information, contact: Department of Animal and Aquacultural Sciences (IHA), www.umb.no/iha

Admission requirements:

Central application procedure through the EM-ABG coordinator (Wageningen) is established. Students who meet the following formal admission requirements will be considered:- BSc degree or equivalent degree in Animal Science or related fields with a number of prerequisites (e.g. knowledge of Statistics and Genetics), - Grade point average needs to be at minimum 70% of the maximum score. English at a level equivalent to the requirements set by the TOEFL test or similar, with results approved by the International Student Office of UMB.

Relevance for society:

Internationally, there is an increased need for candidates with a Master Degree in Animal Breeding and Genetics. The programme is highly relevant for students who wish to work in organizations focused in the field of sustainable animal breeding, and for further PhD studies within the field.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

The degree gives opportunities for positions majorly within organizations doing animal and aquacultural breeding. Students with this degree are hightly demanded as Ph.D students within quantitative or/and molecular genetics worldwide.

Internationalisation:

Cooperation with other institutions:

Wageningen University (WU) - the Netherlands, University of Natural Resources and Applied Life Sciences (BOKU) - Austria, Agro ParisTech - France, Swedish Universiy of Agricultural Sciences (SLU) - Sweden - The Norwegian University of Life Sciences (UMB). The EM-ABG course has been granted by the Erasmus Mundus programme of the European Union.

Possibilities for study abroad:

Norwegian students can choose among the five partner universities. The candidates will receive a double Master`s degree (one for each of the universities the individual student attended), if they satisfy the requirements within each university.

Learning outcomes:

The EM-ABG will concentrate on use of quantitative and molecular genetics for animal breeding purposes. This involves the following concepts: - understanding of and measuring genetic variation (Statistical Genetics) - molecular genetics and bioinformatics (Genomics) - design and evaluation of breeding programmes (Animal Breeding) - understanding of intra-animal biological relationships (other) A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: Competence: - Knowledge on how to utilise theory to meet the challenges in animal breeding and genetics. Knowledge: - Knowledge about both quantitative and molecular genetics for animal breeding purposes. Skills: - How to write a master thesis based on own experiments, available data and/or available literature.

Learning and teaching methods:
Teaching methods are varied and include lectures, laboratory exercises, field trips, group work, independent studies, exercies and seminars by students

Student Assessment:
Final oral or written examinations or continuous assessment.

Contents:
To receive a MSc at UMB, students have to fulfil at least 60 ECTS and minimum 30 ECTS for thesis under (joint) supervision of UMB and one of the other partner universities. You can compose your own study plan with several courses in quantitative and molecular genetics. Some recommended courses are: Models and Algorithms in Bioinformatics, Genome Analysis - methodology, Molecular Genomics, Animal breeding Plans, Theory and Application of Inbreeding Manegement.

Student guidance:

Master in Aquaculture

Language of instruction: English.

Credits: 120

For information, contact: Department of Animal and Aquacultural Sciences (IHA), www.umb.no/iha

Admission requirements:
Bachelor degree that includes minimum: 60 credits biology, 10 credits mathematics, 10 credits chemistry/ physics and 10 credits statistics courses. English at a level equivalent to the requirements set by the TOEFL test or similar, with results approved by the International Student Office of UMB.

Relevance for society:
The aquaculture industry word-wide develops fast with an annual increase about 10%. Productions are estimated to be doubled in less than ten years. The industry requires leading knowledge of breeding, nutrition, engineering, product quality, animal welfare and economics at a MSc level.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):
The degree gives opportunities for leading positions within a wide part of the Aquaculture industry and related areas like consulting and feed production. The degree also qualifies for PhD studies within several scientific subjects.

Internationalisation:

Cooperation with other institutions:
NOFIMA and the other departments at UMB, especially Department of Mathematical Sciences and Technology.

Possibilities for study abroad:
Sections of the programme may be completed abroad. The NOVA University network: All aquaculture and freshwater fisheries courses that are registered at any of the other participating universities are available for the students.

Learning outcomes:

A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: Competence: - Highest competence level within modern aquaculture production. - Competence to solve practical problems and participate in development projects. - High competence in animal breeding, nutrition and production technology. Knowledge: - How to select the best production animals and how to supply their nutritional needs in different production environments. - How to secure animal welfare in modern farm animal production systems. Skills: - Able to keep him-/herself up-to-date in scientific literature and new technology. - To place practical solutions into a broader social perspective regarding general values within society, such as utilisation of resources, environment and animal welfare.

Learning and teaching methods:

Teaching methods are varied and include lectures, field trips, group work, independent studies and exercises and seminars by students.

Student Assessment:

Final oral or written examinations or continuous assessment.

Contents:

The Master of Science in Aquaculture consists of: 50 credits compulsory courses in aquaculture at the 200-level within fish health, breeding and nutrition, and Special course in Aquaculture (5 credits) at the 300-level. In addition, 20 credits at the 300-level within fish breeding, fish nutrition or planning and design of aquacultural facilities. Master thesis is 30 credits.

Student guidance:

Master in Development and Natural Resource Economics

Language of instruction: English.

Credits: 120

For information, contact: UMB School of Economics and Business, www.umb.no/hh

Admission requirements:

A Bachelor\'s degree or equivalent degree with a major or specialization in economics (minimum of 60 credits). This includes microeconomics, macroeconomics and econometrics. Introductory courses in mathematics and statistics are also required. This general rule can be exempted in case of other relevant academic backgrounds.

Relevance for society:

There is a great need for policy-oriented economists who are able to integrate and apply knowledge from resource, environmental, agricultural and development economics. This programme has an applied profile, and students get knowledge, training and practical experience in using economic methodologies, as a bridge between theories and real-world problems.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

Graduates of this programme may work in teaching and research institutions, in national ministries or regional departments of agriculture, forestry, environment, and development planning, or in international organizations and development/environment NGOs. Candidates also qualify for other positions where a Master degree in Economics is required. This programme qualifies for Ph.D. studies as well.

Internationalisation:

Cooperation with other institutions:

This program has had an extensive cooperation with Makerere University in Uganda, Hawassa University and Mekelle University in Ethiopia, University of Malawi and Bunda College in Malawi. The cooperation with these and other universities in developing countries will continue.

Possibilities for study abroad:

The students on this Masters programme will have the opportunity to do field work for the thesis research in a developing country. This field work is a core aspect of this Masters programme. It enables the students to get first hand experience with working and doing research in a developing country. Students can also choose to study abroad for one semester as a part of their degree.

Learning outcomes:

A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: Competence: - Has acquired in-depth and specialized disciplinary competence through the education in economics. - Has the required basis for participation in research projects and for doctoral studies. - Is able to resolve work-related tasks with high-level skill requirements. - Is able to use his/her theoretical and methodological skills in new areas. Knowledge: - Has advanced knowledge of economic theory as well as having solid skills in mathematical and econometric methods. - Has comprehensive knowledge at a high level in applied development economics and environment/ resource economics. Skills: - Methodological skills: The candidate is able to evaluate and analyze relevant sources of information in a critical manner. The candidate is able to generate independent assessments and develop projects under supervision. - Analytical skills: The candidate is able to formulate relevant research questions in an independent manner as well as analyze large amounts of information through the application of appropriate methods and according to ethical norms in research. - Dissemination of information: The candidate is able to present information and ideas in an instructive manner to both researchers and the general public. - Work-related skills: The candidate is able to carry out analytical and management tasks as well as assume responsibility for such tasks in the public sector, private businesses, and voluntary organizations.

Learning and teaching methods:

The programme relies on varied learning methods, including lectures, tutorials, group assignments, presentations and fieldwork. The program has an emphasis on student participation and on problem based learning, with a special focus on developing the students ability to apply economic theory and methodology to real world problems.

Student Assessment:

A variety of assessment methods are used, including final examinations, semester papers and assignments.

Contents:

The programme consists of compulsory courses in the following fields of study: Mathematics for Economists, Econometrics, Microeconomics, Resource and Environmental Economics, Research in Development Economics, Decision Modelling, Development Economics Micro, Development Economics Macro, Development and Environment Economics. This comes in addition to compulsory field work, the master thesis and elective courses.

Student guidance:

Master in Ecology

Language of instruction: English.

Credits: 120

For information, contact: Department of Ecology and Natural Resource Management (INA), www.umb.no/ina

Admission requirements:

The applicants must have obtained a Bachelor&#65533;s degree, or its equivalent, in Natural Sciences (biology, ecology, agricultural or environmental sciences) with basic knowledge in statistics/research methods.

Relevance for society:

Challenges due to human impact on the environment require a deep knowledge of ecology. The study programme educates graduates with a high competence in ecology, with the idea to facilitate this competence through teaching and cooperation with other professional groups, and by using it in research and development work.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

In Norway and Europe, this education provides the competence to obtain positions within public management, non-governmental business organisations and organisations with the need for employees with high competence in ecology. With pedagogical training, graduates can also work in the Norwegian school system. In developing countries, the opportunities include jobs in protected areas, positions in ministries and regional/ local offices, NGOs, consultancies, teaching, environmental/rural/agro development agencies or working as planners and conservationists. The programme qualifies graduates for Ph.D. studies in ecology in Norway and abroad.

Internationalisation:

Cooperation with other institutions:

INA has close collaborations with many universities and other institutions abroad. A number of the students on the program come from collaborating institutions for instance in Asia and Africa.

Possibilities for study abroad:

The course allows for the possibility of studying abroad, provided the student takes the compulsory subjects in the Master&#65533;s degree programme. These subjects can be taken at UMB or at another college or university abroad, subject to approval. The field work in tropical ecology and management of natural resources is conducted in a tropical or sub-tropical area and lasts for 3-6 months.

Learning outcomes:

The candidate will through an in-depth understanding of ecological and evolutionary processes, and a solid basis in scientific methodology and statistics, be able to analyse current ecological issues in a critical and thorough manner. The students choose between two main directions.1) General Ecology The candidate will have advanced theoretical knowledge of ecological science and the possibility to specialise in topics like evolutionary ecology, population ecology, behavioural ecology or plant ecology. Upon completion the candidate has conducted an independent research study analysing the results using scientific methods. 2) Tropical Ecology and Management of Natural Resources The candidate will have advanced knowledge of tropical ecosystem and how these are managed from an ecological as well as human perspective. Upon completion the candidate will know the importance of biodiversity for ecosystem functions, how to manage biodiversity and the main treats to species extinction.The students will gain in depth knowledge and understanding of species interactions within and between trophic levels. The candidate should be able to apply knowledge on harvesting of wildlife and fishery resources. The candidates will have knowledge about recent theories applications of community based natural resource management and be able to apply biological principals in restoring terrestrial and aquatic ecosystems. Upon completion the candidate has conducted an independent study in a tropical area and analysed the results using scientific methods.

Learning and teaching methods:

Teaching and evaluation methods consist of lectures, student assignments, study groups, seminars, and oral and written presentation of work, fieldwork and completion and reporting of the individual research project (Master\'s thesis).

Student Assessment:

The types of evaluation include written and oral exams, semester assignments, participation in and reporting from compulsory activities, and student presentations. The Master\'s thesis and the special syllabus related to it are defended with an external examiner present.

Contents:

The following courses are compulsory for all students: Conservation Biology and Scientific Methodology in Ecology and Management of Natural Resources. For students with weak statistical background a course in statistics is recommended. In addition for students that follow the study direction General Ecology: Global Change Ecology, Genetic Basis of Biodiversity and at least one of the following 300-level courses: Photobiology, Pollination and Reproductive Ecology of Plants, Molecular Evolution, Ecological Entomology, Behavioural and Population Ecology, Landscape Ecology, Ecology and Management of Rivers and Lakes, Environmental pollutants and Ecotoxicology or Restoration Ecology. In addition for students that follow the study direction Tropical Ecology and Management of Natural Resources: Tropical Ecosystems and Biodiversity, Ecology and Management of Natural Resources in the Tropics, Restoration Ecology and Community Based Natural Resource Management.

Student guidance:

Master in Ecology

Language of instruction: English.

Credits: 120

For information, contact: Department of Ecology and Natural Resource Management (INA), www.umb.no/ina/

Admission requirements:

The applicants must have obtained a Bachelor?s degree, or its equivalent, in natural sciences, with solid knowledge of ecology and ecological processes. Applicants must demonstrate English language ability in

accordance with the UMB regulations for programmes taught in English. Applicants must have obtained a minimum grade point average (GPA) of C (in Norwegian scale) or equivalent from the specialization in their degree.

Relevance for society:

Challenges due to human impact on the environment require a deep knowledge of ecology. The study programme educates graduates with a high competence in ecology, with the idea to facilitate this competence through teaching and cooperation with other professional groups, and by using it in research and development work.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

In Norway and Europe, this education provides the competence to obtain positions within public management, non-governmental business organisations and organisations with the need for employees with high competence in ecology. With pedagogical training, graduates can also work in the Norwegian school system. In developing countries, the opportunities include jobs in protected areas, positions in ministries and regional/ local offices, NGOs, consultancies, teaching, environmental/rural/agro development agencies or working as planners and conservationists. The programme qualifies graduates for Ph.D. studies in ecology in Norway and abroad.

Internationalisation:

Cooperation with other institutions:

INA has close collaborations with many universities and other institutions abroad. A number of the students on the program come from collaborating institutions for instance in Asia and Africa.

Possibilities for study abroad:

The course allows for the possibility of studying abroad, provided the student takes the compulsory subjects in the Master?s degree programme. These subjects can be taken at UMB or at another college or university abroad, subject to approval. The field work in tropical ecology and management of natural resources is conducted in a tropical or sub-tropical area and lasts for 3-6 months.

Learning outcomes:

A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: GENERAL ECOLOGY: Competence: - Has developed good skills in the communication of scientific information to scientists, to natural resource management authorities and to the general public. - Is able to use his/her knowledge and skills on new scientific areas to carry through advanced tasks and independent research projects. Knowledge: - Has a thorough knowledge of ecological theories and factors that regulate the structure and diversity of ecosystems. - Has a comprehensive understanding and in-depth knowledge of two or more areas related to general ecology. - Has in-depth knowledge of nature?s complexity, and the adaptability of life. - Has up-to-date knowledge on global environmental change and how it affects organisms and ecosystems. Skills: - Can plan and conduct advanced scientific field work in an independent way, as well as evaluate, analyze and synthesize the data afterwards. - Can apply new information to analyze ecological problems. - Can use ecological principles and knowledge in an applied perspective; such as in nature conservation and the management of natural resources. TROPICAL ECOLOGY AND NATURAL RESOURCE MANAGEMENT: Competence: - Has developed good skills in the communication of scientific information to scientists, to natural resource management authorities and to the general public. - Is able to use his/her knowledge and skills on new scientific areas to carry through advanced tasks and independent research projects. Knowledge: - Has an in-depth knowledge of tropical ecosystems, ecological processes and the interactions between humans and ecosystems. - Has an understanding of the ecological challenges that tropical areas are facing today. - Has knowledge of the significance of biodiversity for ecosystems and underlying causes for the loss of biological diversity. - Has a deep and comprehensive understanding and in-depth knowledge of tropical ecology and natural resource management as a field of study, in addition to its accompanying research areas. Skills: - Can plan and conduct advanced scientific field work in an independent way, as well as evaluate, analyze and synthesize the data afterwards. - Can evaluate results from scientific research and utilize these in practical management. - Can use biological principles in the restoration of terrestrial and aquatic ecosystems. - Is able to develop operative management plans which balance human need for natural resources and the carrying capacity of nature.

Learning and teaching methods:

The student learn, process, discuss and synthesize advanced knowledge through a combination of lectures, seminars, project reports, lab reports, term papers, and field work. The study is completed with an independent research project (Master\'s thesis, 60 ECTS).

Student Assessment:

The types of evaluation include written and oral exams, semester assignments, participation in and reporting from compulsory activities, and student presentations. The Master\'s thesis and the special syllabus related to it are defended with an external examiner present.

Contents:

The following courses are compulsory for all students: Conservation Biology and Methods in Natural Sciences. For students with weak statistical background a course in statistics is recommended. In addition for students that follow the study direction General Ecology: Global Change Ecology, Genetic Basis of Biodiversity and at least one of the following 300-level courses: Photobiology, Molecular Markers for Plant Genomics, Ecological Entomology, Behavioural and Population Ecology, Landscape Ecology, Ecology and Management of Rivers and Lakes, Environmental pollutants and Ecotoxicology or Restoration Ecology. In addition for students that follow the study direction Tropical Ecology and Management of Natural Resources: Tropical rainforest ecology and conservation, Ecology and Management of Natural Resources in the Tropics, Restoration Ecology and Human Wildlife Interactions.

Student guidance:

Master in Economics

Language of instruction: English.

Credits: 120

For information, contact: UMB School of Economics and Business: www.umb.no/HH

Admission requirements:

Bachelor\'s degree in Economics or equivalent.

Relevance for society:

Modern economics is characterized by complexity and rapid changes. Decision-makers in both the private and public sector demand an ever higher degree of the information that renders it possible to make the right decisions. Economists hold theoretical and methodological knowledge which equips them to function as premise providers in such situations. The programme provides comprehensive training in economic approaches, theories, topics and methods. This degree qualifies for work with economic analyses within business and public administration. It also qualifies for further studies at doctoral level.

Degree awarded: Master

Other qualifications or certification:

Master of Science in Economics

The degree qualifies students for (further studies / jobs):

A degree in economics provides excellent employment opportunities in private as well as public sector. Typical tasks in the public sector are planning, monitoring the economy and assessment of social impacts of government measures. Typical tasks in private sector are forecasts of macroeconomic development (employment, inflation, interest rates, exchange rates), reporting for banks, other companies and organizations, including analysis of developments in specific sectors or markets. There are also many economists in international organizations, where appropriate tasks include trade, globalization and development. Program also qualifies for admission to doctoral studies (PhD) in economics.

Internationalisation:

Cooperation with other institutions:

The department is a member of the National University Board for Economics and cooperates with other universities.

Possibilities for study abroad:

UMB School of Economics and Business highly recommends its students to include a semester or a year of studying abroad in their education. The department and the university have exchange agreements with universities in Europe and the USA on the master\'s level.

Learning outcomes:

Knowledge: Get extensive training in economic theory and analysis, in accordance with national and international standards. Acquire advanced theoretical and applied knowledge within at least one of the following areas of specialization: - Environment and Resource Economics - Development Economics - Energy Economics - Financial Economics - Trade and Commodity Markets Skills: This MSc is an in-depth master\'s programme and the students are expected to acquire: - A thorough Economic competence in theory and methodology. - Ability to use these theories and methods on real world problems and current issues. Such as: - climate change - rural development - increasing food prices - financial crisis - renewable energy Some of the areas of specialization are specifically designed to address the challenges of environment and sustainable development: - Environment and Resource Economics - Development Economics - Energy Economics - Critical discussion is used actively in lectures, together with recent research showing various views within the same academic field or issue. - Students understand how economic theories and methods have evolved over time to reflect how societies have changed. Globalization and technological change have had great impact on all fields of economic thinking. - Critical use of various sources, theories and conclusions are a central part of the applied parts of several courses in the MSc program. - Through assignments, term papers and thesis students learn to review economic literature, apply relevant micro- and macro economic theories and employ appropriate economic methods. - Economics is about the use and distribution of scarce resources. Thus ethical issues become a central part of most subjects, particularly, Environment, Natural Resource Management and Development related subjects. - Students use economic theory and methodology to analyze real world problems. They are also encouraged to use their own personal believes and interests when they analyze and draw their own conclusions. - Through the mandatory subjects within advanced Micro- and Macroeconomics, Econometrics and Mathematics the students obtain theoretical and methodological knowledge meeting international standards for MSc degrees in Economics. General Competence: - After finishing this MSc program, students are qualified to participate in PhD programs in economics. - MSc thesis prove the ability to work independently and stimulate their academic curiosity. - Students can undertake and analyze specialized and concrete economic problems on their own. - Students have acquired a comprehensive and advanced micro- and macroeconomic and econometric tool box and have learned to use these tools to analyze applied problems. This will also enable the students to apply these tools in new areas. - Communicate and collaborate within the field of economics in an international study- or work context. Students learn to work independently in accordance with ethical norms for research. - Communicate and analyze relevant economic literature, concretize economic problems, and have insights into how you draw the connection between theory and empirical conditions. - Using economic models and communicating both the underlying assumptions of these models as well as the results from theoretical and model-based analysis both with specialists and the general public.

Learning and teaching methods:

Combination of lectures, seminars and independent work on exercises. Considerable use of independent study and semester assignments. Teaching is based on traditional theories, up-to-date research and issues of current interest. Academic discussions make up an important part of the learning experience. The final master\'s thesis is a supervised, independent work of research.

Student Assessment:

Continuous student assessment (assignments and oral presentations) and oral and written examinations. The ability to structure complex problems and a scientific approach to problem solving are important assessment criteria.

Contents:

The degree consists of 120 credits, including the 30-credit master\'s thesis. Compulsory courses amount to 50 credits, and include mathematics for economists, microeconomics, econometrics, macroeconomics.

The various specializations additionally include a few compulsory courses in order to ensure the student\'s academic profile.
For the various 300-level courses, required previous knowledge is defined. It is therefore important that students plan their studies well ahead of time, to ensure that they take the courses necessary for higher-level studies.

Student guidance:

Master in Feed Manufacturing Technology

Language of instruction: English.

Credits: 120

For information, contact: Department of Animal and Aquacultural Sciences (IHA), www.umb.no/iha

Admission requirements:

Candidates with academic qualifications at BSc level or similar may apply. Furthermore, applicants must document knowledge in written and spoken English at a level equivalent to the requirements at TOEFL 6.0 or similar, with results approved by the International Student Office of UMB. Applicants must have university level courses with a total of 180 ECT in basic knowledge in biology, chemistry/physics, mathematics and statistics.

Relevance for society:

Feed manufacturing is a significant global industry. The study program offers combined knowledge about feed processing and feed ingredients in relation to the animals\' nutrient requirements, as well as key topics in management of feed industries. The transfer of theoretical knowledge into practical application is emphasized, and facilitated by active use of UMB\'s Centre for Feed Technology as a teaching tool. Different domestic animals, including fish and companion animals have different requirements, both for composition, quality, and processing of the feed, and the program gives a unique introduction to these topics. This combination of topics qualifies candidtaes from the program as leaders both in ingredient and feed industries. The teaching is research based, and the students become skilled in scientific thinking during their education. Many of the candidates also find employment with R&D in feed processing and feed ingredient science, both in academia and industry.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

The study qualifies for relevant leading positions within the feed manufacturing industry. The Master\'s degree also gives possibilities for PhD studies within feed manufacturing technology.

Internationalisation:

Cooperation with other institutions:

The study program is coordinated with Zhejiang Ocean University in China. Lectures and lab. experiments are in cooperation with Centre for Feed Technology, Department of Mathematical Sciences and Technology and Department of Chemistry, Biotechnology and Food Science.

Learning outcomes:

A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: Competence: - High competence within technologies used in modern feed production. - High, research based competence within the interaction between processing and nutritional value of feed, both for monogastric production animals, fish, companion animals, and ruminants. - Competence within quality assurance and management of economy and personnel. Knowledge: - Operation of different technological units in industrial raw material and feed processing. - Interpretation and use of new results from research to develop new feed production concepts. - Experience from processes both for design and optimizing feed production units, as well as planning and conducting experiments in feed technology. Skills: - Practical understanding of both feed ingredients and feed processing. - Practical experience from all types of processing commonly used in industrial production of feed. - Experience in selection of ingredients and processing optimized for different animals, such as monogastric production animals, fish, companion animals and ruminants.

Learning and teaching methods:

The programme applies a wide range of teaching methods, such as laboratory practice, lectures, excursions, independent studies, exercises, seminars and teaching by students.

Student Assessment:

Examinations, individual reports and group work.

Contents:

3 semesters of teaching and a final semester with thesis work of 30 credits. The programme is based on a series of compulsory core subjects (55 credits). Students may complete the remaining 35 credits by choosing other subjects offered at the Norwegian University of Life Sciences (UMB). Total: min. 120 credits.

Student guidance:

Master in International Development Studies

Language of instruction: English.

Credits: 120

For information, contact: Department of International Environment- and Development Studies - Noragric, www.umb.no/noragric

Admission requirements:

Bachelor \'s degree or equivalent education in any field relevant to development studies, economics, political science, biology, teaching, anthropology, resource management, journalism, geography, etc.

Relevance for society:

Global and local problems related to poverty, environment and social conflicts are central challenges for the world\'s population in general, and for policy formulators, development practitioners and academics specifically. The programme offers a broad understanding of social science perspectives of societies, development, and change, as well as more specialised approaches to poverty reduction, conflict avoidance, and sustainable resource management. A problem and process oriented learning approach in the program provide the students with crucial resrouces and instruments in the transformation of knoweldge into plans, projects,

policies and critique. Job opportunities can be found in academia, in government agencies, in national and international development and environmental organizations and in private consultancy agencies.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

Graduates will be eligible to apply for further studies at the Ph.D. level within the field, both nationally and internationally. Noragric offers a Ph.D. programme within Development Studies that is well suited. Students compeleting the program qualify for jobs in government institutions, in national and international development and environmental organizations, and in private consultancy companies.

Internationalisation:

Cooperation with other institutions:

EDS 255: HEalth, the environment and development is taught in collaboration with COMSATS-Pakistan, and mainly by the means of video conference technology. EDS 360: Conflict and development is taught in collaboration with IØR and ILP. The field courses: EDS 384 and EDS 387 are taught in collaboration with SUA - Tanzania and IDS-Jaipur, India.

Possibilities for study abroad:

Most students do thesis research in another country than Norway, and many in countries in the Global South. During the third semester students attend a 15-credit field course for the time being at partner institutions in Tanzania and India. Internships and/or student exchange to partner universities are alternatives to the field course.

Learning outcomes:

After completing this study program the students should have the following competences: Knowledge: Understand the meaning of development, the various approaches and theories related to the dynamics of development, and the critique of these. A specialized insight into a particular area of development, for example poverty, food security or institutions. Knowledge of theories and knowledge of understanding of different concpetions of development, including the disciplinary and interdisciplinary interpretations. Skills: Utilize the competence in planning and carrying out field research, project management and development work, critically assess new academic developments, within the development studies field as well as polivy directions. Carry out interdisciplinary analyses of development issues and evaluate past experience of various policy instruments in collaboration with colleagues from other academic fields. Use various understandings and methods of social relations and drivers of change. Analyse old and new directions within social sciences in understanding poiverty, wealth accumulation, rights evolution and conflict. Evaluate and use primary, secondary and tertiary sources of data. Develop a critical perspective on power relations, ethical issues and conflicts of vallues related to social and environmental processes of change. Contribute to social innovation and propose new solutions to development challenges. General competence: Plan and carry out independent research, develop innovative resarch questions and engage critically and informed in policy formulation and project development. Solve independently theoretical and methodological and project and policy problems. Apply knowledge in new settings such as development, private sector management or teaching. Participate in networks, negotiations and public debates, and be able to collaboarte with people from different cultural backgrounds and academic fields.

Learning and teaching methods:

The overarching approach to learning in the programme is problem-based and process-oriented. This implies that in many of the core courses, the students will be given responsibility for developing assignments, finding information, and deciding on the form of the presentation. Problem-based work will usually take place in a group setting. The development of collaborative and communicative skills is a central topic in the programme, and problem-based learning within groups is an effective means of learning in this context. This type of work will also form the basis for continual evaluation of students. However, most of the courses will not solely rest on problem-based and process-oriented learning, but will include a mixture of teaching and learning methods and approaches. These will include lectures, seminars, tutorials, and individual work. Teaching and learning methods will also vary somewhat according to the specialisation the student is following.

Student Assessment:

Most courses use different evaluation methods. In some, student work is evaluated continuously on a pass/fail basis, while the final grade is determined by a final examination or a semester assignment. Other courses will only have a final examination or a single semester assignment.

Contents:

The programme is normally of two-year duration. The programme consists of relatively few core corses; Introduction to Development Studies, Development Theory and Policy, two methods courses and one field course in Uganda/ Nepal. In addition, the students will combine elective courses according to interests.
All courses given by Noragric are preapproved. It is also possible to take courses at other departments and universities, although such courses must be approved in each case. A 30 or 60 credit master thesis based on individual data collection, is mandatory.
A minimum of 30 course credits must be at 300 level, and maximum 10 credits can be at 100 level. At least 30 credits must be taken at Noragric.

Student guidance:

Master in International Environmental Studies

Language of instruction: English.

Credits: 120

For information, contact: Department of International Environment and Development Studies

Admission requirements:

Bachelor\'s degree or equivalent education in fields relevant to natural and social aspects of environmental studies (e.g., ecology, agriculture, wildlife management, economics, development studies, political science, sociology, geography, social anthropology etc.)

Relevance for society:

All humans depend on the Earth\'s ecosystems and the services they provide, for food production, water supply, a healthy environment, suitable climate, spiritual well-being and aesthetic pleasure. The rate at which people have changed the ecosystems during the last fifty years is by many considered alarming. In this situation a sustainable future will depend not only on our ability to understand the ecosystems, but also on our realisation of how human societies interact with the environment. Thus, sustainable development depends on competent analytical and management capacity both in the public sector and in civil society. To build the capacity needed to ensure long-term ecosystem services, students will explore complex relationships between society and the environment. Graduates are expected to contribute with integrated and innovative solutions to far-reaching problems, fostering action and change to meet socio-economic and bio-physical challenges.

Job opportunities can be found in government agencies, environmental organisations, private consulting companies, and national and international development agencies.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

Graduates are qualified to apply for Ph.D. programmes in the area of environment, development and governance. Students qualify for jobs in government institutions, environmental organizations, private consultancy companies and in national and international development agencies.

Internationalisation:

Cooperation with other institutions:

Elective and recommended courses for the programme are given by six other departments at UMB. Language courses are offered through Østfold University College.

Possibilities for study abroad:

Most students do thesis research in other countries than Norway, and many in countries in the Global South. During the third semester (Aug.-Sep.), students attend a 15-credit field course for the time being at partner institutions in Tanzania and India. Internships and / or student exchange to partner universities are alternatives to the field course.

Learning outcomes:

After completing this study program the students should have the following competences: Knowledge: A common understanding of socio-environmental relations and the drivers of environmental change. A critical ability to analyze complexity. A specialized insight into one of two areas: 1) resource rights and governance, or 2) food security, transformation of agriculture and climate change. Demonstrate knowlegde of theories and knowledge of understanding concerning environmental change. Skills: Utilise their competence in planning and carrying out of field research, project management and development work. Critically assess new academic developments within the environmental studies field as well as policy directions. Carry out interdisciplinary analyses of environmental change and evaluate solutions related to socio-environmental relations in collaboration with colleagues from other academic fields. Use various understandings and methods of socio-environmental relations and drivers of change in fieldwork. Analyse new directions within social and natural sciences in understanding climate change, biodiversity loss and environmental degradation. Evaluate and use primary, secondary and tertiart sources of data in the elaboration of papers and specific arguments and with correct use of references. Develop a critical perspective on power relations, ethical issues and conflicts of values related to environmental change. General competence: Plan and carry out independent research, develop innovative research questions and engage critically and informed in policy formulation and project development. Solve theoretical and methodological and project/policy problems independently. Apply insights and knowlegde in new settings, such as development or environment management, teaching or business. Engage in public debates, in media, in voluntary organizations, community meetings, popular dissemination and in meetings with policy makers. Contribute to dveloping solutions for environmental problems by bringing out strategic development and insitutional issues, project collaboration and create and lead networks and centres. Building reserarch teams and inter-personal communication cross cultures and across academic fields.

Learning and teaching methods:

Teaching methods in the IES programme include lectures, problem-based learning, Internet-supported teaching, group work, fieldwork and seminars. Inreased emphasis is placed on communication skills and ability to search for and evaluate information. Seminars allow students to develop skills in analysing, applying and presenting ideas. Student interaction for constructive critisism and praise is considered important for preparing them for effective, cross-cultural work situations. Case studies given by guest lecturers and study of current research articles provide an up-to-date learning environment.

Student Assessment:

Courses are evaluated through various combinations of final examinations, term papers, and oral presentations.

Contents:

The master programme is a two-year, full-time programme of study consisting of basis of mandatory courses; An intro core course (10), and research methods course (15) and a field course (15). The students choose one of two specializations which consists of mandatory courses (20), approved elective courses (0 or 30) and a master thesis (30 or 60). Basis: EDS 303: Introduction to international environmental studies, EDS 312: Research methods, EDS 384/387 field courses in India and Tanzania. Specializations: Option 1: EDS 346: National environmental governance, EDS 347: International environmental governance, EDS 304: Political economy - institutions and the environment + electives. Option 2: EDS 355: Climate change and development, new course on food securtiy + electives.

A minimum of 30 course credits must be at 300 level, and a minimum of 30 course credits must be taken at Noragric. Maximum 10 credits can be at 100 level. Apart from the above requirements, the study programme is open concerning choice of courses at Noragric. Courses taken at other departments and universities require approval. Two study paths within the programme with focus on environmental policy or sustainable land use are timetable secured.Students are encouraged to participate in relevant professional fora/seminars elsewhere. Noragric has a tradition of supporting social activities that can also be of professional interest/relevance.

Student guidance:

Master in International Relations

Language of instruction: English.

Credits: 120

For information, contact: Department of International Environment and Development Studies http://www.umb.no/noragric

Admission requirements:

A bachelor degree or equivalent qualification in political science, development studies, the social sciences, theology, humanities, strategic studies, law. The bachelor must contain an introduction course in methods for social sciences, or other equivalent qualifications.

Relevance for society:

Entering the twenty-first century, the world has been confronted with a new set of international relations challenges, notably globalization, poverty, environment and climate change. A master degree in International Relations will prepare students for the new global reality by providing an understanding of how ideology, culture, environment, power balance, religion, war and conflict influence international interactions between states, people and persons.Job opportunities can be found in academia, in government agencies, in national and international organizations, and in private consultancy agencies.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

Graduates will be qualified for positions in public and private institutions where international cooperation is important, such as international environmental negotiations, climate agreements, carbon trading, resource management, etc. Graduates may qualify for PhD programmes in development studies, environmental studies and political science.

Internationalisation:

Cooperation with other institutions:

The programme is offered jointly with the Norwegian Institute for Foreign Affairs (NUPI). NUPI is a leading institutions in Norway with a high international reputation. In addition to the Noragric/NUPI courses, students may choose courses at the Department of Economics and Resource Management.

Possibilities for study abroad:

UMB has exchange agreements with several universities abroad. There are ample opportunities to do parts of the studies abroad, both at universities with which UMB has agreements and other universities/institutions. Some of these institutions, such as University of British Colombia, Stanford, and Aberystwyth, are considered world class in international relations.

Learning outcomes:

After graduation, the candidates are expected to have the following qualifications: Knowledge: An indepth insight into the major approaches to international relation theory, including four major approaches, Realism, Marxism, Constructivism and Liberalism, and understand the factors stipulated in these approaches as drivers of foreign policy making and international interaction. A good understanding of the diversity and overlaps within these major approaches, and the weaknesses of using such macro approaches. A good understanding of the differences between individual scholars within the different approaches. Skills: Apply theory on current issues within international relations. Develop an independent research project. Demonstrate the ability to independently analyze, and to apply research methods to analyze a topic within International Relations. Evaluate and use primary, secondary and tertiary sources of data as a basis for the elaboration of term papers with coherent and balanced arguments and with correct use of references. Understand the contextual factors in theory generation as well as in cases. Develop, plan and carry out an independent research project applying relevant methods in IR. Analyze ethical issues in the use of relevant research methods and be able to account for power relations and value and interest conflicts and the researcher\'s position in relation to a research field. Contribute to discussions feeding into research and produce an innovative master thesis. General competence: Plan and carry out independent research, develop innovative research questions, engage critically and informed in policy formulation and project development. Solve theoretical and methodological and pproject and policy problems independently. To have experience with practical international interaction through participation in multi-national classes and by exchange with other educational institutions. Present empiric work and academic readings in written and orally, and write and present orally a master thesis. Engage in publid debates in media, in voluntary organizations, civil society and community meetings, popular dissemination, and in meetings with policy makers. COntribute to developing solutions for environmental problems by bringing out strategic development and institutional issues, project collaboration and lead networks and centers. Build reserach teams and inter-personal communication cross academic fields and cultural backgrounds.

Learning and teaching methods:

In addition to regular lectures and guest lectures, emphasis is put on problem-based teaching, group- and project teaching, individual work, seminars and field trips.

Student Assessment:

Methods of evaluation are varied and may consist of written or oral exams, evaluation of term papers, student presentations and reporting from various activities.

Contents:

The programme is a two-year, full-time study consisting of a basis of mandatory courses; an introduction course (5), a core course in IR-theory (15), a method course (15) and a 30 or 60 ECTS master thesis. In addition the students can choose from 9 different elective courses offered in the program. All courses given by Noragric are preapproved. It is also possible to take courses at other departments and universities, although such courses must be approved in each case. It is possible to integrate internship, exchange or field course as components in the study program.

A minimum of 30 course credits must be at 300 level, and a minimum of 30 course credits must be taken at Noragric. Maximum 10 credits can be at 100 level. Apart from the above requirements, the study programme is open concerning choice of courses at Noragric. Courses taken at other departments and universities require approval.

Student guidance:

Master in Microbiology

Language of instruction: English.

Credits: 120

For information, contact: Department of Chemistry, Biotechnology and Food Science (IKBM), www.umb.no/ikbm

Admission requirements:

Bachelor\'s degree in Biotechnology or equivalent that satisfies the requirements for specialisation. Students who lack some Bachelor-level courses at the 200 level, must arrange for a transition agreement with the study coordinator. To be admitted into this program, the average grade must be C (ECTS) or better in the BSc degree. In BSc degrees with a more practical approach, the average grade must be B (ECTS) or better.

Relevance for society:

Microorganisms represent an extremely large biological diversity that has great significance for the daily life of humans. Some bacteria make us sick, while others help to protect us and the food we eat. Many microorganisms have characteristics that are utilised by different industrial processes and within medicine and health. Use of microorganisms to solve different environmental problems is increasing. Examples of this are the decomposition of pollutants in nature, biological filtering processes and biological control of plant diseases. Microorganisms have an important role in the production of better, healthier and safer food and fodder. The study programme gives fundamental knowledge of microbiology, microbial genetics, systematics, physiology and metabolism and the role of microorganisms in different ecosystems. Since microorganisms are important in a number of different fields, a Master degree in microbiology will provide opportunities for an exciting career within many different professions, e.g. in research and developement, education, biocontrol and analyses.

Degree awarded: Master

The degree qualifies students for (further studies / jobs):

Graduates with a Master\'s degree in microbiology can work with quality control, hygiene, research, councelling and teaching. The study programme qualifies graduates for Ph.D. studies.

Internationalisation:

Cooperation with other institutions:

This Master\'s programme includes courses from other departments at UMB.

Possibilities for study abroad:

There are good opportunities to take parts of the study abroad at selected universities within a normal study period. A study period abroad can be organised with the help of the study advisor and/or the thesis advisor. A summer course in Arctic microbiology at the Svalbard University Center, is recommended.

Learning outcomes:

A candidate who has completed this education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: COMPETENCE: - Have an objective understanding of the scientific literature and can present both oral and written presentations of scientific topics and results. - Can reflect on important ethical and scientific challenges in relation to their own and others\' work. - Can contribute to innovation and innovation processes in the field and neighboring fields. - Have thorough training in working independently, through five years of theoretical studies of chemical, biological and molecular biological literature, through practical laboratory exercises in most subjects and through a master thesis. The master thesis is an independent, limited research project, carried out under the supervision, and in accordance with applicable ethical standards. - Can apply their knowledge and skills in new areas, to carry out advanced tasks and projects. - Can communicate and work professionally in an international study or work context. The program has only English literature, and the candidate reads international research literature throughout the study. - Can carry out an independent and defined research and development (R

Learning and teaching methods:

The theoretical teaching is given in the form of lectures, seminars/study groups, teacher-supported independent study or advanced laboratory courses. Students will gain experience in reading and understanding scientific literature. The main part of the study is an experimental assignment of 60 or 30 credits (ECTS), which is an independent research work with supervision. A 60-credit (ECTS) thesis is normally recommended.

Student Assessment:

The competence of students is evaluated during the study and in final exams. There is emphasis on testing the understanding and use of acquired knowledge, as well as on the development of independent work skills during the Master\'s thesis work.

Contents:

The course Experimental molecular microbiology (10 credits, (ECTS)) is compulsary for all students in this programme. In addition, students must choose at least one of the following courses: Mycology (10 credits (ECTS)), Environmental microbiology (10 credits (ECTS)) or Pathogenic microorganisms (10 credits (ECTS)). In addition, one may choose between additional courses in microscopy and molecular, biochemical and chemical methods at the bachelor- or master-level. A study plan with good progression and developement towards the master thesis will be presented for the students. Basic courses will generally not be approved in this master study. A minimum of 30 credits (ECTS) of the courses must be at the master-level; a maximum of 30 credits (ECTS) can be at the upper-bachelor-level.

Student guidance:

Master in Radioecology

Language of instruction: English.

Credits: 120

For information, contact: Department of Plant- and Environmental Sciences

Admission requirements:

You can find general information on admission to UMB here: http://www.umb.no/study-options/article/admission Bachelor\'s degree (average of C or higher) or equivalent education in any field relevant to the environment (e.g. chemistry, ecology, biology, environmental sciences etc.), including background in inorganic chemistry. Applicants must demonstrate English language ability in accordance with the Admission regulations at University of Life Sciences (UMB), Chapter 5.

Relevance for society:

Strengthening competence within the nuclear field is consistent with the EU aim to produce an educated workforce that is able to meet future economic and social needs. Radiological protection of the environment, including man, has also become a matter of significant public concern. It follows that the establishment of public confidence in nuclear technologies will depend upon the availability of well-educated personnel and independent experts / advisors within the fields of radiochemistry, radioecology and radiation protection. 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 capacity. As recently stated by several EU politicians and experts, there are increasing pressures to build new nuclear power stations in many EU member nations. This pressure comes from the need to meet Kyoto greenhouse gas emission targets at a time when many currently installed, CO2-clean nuclear power stations are coming to the end of their useful lives. They also come from the decreasing stocks of domestic fossil fuels, with an increasing reliance upon politically unstable nations for the provision of oil and gas and from the increasing prices of domestic and imported fuels. Finally, the pressures are facilitated by new improved reactor systems that are being developed in Europe and the USA, giving a hope for a new age of nuclear energy for countries that don\'t have other alternatives. Therefore, the need for nuclear competence is probably greater now than was earlier anticipated. 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 courses will provide the students with permission to use open, ionising radiation sources in their future work.

Degree awarded: Master

Other qualifications or certification:

The students will learn how to use open, ionising radiation sources.

The degree qualifies students for (further studies / jobs):

Students will have an understanding of the properties of radionuclides and emitted ionising radiation, use of radioactive tracers and simple measurement methods as well as radiation protection. The programme prepares students for a wide range of positions related to the nuclear energy industry and authorities responsible for the national legislation e.g., within government, service, development projects, nuclear energy industry, technical support and consultancy, management of natural radioactive resources, environmental protection, research, and education.

Internationalisation:

Cooperation with other institutions:

The course modules will be held at UMB and at collaborating European universities. Course modules will be presented by highly competent Norwegian and European teacher within the different fields of study, and in close cooperation with other European Universities.

Possibilities for study abroad:

Two of the course modules might be held in France, and therefore, the students must be prepaired for a stay of some months in France.

Learning outcomes:

A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: Competence: - Is able to communicate and cooperate with scientists working on other subjects. - Has insight in ethics and risk connected to use of radioactive sources. - Is able to use scientific papers with a critical realization. Knowledge: - Understands the transport and spreading of radioactive substances in various ecosystems. - Understands the basis for assessing environmental impact and risks. - Is able to assess environmental impact and risks from radioactive contamination. - Is able to evaluate alternative countermeasures and clean-up strategies. Skills: - Is able to contribute to national preparedness associated with nuclear accidents and contamination of different ecosystems. - Is able to conduct radioecological studies using tracer techniques, radiochemical separation techniques and advanced measurement methods. - Is able to conduct experimental radioecological studies.

Learning and teaching methods:

In a diverse learning process, you will gain knowledge about radiochemistry, the nuclear industry and waste management, project management and research methods, the behaviour of radionuclides in the environment, together with risk assessment and management. The learning will take place as lectures, intensive courses, laboratory work, group work, real-life case studies with interdisciplinary approach, and through reflection on links between real-life situations and theory.

Student Assessment:

Courses with a large amount of practical field and laboratory exercises will to a certain degree have continuous evaluation (field reports, laboratory journals, etc.) both in groups and individually. Semester assignments (with continuous evaluation) are given in many courses, and represent part of the grade. Many of the courses will have a final exam (written). The Master#s thesis will be evaluated, and a final grade will be given after an oral discussion.

Contents:

In a diverse learning process, you will gain knowledge about radiochemistry, the nuclear industry and waste management, project management and research methods, the behaviour of radionuclides in the environment, together with impact and risk assessment and countermeasures. The learning will take place as lectures, intensive courses, laboratory work, group work, real-life case studies with interdisciplinary approach, and through reflection on links between real-life situations and theory. Study program structure: The study consists of two years of academic work. The master programme is developed using the framework provided by the Bologna Convention and will be taught within a network of collaborating universities. The degree comprises three basic modules (2 x 10 ECTS credits), three specialist modules (2 x 10 ECTS credits) and a research project (1 x 60 ECTS credits). 15 ECTS are eligable. .

Chemistry from bachelor level

Student guidance:

AOS233 Strategic Processes and Decision-Making

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: This interdisciplinary course focuses on a class of problems called \'wicked problems\' or \'messes.\' Evidence of wicked problems comes from experts in many areas

AOS332 Strategy Dynamics

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The course gives an introduction to system dynamics as a language and a methodology for analyzing and understanding organizations business policies and strategies. This is accomplished by presenting the effects of the cognitive dimension on strategic business activities. This leads to the development of a conceptual structure for understanding organizations as complex systems. This perspective gives strategic decision makers a powerful methodology for both analyzing and communicating the long-term consequences of their strategic planning activities.

APL405 Framing the PhD

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: By demand
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.

APL406 Academic Writing

Credits: 5 **Language:** English upon request
Start term: January block
Terms: By demand
Learning outcomes: The course will enhance the awareness of writing as a thinking tool. The course will have a practical approach to enable you to reach out with you message and beeing understood. You will get to know the structure of a scientific publication, either as an article or a monograph. You will also know main principles of rethorics and argumentation. You will gain practical experiences in writing in different styles, to give feedback to work made by ohters and to present your work orally.

AQB200 General Breeding

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel January block
Learning outcomes: Engelsk:Students should be able to analyse the effect of different approaches to breeding (in pure- and cross-breeding) and possess sufficient knowledge to continue studies in the subject area.

AQB270 Aquaculture Breeding and Genetics

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Students are to acquire sound knowledge in the use of traditional and modern fish breeding methods, as well as some major aquaculture breeding programmes. The students are to gain skills in the evaluation of various breeding strategies.

AQF200 Primary production -Aquaculture and Fisheries

Credits: 7 **Language:** English
Start term: August block
Terms: August block Autumn parallel
Learning outcomes: The requirement for fish and seafood in the word is increasing. This can either be harvest from the sea, traditionally fishery or it can be produces trough aquaculture. These are complex systems and productions that may interfere to each other and on to the surrounding environment. The overall aim with the course is to give the students the necessary basic information about fishery and aquaculture. This should be set in overall view so the students are able to critically evaluate the factors which are important for a sustainable growth in the industry. A student who has met the objectives of the course will be able to: - discuss advantages and disadvantages with the two aquatic food primary production systems, fishery and aquaculture - discuss important factors for performing a sustainable fishery and a sustainable aquaculture

AQF210 Aquatic Food Processing and Technology

Credits: 8 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: A student who has met the objectives of the course will be able to: give an overview of the muscle structure and biochemistry of fish as well as the most common storage and processing methods used on fish and fish products, and be able to discuss how different processing and storage parameters will influence the product quality and the shelf life.

AQF220 Safety and Human Health Effects of Aquatic Food

Credits: 8 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: A student who has met the objectives of the course will be able to: - Describe basic concepts of aquatic food risk analysis. - Apply the HACCP system for safety management of

aquatic food. - Describe human health benefits of aquatic food consumption. - Evaluate and compare risks and human health benefits of aquatic food consumption. - Explain human health benefits of specific functional aquatic food components. - Analyse data from database about aquatic food-borne diseases outbreaks - Review and analyse data in a synthetic report - Critically analyse \'hot topics \'related to safety and health of aquatic foods

AQF230 Aquatic Food Supply Chain Management, Environment and Resources

Credits: 8 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: A student who has met the objectives of the course will be able to: - describe basic and advanced ideas, theories and concepts of sustainable development. -compose, organize and present sustainability indicators. - explain, evaluate and apply common methods used in environmental and resource analysis as it relates to sustainable development. Can present interpret, analyze and explain results. - critically synthesize literature, and formulate practical and theoretical solutions to environment and resource issues as they relate to sustainable development. - describe the processes, functions, flows and players in a logistics system, the supply chain objectives and performance indicators. - describe and analyse the environmental issues related to transportation and logistics - apply the SCOR model for processes, functions, and flow descriptions in a logistics system. - describe SCM (supply chain management) issues that are important such as collaboration, use of information technology and information systems, and more

AQN251 General Aquaculture - Nutrition

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The aim of the course is to provide students with a basic understanding of coldwater and warmwater fish nutrition. 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 feeding of farmed fish.

AQN350 Aquaculture Nutrition

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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 todays and tomorrow\'s aquaculture industry from a feed management perspective. In addition the students will gain practical experience from nutritional studies with fish.

AQP350 Planning and Design of Intensive Fish Farms

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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.

AQQ253 Product Quality in Aquaculture

Credits: 5 **Language:** English
Start term: June block
Terms: June block
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.

AQT250 Laboratory Course in International Aquaculture

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
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.

AQT254 Basic Aquaculture Engineering

Credits: 5 **Language:** English
Start term: January block
Terms: January block
Learning outcomes: The aim of the course is to give the student basic knowledge on technical equipment, methods and systems that are nessessary for aquaculture production.

AQX251 General Aquaculature - Animal Welfare and Health in Farmed Fish

Credits: 10 **Language:** English
Start term: August block
Terms: August block Autumn parallel June block

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.

AQX350 Aquaculture, Special Course

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students will acquire an interdisciplinary understanding and technical independence in the area of aquaculture.

BIN300 Statistical Genomics

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: KNOWLEDGE: Students will be able to explain: The optimal algorithms for pairwise alignments, and the scoring models. The principles behind the heuristic algorithms for mutliple alignments and the commonly used evolutionary models in phylogenetic analyses.

How sequences can be described by probabilistic models like profiles, ordinary Markov models and hidden Markov models, train such models from data and use them for sequence classification. Simpler linear models and multivariate methods for analyzing gene ekspression data. SKILLS: Students will be able to: Apply elements from the topics above to solve a project assignment in the course. Implementing the algorithms in R and use this scripting language for effective processing of large data sets. Present material in a written report and orally.

BIN350 Genome Analysis, Methodology

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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 cases.

BIO223 Population Genetics and Molecular Ecology

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The students shall understand the theoretical foundation for population genetics and how evolutionary forces are shaping the genetic variation within and between populations. An important goal is to understand the properties of molecular markers, what kind of information they give and how they can be applied in evolutionary and ecological studies. The course shall give the students generic knowledge applicable in studies of all kinds of organisms. Molecular ecology seeks to understand adaptation and changes in populations from a molecular perspective by linking variation at the DNA level with phenotypic observations. Through practical training the students will learn how large amounts of next-generation DNA sequencing data are analyzed and used to enhance our understanding of adaptation in natural populations (ecogenomics) and genotype-phenotype associations (breeding populations). The course will provide the students

with solid theoretical and conceptual knowledge as a background for attending master courses in population genetics and evolution, molecular genome analyses, bioinformatics, plant breeding, animal breeding and nature management.

BIO244 Plant Biotechnology: Cell- and Tissue Culture and Genetic Modifications

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
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: Celle- and tissue culture: In vitro propagation through adventitious and axillary propagation (different tissues), chimeras and their importance in propagation, somatic embryogenesis, double haploids, gene modifications, gene expression. Through lectures only: disease elimination through meristem cultures,Genetically modified crops: Current and potential role in plant production, potential and limitations of different types of transgenes, laws and regulations in Norway (and EU) related to genetically modified (GM)crops.

BIO246 Thematic Essay in Plant Biotechnology/Plant Breeding

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The students are supposed to find litterature on a chosen topic, choose the most relevant, read through and write an essay in their own words compiling a synopsis of what they have read while using the references in a correct manner. This eassy is what forms the basis for the evaluation of the course by the teacher and the external examiner. At the end of the course, the

students will present their work orally. This is for training purposes and to educate the other students on the theme chosen, and will not be part of the evaluation to mark the course.

BIO300 Microscopy Techniques

Credits: 10 **Language:** English upon request
Start term: January block
Terms: January block Spring parallel
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 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) Ultramicrotrome for cutting in LM and TEM. 2) Cryostate for cutting in LM and SEM. 3) Coating-units (Sputter coater) in SEM. 4) Critical point drying (CPD) in SEM. C) Using a selection of methods in connection with sample treatment, colouring/marking and simple image treatment (will vary somewhat from one year to the next).

BIO301 Advanced Cell Biology

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: After completing the course, students should have a thorough understanding of molecular mechanisms of eukaryotic 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
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
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: 5 **Language:** English
Start term: January block
Terms: January block
Learning outcomes: The students shall understand the evolutionary genetics of host-pathogen interactions and involves an understanding of the genetics of both host and pathogens.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 how plant protection strategies based on resistance can be made stable and sustainable.

BIO324 Adaptation of Plants to Climate

Credits: 10 **Language:** English upon request
Start term: Spring parallel

Terms: Spring parallel
Learning outcomes: The course will provide broad knowledge on how plants respond and adapt to climate and other environmental conditions. This includes acclimation (how plants perceive seasonal and other environmental cues and adapt phenotypically) and adaptation in the longer time scales of evolution and breeding. The obtained knowledge will enable students to better understand which effects climatic change may have on natural and man-made ecosystems and global and regional food production, and how we may approach problems and possibilities related to plants and climatic change.

BIO330 Environmental Microbiology

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
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
Start term: January block
Terms: January block Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The students will get an overview over basic fungal systematics, -genetics, -physiology and -ecology. Students will acquire knowledge of industrial uses of fungi, and their applications in the biological control of plant diseases. The students will 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. The course includes laboratory excercises and a written term paper.

BIO350 In Situ RNA Hybridisation Techniques

Credits: 5 **Language:** English upon request
Start term: January block
Terms: January block
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 Geneticallly Modified Plants - Case Study

Credits: 5 **Language:** English upon request
Start term: Autumn parallel

Terms: Autumn parallel
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
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel

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
Start term: January block
Terms: January block
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
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The course provides knowledge and understanding of plant structure and function. The course also provides insight into the responses of plants to environmental and climatic conditions and how these interact with the metabolism and mechanisms of plant growth regulation. The students will get experience in the conduction of practical experiments as well as presentation and discussion of experimental results. The course will provide training in application of methods and terminology of the field as well as cooperation in groups.

BOT201 Physiology of Plant Production

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Knowledge of how crop and leys plants respond to environmental factors through fundamental physiological processes as photosynthesis, respiration, water balance, changes in morphology and phenological development. Training in integrating this knowledge in order to understand crops growth rhythm, yield, yield index and interaction with other plants. Dynamic growth models will be used as a mean to achieve this integration. Knowledge about how to evaluate the models\' performance. Experience about models strength and pitfalls, and of how models can be used to estimate impacts of climate changes and of nitrogen supply. Experience in the quantification of growth processes at field scale, for example with genotypes of varying earliness. The course will also give some experience in the use of simple regression analysis

BOT230 Plant Ecology and Diversity

Credits: 10 **Language:** English upon request
Start term: August block
Terms: August block Autumn parallel
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 and diversity of plant communities. A substantial part of the course takes place in the field and gives students good insight into the integration between ecological theory and field methodology. During the autumn parallel the focus will be on ecologic theory and plant diversity. Different approaches to the study of plant diversity will be presented, e.g. DNA-based methods, cladistics and morphometrics. 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.

BOT240 Plant Ecophysiology

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The course will give an introduction to the physiological adaptation of plants growing in different places and climates to climatic, eudafic and biotic environmental factors.
The main aim is for students to achieve a good understanding of how these environmental factors influence basic processes such as the photosynthesis, water balance and mineral nutrients of plants. The knowledge will then be used to explain ecological problems such as the distribution, production, survival, rest and growth rhythm of plants, as well as the interaction between plants and between plants and other organisms.

BOT320 Advanced Course in Plant Developmental Physiology

Credits: 15 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
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.

BUS305 Strategy Analysis and Strategy Development

Credits: 5 **Language:** English
Start term: August block
Terms: August block
Learning outcomes: By presenting and discussing theories/ perspectives applied in strategic management and by analysing strategic action in various industry contexts, the students will develop an understanding of why some firms succeed in competition and others do not. The students will understand how different theories complement and contradict each other, and deepen their knowledge of factors that influence firm strategy as well as the antecedents and consequences of various strategic choices. The course will strengthen the skills in using different methods in the analysis of external and internal environment and in choosing the appropriate strategies. The students will see the uncertainty and trade-offs that management must deal with in strategic decision making.

BUS311 Environmental Accounting and Management

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
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.

BUS320 Empirical Analyses of Financial and Commodity Markets II

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
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: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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 Natural Resource Economics

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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,valuation of environmental resources and accounting for the environment, and international environmental agreements.

ECN271 Cost Benefit Project Evaluation and Environmental Valuation

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel

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
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: August block
Terms: August block
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
Start term: Autumn parallel
Terms: Autumn parallel

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 an experience with their application.

ECN304 Behavioral and Experimental Economics

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Get an overview of important lessons in behavioral economics including recent contributions in the literature, an overview of research methods in experimental behavioral economics including laboratory and field experiments

ECN305 Research Methods in Economics

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: In this course, students should be able to find and present a researchable topic within 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 hypotheses; - identify relevant data sources; either existing data siurces or through a plan to collect their own data; and understand the methods used to compile and analyse the data.

ECN311 Microeconomics III

Credits: 10 **Language:** English
Start term: Autumn parallel

Terms: Autumn parallel
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
Start term: January block
Terms: January block
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
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel

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
Start term: August block
Terms: August block
Learning outcomes: The course is designed to complete the students\'s 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 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 marekts, 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 Natural Resource Economics

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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.

ECN352 Poverty

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The aim of this course is to introduce students to the multi-dimensional study of poverty, thereby acquiring a thorough understanding of key debates and controversies. The course is designed to provide students with the practical and analytic skills needed to undertake research on poverty as part of their Master theses, or later employment.

ECN355 Research in Development Economics II

Credits: 5 **Language:** English
Start term: August block
Terms: By demand
Learning outcomes: In this course, students will generate an original data set on which their Master \'s thesis can be based. The data collection process will be described and analysed.

ECN371 Environmental Economics

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
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 Economics

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The course gives the students theoretical insights into environmental economics and game theory, and learn them how to apply this to international climate negotiations and design of national climate policies. The aim is to show how economic methods may provide insights into the current climate debate, and to assess different policy options. Although the combination of theory and application is focused on the climate issues, the methodological part of the course will also be useful for other environmental issues.

ECN380 Energy Markets and Regulation

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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

Start term: Autumn parallel
Terms: Autumn parallel January block
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.

ECOL110 Tropical Ecology and Biology

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Spring parallel
Terms: Spring parallel
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 evaulate 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.

ECOL210 Ecology and Natural Resource Management in the Tropics

Credits: 10 **Language:** English
Start term: August block
Terms: August block Autumn parallel
Learning outcomes: Natural resource management in the tropics is very challenging. Often, solutions are not obvious. We travel 6.000 km through some of the finest parts of East Africa and study both ecology/nature, but also study the challenges in protecting biodiversity and at the same time improve livelihoods. There will be field lectures and presentations both of the responsible teachers as well as local experts every place we go. We emphasise maximum time in the field. The students will get a better understanding of problems related to natural resource management in the tropics. They will also get a good impression of the incredible biodiversity in nature in Africa.

ECOL300 Methods in Natural Sciences

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
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. 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 basic 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
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: January block
Terms: January block Spring parallel
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.

ECOL330 Tropical Rainforest Ecology and Conservation

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: This course provides students with a detailed understanding of the ecology and conservation of tropical rainforests. The students should learn to identify unique animal and plant characteristics of rainforests from each continent and appreciate the complexity of rainforest

ecosystems. The course will further provide insights to current conservation action and future scenarios, particularly related to human impacts.

ECOL350 Restoration Ecology

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: Spring parallel
Terms: Spring parallel
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.

EDS102 Introduction to Development Thinking

Credits: 15 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students will be given a comprehensive introduction to development thinking, through a focus on basic social science concepts, development theory and the history of development, and the roots and developments of \'sustainable development\'.

EDS201 Introduction to Development Studies

Credits: 5 **Language:** English
Start term: August block
Terms: August block
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 Fronter. 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.

EDS202 Introduction to Environmental Studies

Credits: 5 **Language:** English
Start term: August block
Terms: August block
Learning outcomes: The students will have an understanding of the structure and progression of the programme. They will be familiar with and appreciate their fellow students\' position for environmental analysis. They will know options and challenges regarding interdisciplinary environmental studies. Furthermore, the students will have basic knowledge about ecology, global environmental challenges and see the needs to seek solutions including ecological, social and economic factors.

EDS203 Introduction to International Relations

Credits: 5 **Language:** English
Start term: August block
Terms: August block
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.

EDS230 Development Politics

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The objectives of the course is to i) introduce students to critical perspectives on development thinking and practices, drawing on anthropological and social theory, ii) to familiarise students with institutions and actors within the aid industry and the different stances on the merits of aid and iii) to engage students in thinking about current perspectives on development and changing constellations of power in a multipolar world. At the end of the course, students should be well versed in development ideas and critiques of practice, as well as the main trends and actors in the aid industry. Students should be able to critically reflect upon and argue relevant points relating to development theories, practices and politics.

EDS234 Environmental Economics - the Role of Institutions

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: This course covers the theoretical part of EDS304. 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.

EDS250 Agriculture and Development

Credits: 10 **Language:** English

Start term: Spring parallel
Terms: Spring parallel
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
Start term: Spring parallel
Terms: Spring parallel
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 sanitiation) 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 particlar problems and to explain their weighed decision for using a particular approach.

EDS260 Global Environmental Changes

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Be able to describe the major global environmental challenges. Understand the Anthropogenic influences in earth system, and global change including ecosystem processes relating to climate change, land degradation, emission of greenhouse gases and their individual as well as aggregated impacts. Understand the key issues related to major global change at various context

covering climate change, land degradation, soil and carbon sequestration, biological diversity, global food production, Be familiar with life cycle assessment, pathways for agriculture production , relevant international conventions and agreements. Be familiar with prospects of sustainable future with emphasis on agriculture adoption and mitigation options, policy interventions in providing adoption and mitigation options to address global change issues.

EDS275 Writing Seminar

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Learning outcomes: The objective is to help undergraduate students develop writing skills for term papers.

EDS303 Introduction to International Environmental Studies

Credits: 10 **Language:** English
Start term: August block
Terms: August block Autumn parallel
Learning outcomes: The core course is designed to give students a general overview of different ways that environmental change can be understood. It will furthermore instruct students to recognize the critical difference between these approaches (including the implications of choosing a particular empirical and theoretical perspective for understanding the challenges of environmental change). The new core course should cover the main theoretical directions in the field of environmental studies, and ensure that students are able to understand and explain the complex nature of society-nature relationships. By the end of the course students should be familiar with the key concepts used in the field of international environmental studies. Students should also be able to apply different methods and theoretical approaches to practical cases of environmental change.

EDS304 Political Economy - Institutions and the Environment

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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.

EDS305 Development Theory and Policy

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The course gives an introduction to Development Studies as an interdisciplinary and problem oriented study of social, political, economic and environmental dimensions of societal change. The emphasis is on development theory and policy, which is linked to practice through case studies. The course goals are: 1: To give knowledge about major approaches in Development Studies and strengthen skills using theories and concepts in critical discussion and analysis of development policy issues. 2: To develop skills in: working in interdisciplinary teams; searching, managing and sharing information; presenting and debating themes in development policy; writing as a means of learning, reflection and communication in an international setting. 3: To develop awareness of values and normative approaches in development including considering cultural diversity and human rights.

EDS315 Management of Genetic Resources: Law and Policy

Credits: 5 **Language:** English
Start term: June block
Terms: June block
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
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Spring parallel
Terms: Spring parallel
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.

EDS346 The Politics and Governance of the Environment

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: ---Students shall acquire deeper insights into the theories of environmental governance and resource regimes. The course makes explicit and critical use of theoretical approaches drawn from anthropology, economics, political science, political economy and political ecology. ---Students shall develop the capacity to undertake interdisciplinary analyses and obtain higher level understanding of the ways in which social, resource and ecosystem dynamics and complexities influence the way different governance structures work. They shall moreover acquire the skills to study various management strategies for the use and maintenance of various environmental resources. ---Students shall acquire the capacity to use theory to study concrete cases concerning environmental governance at the national and local level. These cases are furthermore studied within the context of international agreements, national policies and local politics. In relation to this, the inter-relationship between state and civil society is emphasized. ---Following the course students will be able to evaluate strengths and weaknesses of existing governance structures, and develop and evaluate ideas for alternative solutions. ---Students will learn to connect theoretical perspectives and approaches to practical political issues, and through analysis suggest political solutions where efficiency, legitimacy and political viability are considered important criteria. The course emphasizes a tools approach to environmental governance where critical awareness is built regarding the possibilities and limitations of a series of standard approaches and methodologies for resource governance. ---Students develop their skills in critical thinking, in understanding both own and other people\'s attitudes, values and norms and develop a self-reflection around both scientific and interpersonal relationships.

EDS347 International Environmental Governance

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel

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.

EDS350 Ecology and Society

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The Ecology and society is a revised course (previously called EDS 350 Dry land Resource Systems and Management), which has been broadened and made highly relevant for students taking Master in International Environmental Studies (M-IES). The course provides an important bridging to other courses offered under the program. The ecology and society course presents students with knowledge of the fundamentals of ecology and their application by human societies. The course by blending biological ecology, with social science and environmental history approaches, provides a better understanding of the relationships between ecology, environment and social changes. The course further examines relations between human needs and environmental stressors. It examines resource diversity, uses and human adaptations to environmental changes at global and local scales. It covers both natural and human made ecosystems. Knowledge of cultural landscapes and human environmental impacts uses the tool of environmental history to

understand how human societies through time adapted to the changing environment. The course would specifically examine changes in human cultural environments using human environmental memory. An aspect of this learning will be the role played by climatology in driving ecological and social systems through time. Environmental desiccation and land degradation processes will be examined from historical and contemporary perspectives. Understanding ecology and environmental relations in the drylands will be related to history of water and the cultures of water management. In this relation, the course will examine human adaptations in the dry lands, considering ecology of degradation and societies’ responses using site and geographically specific case studies. These backgrounds will draw on lessons on continuities and collapses in human civilizations using case studies. Changes in landscapes would be examined from ecological and social perspectives. These will be related to historical relations between cultures and environments, taking global and local deforestation perspectives. At local scales, the course deals with natural ecosystems, human and ecological services, fragmentations, ecosystem restoration and consequences for human and natural systems. The course will guide students to focus on risk management in vulnerable environments. The ecology of indigenous knowledge of natural environments provides local perspectives of the management of human landscape systems. The course will further examine livestock systems from global and regional perspectives-Case studies on rural-urban livestock systems will be presented. Finally, the ecology and society course provides students with a solid anchor of theoretical and practical knowledge of global environmental and social change as mechanisms of adaptation. Objectives a) To help students to synthesize knowledge, understand processes, relations and impacts using global, regional and local case studies; b) the teaching will develop solid knowledge of history of ecology and social change and; c) in depth knowledge of problems of managing natural ecosystems and discuss possible solutions. This is an interdisciplinary course that requires students to synthesize holistic ideas related to the management of global environment with their human societies. The students will gain insights into the structure, functions and historical drivers of change and become familiar with theoretical and practical issues related to the management of the Global environments. The learning goals are critical thinking and syntheses of knowledge related to how societies and their environments respond to natural and anthropogenic disturbances, as well as management decisions for developing policies for sustainable management.

EDS355 Climate Change and Development

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Engelsk:Understand the relationship between climate change and development, to gain an overview of the main socio-environmental mechanisms of change.

EDS360 Conflict and Development

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The course aims to achieve learning goals related to both ethics and knowledge, for example through lectures on themes such as just war and through discussions of the interface between economics and conflict. Studens who wish to obtain an A or a B grade in this couse should display knowledge at level 3; that is, they should display an ability to combine knowledge from different contexts and perspectives. 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.

EDS365 Coastal, Marine and Aquatic Resources

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: \' Coastal and Aquatic Resource Management \' will provide a basis for understanding ecological and social systems in coastal, marine and freshwater environments as the context for international developments within fisheries, aquaculture, integrated coastal zone management and aquatic resource and watershed management. Key ecological and social processes will be explained, and the positive and negative impacts of human interventions will be discussed and analysed. Issues of sustainable and non-sustainable use of resources, livelihoods, conservation, rights, governance, and problems arising from conflicts of interest will be presented, with examples from different parts of the world, and with a focus on the effects of increasing globalisation. A holistic approach and interdisciplinary perspectives will be emphasised, incorporating the conceptual framework of linking social-ecological resilience and vulnerability. Students will be shown how to use these concepts within an analytical approach for research projects that may also be applicable to their own MSc projects.

EDS370 Gender and Development

Credits: 5 **Language:** English
Start term: January block
Terms: January block
Learning outcomes: The course will introduce students to the concept of gender and development through examining the gendered dimensions of agriculture and resource management. Particular attention is given to exploring methodologies that allow for gendered analyses of social change.

EDS372 Current Topics in Security Studies

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel

Learning outcomes: The course provides an advanced understanding of issues in international security since the end of the Cold War. It focuses on security in relation to issues of force and power in international relations, and is placed within the relevant theoretical and empirical contexts of contemporary debates. The students should be able to understand the theories of the Copenhagen school, the welsh school and Realists/ Liberalist approaches to security after finishing the course.

EDS375 Advanced Readings in International Relations

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Advanced Readings in International Relations will be offered on different topics, depending on student interest and teaching resources. Generally, the course will aim at introducing students to a topic not covered by the curriculum, or offer in-depth understandings of topics already covered. In general, though, the level of the course will be quite high, and a good mastery of the fundamentals of International Relations is essential

EDS376 Religion, Politics and Islam

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Objective of course 1) The students will gain a good understanding of the main theories used to explain religion and political islam 2)The students will gain knowledge on the most important religiously based islamic political organisations

EDS377 Foreign Policy

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel

Learning outcomes: 1. The students should obtain a deeper understanding of foreign politics, with Norway as case. 2. Also learn how the foreign ministry functions. 3. Get Knowledge of the history of diplomacy.

EDS380 International Organizations

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The course seeks to give an advanced, graduate-level introduction to the emergence, expansion and influence of International Organizations, with an emphasis on the post-Cold War period. It will also provide a good overview of the daily life of IOs, both global (esp. the UN, World Bank, ILO) and regional (esp. NATO, EU, AU, OSCE), as well as of IO-IO cooperation and competition. Those who complete the course should be able to grasp the role and power of IOs in the international order and in governing global politics in different policy fields.

EDS381 Sovereignty and the State in International Relations

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The course aims at providing students with an understanding of historical processes and contemporary debates surrounding sovereignty. The first seminars will aim at broadening students understanding of the historical emergence of the sovereign state, and its importance in international politics. In so doing, the course offers an overview of the historical literature on state formation, linking this to classical texts on sovereignty. The second part of the course introduces more contemporary takes on sovereignty and the role of the state in processes of globalization. The level of the course is advanced, and a good mastery of the fundamentals of International Relations is essential.

EDS382 The Politics and Security of the EU

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: What characterises the EU as a political entity and actor? How does the EU differ from states and non-state actors, and which theories can best capture the EU polity and EU actorness? What are the powers and limitations of the union as a regional and global security actor in its own right? These are the key questions that the module seeks to respond to. It pays special attention to the Common Security and Defence Policy and its institutions, military and civilian crisis management operations the EU has been involved in, the EU\'s cooperation with other IOs in various policy fields, as well as how the EU is using it\'s \'soft power vis-a-vis partners inside and outside of Europe. The level of the course is advanced, and a good mastery of the fundamentals of International Relations is essential.

EDS384 Development and Environment in Practice, Tanzania

Credits: 15 **Language:** English
Start term: August block
Terms: August block Autumn parallel
Learning outcomes: The course has been designed to assist student preparation for the research work on their M.Sc. thesis. In this field course students have the opportunity to test out theoretical learning about development theory and methodology in a practical problem-based setting. At the end of the course the student should be able to: 1) Understand and critically apply concepts and practices of development in the context of natural resource management; 2) Test key concepts in development and resource management in the context of Tanzania; and 3) Apply qualitative and quantitative research methods with relevance to development and natural resources management

EDS387 State and Civil Society in Development and Environmental Governance in India

Credits: 15 **Language:** English
Start term: August block
Terms: August block Autumn parallel
Learning outcomes: Knowledge and skills to work with rural and urban issues in development and environmental governance;advanced understanding of the synergy between state and civil society organisations in India in implementing development and environmental policies and programmes;developing skills in conducting field research in a developing country context through hands-on fieldwork

EDS410 Doctoral Course in Environment and Development Studies

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The main objective of this introductory PhD course is to provide PhD candidates in international environment and development studies with a broad and solid interdisciplinary basis for understanding environment-development relations, together with insight into basic knowledge and critical approaches to development theory, policies and practices, with due regard to the diversity and complexity of the real world. The course draws on research and perspectives in both social and natural sciences, presenting theory and approaches that seek to integrate political, economic, cultural and ecological dimensions of change at macro, meso and micro levels.

EDS415 Research Methodology in Development Studies

Credits: 5 **Language:** English
Start term: January block
Terms: January block Spring parallel
Learning outcomes: Knowledge: About the relationship between theoretical perspectives and research methods in Development studies. Abilities: Be able to develop a good and feasible research design for a PhD proejct. General competence: A better understanding of how to use qualitative

methods in research. 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.

EDS422 Thor Heyerdahl Summer School in Environmental Governance: Governance of local resources

Credits: 10 **Language:** English
Start term: June block
Terms: June block
Learning outcomes: -

EIE305 Individual Specialisation (literature study) in Land Consolidation and Related Subjects

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Learning outcomes: a) Use literature to study a professional topic. b) Write a professional academic report.

FMI309 Environmental Pollutants and Ecotoxicology

Credits: 10 **Language:** English
Start term: January block
Terms: January block Spring parallel
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.

FMI310 Environmental Pollutants and Ecotoxicology

Credits: 15 **Language:** English
Start term: January block
Terms: January block Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
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.

FYS271 Energy Physics and Energy Conversion

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students will be given the fundamental of thermodynamics and its applications to the energy industry world. Students will be taught to describe, understand and calculate various forms of energy transport and work-producing and work-consuming cyclic processes. The student is to know about renewable and non-renewable energy reserves, their availability, size and expected duration in various scenarios. The student is to learn about the known options for covering the earth \'s future energy needs at different per capita energy consumptions. The student is to be able to apply the necessary thermodynamics and other general physics in order to understand how we can make the most of our energy resources and use various energy transformation principles. The student is also to understand principles and the existing techniques for storing and distributing energy.

FYS373 Chemical and Biochemical Energy Conversion

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students will be given the fundamental of chemical and biochemical conversion and its applications. Students will be taught the chemical kinetics of a process reaction, the interpretation of the results and the design of industrial reactors (ideal and non-ideal scenarios). The student will learn about the relevance of knowing the conversation ratio and how this is related to the energy production as well as energy sustainability of a process. The students will learn the know-how of design chemical reactors for different scenarios; it will learn different cases such as adiabatic, isothermal, and auto-thermal equipment.

FYS381 Biological Physics

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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) hydronamics at small spatial scales (cellular level), iv) what entropies 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
Start term: Autumn parallel
Terms: Autumn parallel January block
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
Start term: August block
Terms: By demand

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.

FYS401 Light and Biological Material

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: To obtain theoretical knowledge in the field light and biological material. To be able to present to present topics from this field orally. To be able to analyse spectroscopic measurement data.

GEN220 Genetic Basis of Biodiversity

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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 Plant Genomics

Credits: 5 **Language:** English
Start term: January block
Terms: January block

Learning outcomes: The students will learn DNA marker-based approaches for understanding plant genomes.

GEO220 Hydrogeology

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
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 connections between soil-forming rock, surficial deposits and groundwater, will be emphasised through the use of maps and databases. The student should understand how groundwater behaves and moves including the basic equations for groundwater flow. The student will become familiar with the most important properties of groundwater as compared to surface water. 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 sustainable 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
Start term: Autumn parallel
Terms: By demand
Learning outcomes: The student will 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 researchers in geology, and possibly with employers. The student will learn to write a report.

GEO300 Avanced Hydrogeology

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The student should through the course have acquired knowledge about quantitative methods for describing water and solute transport in the unsaturated and saturated zones. Knowledge obtained about geo-chemical processes, dispersion, diffusion, retardation and degradation should be sufficient for the student to be able to evaluate the effect of human activities on the aquifer system. Students will become familiar with methods to describe the subsurface, including geophysical methods and geostatistics, as well as the use of groundwater models for quantitative prediction of changes. The student should be able to evaluate the risk of irreversible changes of groundwater resources quantitatively and qualitatively in view of sustainable management of groundwater.

GEO310 Paleoenvironment and Climate Change

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: June block
Terms: By demand
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.

GMBB201 Image Processing in Geomatics

Credits: 5 **Language:** English upon request
Start term: August block
Terms: August block
Learning outcomes: Have knowledge of the most central ideas connected with the types of digital image processing that are relevant in geomatics, as well as be able to carry out such types of image processing, interpretation and analysis using a selected image processing tool (currently ERDAS Imagine). Through doing the compulsory exercises, the students are to become skilled in working in small, efficient groups. Through the writing of exercise reports, the students are to have gained skills in relevant presentation techniques through the use of suitable software. When using satelite pictures, the students are to see the opportunities and limitations that satelite images have as an integrated part of geographical information systems (GIS), used in connection with landscape planning, natural management and environmental monitoring . Have completed a field survey that forms the basis for the ability to assign information classes to spectral classes resulting from unsupervised classification. Have knowledge about and an understanding of image processing methods that are used for automatic measurement techniques in images.

GMGD300 Geodesy Graduate Course

Credits: 15 **Language:** English upon request
Start term: Spring parallel
Terms: Autumn parallel Spring parallel
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

Start term: Autumn parallel
Terms: Autumn parallel
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.

GMGM399 Geomatics, Project Work

Credits: 5 **Language:** English upon request
Start term:
Terms: By demand
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.

GMSG200 Satellite Geodesy

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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.).

GMSK300 Satellite Mapping

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel

Learning outcomes: After completing the course, the student is to have obtained substantial knowledge about and have practical experience with a limited number of selected techniques that are relevant for use in connection with satellite mapping.

HET401 Individual PhD Course in Ethology

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: By demand
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
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Students will learn about the importance of biological, technical and economic conditions within the different animal species, including aquatic species, and evaluate this in alternative breeding plans.

HFA301 Calculation of Breeding Values

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: August block
Terms: August block Autumn parallel
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
Start term: Autumn parallel
Terms: By demand
Learning outcomes: The students should acquire a solid understanding of quantitative genetics.

HFA401 Biometrical Methods in Animal Breeding

Credits: 10 **Language:** English upon request
Start term: August block
Terms: By demand
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).

HFE200 General Animal- and Fish Nutrition

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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.

HFE303 Nutrition and Optimisation of Diets for Monogastric Animals

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students should have a detailed understanding of the digestion and intermediary metabolism of energy and nutrients in monogastric animals, as well as the theoretical basis for energy and protein evaluation systems for monogastric animals (pigs, poultry, dogs). Students should be able to use this knowledge for evaluating feedstuffs and complete feeds used for different domestic animal productions, based on physiological, nutritive, quality-related and resource-related conditions.

HFE305 Feed Manufacturing Technology

Credits: 10 **Language:** English
Start term: August block
Terms: August block Autumn parallel
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
Start term: Spring parallel
Terms: Spring parallel

Learning outcomes: The purpose of this course is 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 will be able to understand the principles used for key processes and to optimise these processes through discussions with factory personnel and scientists.

HFE307 Feed Production Planning and Management

Credits: 15 **Language:** English
Start term: Spring parallel
Terms: Autumn parallel Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The purpose of this course is to gain knowledge about special needs of different animal species (including dog, cat, horse and fish) with respect to feed formulation, processing, and physical quality, and special requirements for feed to ingredients used. The students will also gain experience in reviewing and presenting new information based on research data.

HFE309 Quantitative Nutrition to Prevent Nutrition-Related Diseases

Credits: 5 **Language:** English upon request
Start term: June block
Terms: June block
Learning outcomes: The candidate will after finishing this course have the necessary scientific foundation to understand the interaction between diet and the most important diet-related health issues in the population. This is achieved by including known facts regarding human minimum

requirement for different nutrients, and overview of the role of different foods in providing these, and thereby an analysis of the likelihood of nutrient deficiency. Further, the physiological and anatomical adaptations such as the capacity of the digestive tract, retention time and transport and metabolism for different nutrients will be discussed, and effects of foods and nutrients on these. Lastly, the three most important diet-related health issues obesity, diabetes 2 and coronary heart disease will be discussed in relation to basic quantitiative nutrition, focussing on causal mechanisms and preventive nutrition.

HFE400 Lipid Metabolism

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: By demand
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
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: Autumn parallel
Terms: Autumn parallel
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.

HFX300 Experimental Design and Analysis in Animal Science and Aquacualture

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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.

HFX310 Product Quality, Meat, Milk and Eggs

Credits: 10 **Language:** English upon request
Start term: Spring parallel

Terms: Spring parallel
Learning outcomes: The student will have gained a solid theoretical understanding of quality and the comonents responsible for the quality of different meats,and effects of genetic bacground, nutrition, handling and slaughter. The student will further gain some insights related to quality of milk and eggs, to methods of measuring quality parameters, and to expectations from food industry and the consumers.

HFX400 PhD Course in Nutritional Biochemistry and Physiology

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
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
Start term: Autumn parallel
Terms: Autumn parallel January block
Learning outcomes: After completing the course, you will be able to: - develop programs based on procedural and object-oriented programming; - read and understand programs at an equivalent level of complexity; - analyse tasks and implement algorithms to solve them; - use functionality delivered by standard libraries; - combine functionality implemented in different programming languages; - localize errors in programs; - use programming tools such as debuggers, profilers, testsuites, documentation tools and version control. You will be able to evaluate the applicability

of more complex programs and able to assert their quality, and 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.

JORD201 Process Modelling in Soil Water and Plant Systems

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
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.

JORD221 Soil Physics, Laboratory Course

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: January block
Terms: January block
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
Start term: Spring parallel
Terms: Spring parallel
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
Start term: Spring parallel

Terms: Spring parallel
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
Start term: Autumn parallel
Terms: By demand
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.

KJB310 Protein Chemistry

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Basic knowledge on how proteins are built up and protein structures. 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. Understanding and practical use of the most common bioinformatics tools used to study the structure and function of proteins. Discussion of various types of proteins and their biological functions. Protein folding and the role of proteins in disease. Enzymology. Protein engineering and directed evolution. The students will gain experience in 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
Start term: January block
Terms: January block
Learning outcomes: Theoretical and practical training in methods to study the proteome, enabling the student to use the methods independently in a research project. Mass spectrometry, liquid chromatography, electrophoresis, bioinformatic analysis of large data sets.

KJB420 Proteomics II

Credits: 10 **Language:** English upon request
Start term: January block
Terms: January block Spring parallel
Learning outcomes: Theoretical and practical training in methods to study the proteome, enabling the student to use the methods independently in a research project. Mass spectrometry, liquid chromatography, electrophoresis, bioinformatic analysis of large data sets.

KJM310 Chromatography

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The student will learn to evaluate the use of various methods for separation (e. g. HPLC, GC) and conduct separation of organic molecules using GC, LC, various columns and evaluate alternative detectors and interpret the results. The students will obtain in-depth knowledge of and insight into chromatographic theory, and knowledge of chromatographical practices and the theory behind various separation principles. Through independent practical and theoretical

study the students will achieve competence in comparing different methods, and gain a basic understanding for quantitative results related to for instance the pollution of food and environment. The students will learn how to prepare and deliver effective oral and written presentations of technical information and of scientific results. They will learn critical thinking, complex and multidisciplinary problem solving, as well as accurately interpretation of current research literature.

KJM311 Organic Spectroscopy

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Gain comprehensive knowledge of organic spectroscopic methods, especially UV/visible, IR, NMR (especially 1H and 13C) 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. KNOWLEDGE: Know the most important concepts of organic spectroscopy. Be able to interpret spectra without remedy. SKILLS: Be able to work independently, and solve complex spectra.

KJM312 Natural Product Chemistry

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
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 and spectroscopic characterisation will also be part of this class.

KJM313 Mass Spectrometry

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students will obtain both practical and theoretical background for using mass spectrometry, e.g. GC-MS, MALDI-MS and LC-MS. They wil be able to use mass spectrometry for identifying organic and biological compounds. Candidates will get familiar with the various techniques used to separate ions in a mass spectrometer, such as quadrupole (Q), sector instruments (B and ESA), TOF, ion traps and FT-ICR. Interpretation of mass spectra is a central topic in the course and the students will spend time interpreting structures. Students will become familiar with the theory behind the different fragmentations of various compounds formed by different ionization techniques.

KJM314 Applied Organic Analytical Chemistry

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: A practical guidance is provided into the analytical organic chemistry as a versatile tool in a variety of applications spanning from technical control, product control to pharmaceutical application, environmental chemistry and medical/ health related applications. The course will be designed as a combination of lectures and practical exercises where basic methods in organic analytical chemistry will be applied for specific technical tasks and problem oriented solutions (method validation, concentration determination, product control etc.). Quantitative standard methods like GC/MS, LC/MS, GC/ECD, GC/FID as well as purification methods like GPC/SEC, Ion-exchange chromatography, Silica based, Alumina-based chromatography will be applied and evaluated. After completion, the candidates should have knowledge of, and be familiar with, the various analytical techniques used for sample purification and quantitative analysis using a variety of separation and detection techniques, including mass spectrometry, UV-VIS detection etc. Interpretation of chromatograms and quantification procedures are central topics. Students will become familiar with the validation of methods for specific applications and will be able to select appropriate methods for a specific application within the field of organic analytical chemistry.

KJM350 Radiation and Radiochemistry

Credits: 10 **Language:** English upon request
Start term: August block
Terms: August block Autumn parallel
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 radiouclides 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 Experimental Radioecology

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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 become 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 assements 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.

KJM352 Radiation and Radiochemistry

Credits: 5 **Language:** English upon request
Start term: August block
Terms: August block Autumn parallel
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 radiouclides 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. Knowledge is important in reducing unnecessary fears and anxiety related to radioactivity among the population.

KJM353 Radioecology

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The students are expected to have an overview over radioecology and be able to conduct experimental radioecological 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 become 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 assements 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
Start term: June block
Terms: June block
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 chemitsry and ecotoxicology. For radioecologies it will enable them to put the models and approaches for assessing radiation in to contect 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
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The students will obtain both practical and theoretical background for using mass spectrometry, e.g. GC-MS, MALDI-MS and LC-MS. They will be able to use mass spectrometry for identifying organic and biological compounds. Candidates will get familiar with, the various techniques used to separate ions in a mass spectrometer, such as quadrupole (Q), sector instruments (B and ESA), TOF, ion traps and FT-ICR. Interpretation of mass spectra is a central topic in the course and the students will spend time interpreting structures. Students will become familiar with the theory behind the different fragmentations of various compounds formed by different ionization techniques.

LAD202 3D Computer Modelling for Landscape Architecture

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The course will provide a hands-on experience of basic 3D modelling techniques, using 3D modelling software packages such as AutoCAD and SketchUp and others for landscape designers. Students will gain knowledge of basic 3D modelling and visualization techniques. The techniques Introduced in the lectures will be practiced with through exercises at computer lab which later could be applied to a selected landscape design project. At the project

stage, students could work with a selected case study. The expected final output from student for the course is the collection of the assignments work, and final project showing how 3D modelling techniques are implemented through a case study.

LAD302 Advanced 3D Tools for Design and Planning

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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 or in groups with supervision on a selected case study.

LAØ370 Landscape Ecology

Credits: 10 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: - be able to undertake 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.

LNG150 Swahili Intensive Course

Credits: 5 **Language:** English
Start term: June block
Terms: June block

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.

LNG240 Academic Writing

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Learning outcomes: The objective is to help M.Sc. and Ph.D. students develop writing skills for term papers, theses, and scientific publications.

LAA211 The History and Theory of Landscape Architecture

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Knowledge: show understanding of relevant academic and professional ethics, as well as issues related to sustainability and participatory processes. Upon completion of the course, students will be able to reflect on and apply the scientific landscape theories, methods, and traditions associated with historic gardens and landscapes. Students will have an overview of a range of horticulture and landscape architecture historical basic knowledge that is necessary to solve the landscape professional issues related to the management of cultural heritage in gardens and landscapes, as well as insight into the theories and methods that are relevant to the landscape architecture profession\'s construction history and theory tradition, and overview of social relevant technical issues and challenges in this area. Skill: Finding, evaluating and referring to the subject matter and present it so that it highlights an issue. Students will learn to analyze and assess the place and task contextual information for identifying garden historical issues and challenges, and outline draft rehabilitation and management plans in terms of sustainable solutions. Students should be familiar with the theories, methods, tools and communication methods that relate to

working with historic gardens and landscapes, and prepare a bounded project or research paper. Competency: Participate in and contribute to cross-cultural communication in an international study and professional environment.

LAA340 Sustainable Design and Management of Blue/Green Environmental

Credits: 20 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes:

LAA345 Specialization Module, in Continuation of LAA 340 or LAA 341

Credits: 5 **Language:** English upon request
Start term: January block
Terms: January block Spring parallel
Learning outcomes:

MAST300 Planning the Master Thesis

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Knowledge: Provide understanding of the significance of theoretical foundation and choice of methods. Grasp of the fundamental principles for scientific work. Understanding the work process of a MA thesis: Planning, Execution, and Academic Writing. Skills: Develop skills in preparing a plan of work on your MA thesis. Develop particular skills often used in academic writing such as use of literature, footnotes, figures, tables, etc. Attitudes: Understanding ethical problems often encountered in working on a MA thesis, including protection of personal identities and use of sources.

MATH250 Partial Differential Equations and Models

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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, classification of partial differential equations, the wave equation, diffusion equations, the Laplace equation, separation of variable techniques, Sturm-Liouville theory, Fourier series and Fourier transform techniques, 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
Start term: Spring parallel
Terms: Spring parallel June block
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 Applied Linear Algebra

Credits: 10 **Language:** English upon request
Start term: Spring parallel

Terms: Spring parallel
Learning outcomes: Theoretical understanding of the basic methods in applied 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
Start term: Autumn parallel
Terms: Autumn parallel
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 metric spaces, completeness, compactness, - convergence and uniform convergence, - the Riemann integral, - selected topics in functional analysis.

MATH310 Continuous Dynamical Systems

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Students will learn applied mathematics and how it can be used to study selected problems in environmental sciences, biology and physics.

MATH401 Modern Applied Mathematics

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Learning outcomes: Students will learn modern applied mathematics and how it can be used to study selected problems in environmental sciences, biology and physics.

MINA310 Project Management and Research Methods

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel January block
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
Start term: June block
Terms: August block June block
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.

MVI240 Sensory Science

Credits: 5 **Language:** English upon request
Start term: January block
Terms: January block
Learning outcomes: Students will learn about the most important and most frequently used sensory methods. Will be able to perform a sensory analysis. Students will know how to: choose persons suitable for attending a sensory panel, train panellists, choose sensory methods depending on sensory problem, perform sensory methods, do data collections and write a simple sensory report.

MVI261 Heat Engineering I

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students will acquire knowledge of unit operations and machine equipment that are part of processing lines.

MVI270 Unprocessed Milk

Credits: 5 **Language:** English upon request
Start term: January block
Terms: January block
Learning outcomes: Students will gain elementary knowledge about the chemical structure, composition and quality of milk. This is a good foundation for an understanding of processes used in the food and dairy industry.

MVI271 Fish and Meat as Raw Materials

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel

Learning outcomes: The students will 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.

MVI291 Diet and Health

Credits: 5 **Language:** English upon request
Start term: January block
Terms: January block
Learning outcomes: Students will be updated on current knowledge about the relationship between diet and reduced or increased risk for health problems or disease.

MVI292 The immune system, food and health

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: After completion of the course, the students will have a broad and thorough understanding of the organization and the function of the immune system. This is fundamental to understand how the immune system also may react to innocuous and non-infectious agents and in that way lead to the development of hypersensitivity reactions like food allergy. The difference between food allergy and various types of food intolerance reactions will be expanded on to provide the students a clear understanding of the difference between immunemediated hypersensitivity and other unwanted responses to food. The course will concentrate on the immunology of the muucosae and the gut and describe important elements in the maintenance of a balanced gut function (gut homeostasis). Thus, the students will obtain a good understanding of the importance of food and food components for the function of the gut mucosa and the immune system, including the impact of food on the gut microbiota and the connection between microbiota, health and disease development. The students will acquire a broad understanding of topics like nutritional immunology

and immunometabolism that include the significance of food and food components on immune defence against infectious diseases and the involvement of the immune system in the development of metabolic life style-related diseases. The course will also provide an introductory presentation of the most common immunological techniques that are exploited in modern biomedical research and in the diagosis of food allergy. The learning goals are compatible with the students acquiring knowledge and a system of concepts that will make them capable of reading and understanding relevant scientific literature, make justified assessments and give qualified advise on problems related to food allergy and intolerance reactions to food, but also the functional properties of food and food components that extends beyond the nutritional aspects, only. The students will learn how to prepare and present technical and scientific information both orally and written, and they will learn critical thinking and evaluation of complex problems associated with the different topics treated during the course.

MVI310 Proteins, Polysaccharides and Fat/ Oils: Structure and Functionality

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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 will 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

Start term: August block
Terms: August block
Learning outcomes: Students will gain knowledge and laboratory skills on identification, characterization and maintenance of microbiological cultures for fermentation purposes. Students will be familiar with the usage of bacteria, yeasts and moulds in different fermented foods and industrial processes. Students will gain knowledge about connections between growth, metabolism and product properties.

MVI322 Pathogenic Microorganisms

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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.

MVI340 Sensory and Consumer Science

Credits: 5 **Language:** English upon request
Start term: June block
Terms: June block
Learning outcomes: The students will be able to conduct sensory tests and consumer tests and also analyse and interpret the results from these tests. The students should also be able to collect, 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
Start term: Autumn parallel

Terms: Autumn parallel
Learning outcomes: Students will aquire deeper knowledge and in-depth skills in relation to unit operations in food engineering. They will also acquire a thorough 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.

MVI382A Alcoholic Beverages

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Students learn about the production of cider, beer, wine and spirits.

MVI382B Cereal Technology

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Students will gain advanced knowledge of different aspects concerning the quality and use of cereals.

MVI383A Dairy Technology

Credits: 15 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
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
Start term: Spring parallel
Terms: Spring parallel
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.

MVI384 Functional Foods: Bioactive Components in Foods

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel

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
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students will 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 optimalisation. 4) Managing and improving product development processes.

MVI392 Gastrointestinal Anatomy and Physiology

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The students will get a basic understanding of the biology and the different elements and processes in the alimentary tract, how they function and interact to achieve optimal nutrition absorption to promote health.

MVI480 Food Process Technology

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel

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
Start term: June block
Terms: June block
Learning outcomes: The students will acquire 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 will be able to exploit and organise new knowledge within the area of meat science/technology.

MVI482 Processed Meat Technology: Dry-Cured Products

Credits: 5 **Language:** English upon request
Start term: June block
Terms: June block
Learning outcomes: The students will acquire an in-depth knowledge in the different biochemical and technological aspects of producing dry-cured intact meat products. The students should be able to exploit and organise new knowledge within the area of meat science/technology.

MVI483 Dairy Technology

Credits: 10 **Language:** English upon request
Start term: August block
Terms: By demand
Learning outcomes: Students will gain an in-depth understanding of the selected topics for the course. They will obtain knowledge at the level of the most recent research documentation. The students will approach the highest level of knowledge within their chosen topics.

MVI484 From Milk to Cheese

Credits: 5 **Language:** English
Start term: August block
Terms: By demand
Learning outcomes: The students will obtain a scientific basis to understand the principles of cheesemaking and factors that influences the cheesemaking process. The students will 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. Students will approach the highest level of knowledge within their chosen topics.

NATF300 Conservation Biology

Credits: 5 **Language:** English
Start term: August block
Terms: August block
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
Start term: Spring parallel
Terms: Spring parallel
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 Human Wildlife Interactions

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The course is designed to provide an in-depth understanding of how people and wildlife may interact. The main goal is to explore problems and opportunities where humans and wildlife co-exist. The course also addresses issues of development and conservation and how potential conflicts can be reduced by community involvement in natural resource management.

PAE301 Ecology of Farming and Food Systems

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
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: Action Learning in Farming and Food Systems

Credits: 30 **Language:** English
Start term: August block
Terms: August block Autumn parallel
Learning outcomes: After completing the course, the students should know how to: - Describe and analyse farming and food systems, - link theoretical knowledge and concrete action, - acquire knowledge about their own learning. Further, the students should acquire: - Knowledge of structure and functioning of conventional and alternative (e.g., organic and local) farming and food systems, - knowledge of links between disciplinary (sub-system) knowledge and systemic (holistic) approaches, - experience with methods for systems analysis and improvement, including assessment

of sustainability within a methodology of participatory action research, - 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 the learning community. Through real-life case studies with focus on change processes, attitudes of both students and actors in the farming and food systems 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.

PHI302 Causation in Science

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The course will give students a philosophical and theoretical introduction to the notion of causation and related issues. The aim is to give students a critical perspective on some fundamental assumptions within their own research as well as in other research fields.

PHI401 Research Ethics and Philosophy of Science I

Credits: 5 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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 field. In the course we will look into what is specific about scientific practice, rationality and method in different fields; what are its aims, how is it influenced by society and what kind of social and cultural consequences does it seem to have? The objective is to stimulate students to reflect on their own and to understand other research projects and research fields, in particular with regard to increasing 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
Start term: Autumn parallel
Terms: Autumn parallel January block
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
Start term: Spring parallel
Terms: Spring parallel June block
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 - Managment 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 conserns - Optimalisations in management practises and cropping systems to meet requirements to production methods, productivity, product quality, sustainability and environmental conserns

PJH250 Production in Greenhouses

Credits: 15 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel

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 in able to measure and understand measurements of climate parameters and interpret plant growth responses.

PJH251 Bedding Plant Production of Flowers and Vegetables in Greenhouses

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel June block
Learning outcomes: The studenst will have insight into the production of bedding plants of flowers and vegetables in greenhouses. They should be familiar with the terms of the trade like: rooting of cuttings, sow, pot, pin, space out. They are to have a notion on how different plants are in their development into saleable plants, know about short- and long day plants. They should know why some plants needs to be clonally propagated, while others can be grown from seeds. They should have some insight into the economy and production planning.

PJH300 Sustainable Production Systems

Credits: 15 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: This course is intended for students that aim at playing a role in agricultural production, might it be as advisor, industry consultant, farmer or public decision maker. The course is intrinsically interdisciplinary. The candidate will attain: - operative knowledge about how to design and manage a sustainable farming system taking into account the nature-given conditions (as soil, climate or pests) and the possible management improvement (as tillage, fertilization, improved plant material, management of biodiversity though crop rotation and mixtures, plant protection and

so on); the main focus will be on Norwegian agriculture; - knowledge of the role of agriculture for food security, its responsibility in the exploitation and management of Earth\'s resources, and its contribution to and mitigation of global changes (both Norwegian and global aspects will be considered); - awareness of the political setting as public expectations and international regulations; - training in looking at the consequences of management at both long-term and global scale in order to evaluate the dynamics, strength and fragility of the agroecosystem; - training in applying knowledge from previous courses to practical situations, where a number of productivity and environmental concerns can be in conflict with each other.

PJH340 Quality in Food Plants

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Students following the course are expected to have obtained the following: Competence: -be able to use existing knowledge and skills to obtain new knowledge in the field -be able to communicate relevant problems and discuss possible solutions with specialists in the field -be able to communicate relevant knowledge to the public Knowledge: -Obtain knowledge on attributes related to quality in food plants -Obtain knowledge on how quality attributes in food plants are influenced by genetics and environmental conditions -Obtain knowledge on individual compounds in food plants and their effect on human health Skills: -Be able to provide assistance to the food industry regarding quality and quality variations in food plants -Be able to contribute to increased knowledge regarding quality of food plants through research

PJH350 Applied Plant Physiology in Greenhouses

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The course will provide an insight into the interaction between plants and environment (abiotic and biotic) with focus on crop production in protected environment. The

students will make use of knowledge in plant physiology to understand and solve biological and technological problems in greenhouse production. The course will provide a broad knowledge in how the environmental principles of light and temperature, control of air humidity and CO2, growth medium and nutrition affect growth, yield, diseases and energy consumption of greenhouse crops. The students will understand how to produce environmental friendly high quality products.

PJH360 Term paper in Plant Production

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Look at the courses PJH300, PJH340 and PJH350.

PLV320 Plant Pathology in a Changing World

Credits: 5 **Language:** English
Start term: August block
Terms: August block
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

PLV321 Plant Pathology

Credits: 10 **Language:** English

Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Knowledgwe: Shall understand: - The biology of importent viruses,viroids, bacteria, phytoplasma, oomycetes and fungi that are causing plant diseases. - Methods for identification and diagnosis (both classica and molecular) - Host-pathogen interactions, at both cell level and population level. Skills: Shall be able to: - Employ the knowledge for developing strategies for plant disease management. - Evaluate how epidemics develop and advice on risk managemnet. Competence: Shall be able to: - Evaluate envioronmental and social consequences of plant diseses and the strategies to combat the diseses. - Stay updated on plant diseases threatening our culivated plants. - Critically evaluate published literature in this area

PLV330 Insect-Plant Relationsships

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The students acknowledge the complicated biological and chemical interactions between plants on one side and herbivore animals and their enemies on the other side

PLV340 Weed Biology and Weed-Crop Relationships

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Knowledge: -Shall understand the biology of the different groups of weeds as well as for the most important weed species -Shall understand how different direct and preventive methods influence different weeds in a species dependent point of view. -Knowldge on weed-crop relationships, including both competition and allelopathy, and how different weed managements influence on the relationships. -Knowledge on innovative and site specific management strategies. Skills: -Shall be able to emply the knowledge for developing new strategies in different weed-crop

situations. Competence: - Evaluate and include different weed strategies in a broader point of view, including also other aspects in the agroecology perspective.

PLV420 NOVA PhD-Course in Plant Pathology

Credits: 5 **Language:** English
Start term: Spring parallel
Terms: Spring parallel June block
Learning outcomes: See description on the NOVA home page

PPDA400A Discourse Analysis of School Subjects Practices

Credits: 5 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel January block Spring parallel
Learning outcomes: The aims of the course is to provide participants with theoretical tools for working with discourse in terms of theoretical understandings into language and its interrelations with context from dialogic, pragmatic and social semiotic perspectives, to be able to apply a variety of methodological approaches in designing and analyzing discourses, and be able to participate in science educational discourses. The course is primarily intended for participants who want to engage in discourse analysis in science education and other subject didactics.

PPDA400B Discourse Analysis of School Subjects Practices

Credits: 2 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel January block Spring parallel
Learning outcomes: The aims of the course is to provide participants with theoretical tools for working with discourse in terms of theoretical understandings into language and its interrelations with context from dialogic, pragmatic and social semiotic perspectives, and to be able to draw on a variety of methodological approaches in designing and analyzing discourses. The course is primarily

intended for participants who want to engage in discourse analysis in science education and other subject didactics.

PPUT301 Science and Technology in School and Society - LUN

Credits: 20 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel January block Spring parallel June block
Learning outcomes: The course shall provide students with adcanced knowledge in science education or agriculture education by investigating relevant literature and key issues in occupational practice, and apply this literature to their own problem formulations within these fields of study. The students are expected to develop the correct use of citations 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 firm basis for their master\'s theses.

REIS300 Nature-Based Tourism

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The course will: - Provide a theoretical basis for analyzing nature-based tourism in Norway - Impart concrete knowledge about the subject

SKOG310 Nordic Forestry and Forest Research

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel

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.

STAT200 Regression Analysis

Credits: 5 **Language:** English
Start term: January block
Terms: January block
Learning outcomes: The students will learn how to analyze data using linear regression, both single and multiple regression, and also with categorical explanatory variables.

STAT210 Design of Experiments and Analysis of Variance

Credits: 5 **Language:** English
Start term: August block
Terms: August block
Learning outcomes: The students will learn to use fundamental statistical principles when they design experiments, to compare different groups or treatments, and to analyse data from such experiments by means of analysis of variance. They will also be able to use the knowledge of practical problems in their studies and in actual problems in the working life. By means of exercises with real problems and data, the students will show that they have achieved these goals.

STAT300 Statistical Data Analysis

Credits: 10 **Language:** English
Start term: January block
Terms: January block Spring parallel

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 period or later, in work, are 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) to use 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 of and to assess the validity of models, methods, and results.

STAT310 Design of Experiments and Analysis of Variance II

Credits: 10 **Language:** English
Start term: August block
Terms: August block Autumn parallel
Learning outcomes: The students will 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
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Be able to analyse contingency tables and binary data by chi-square tests, loglinear regression, logistic regression and multicategory logistic regression.

STAT360 Theoretical Statistics

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The students will acquire a basic theoretical understanding of the most important classes of mathematical-statistical models used for instance 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. They will also understand why and when a model reduction produces better result. The students will also be able to present subject-relevant material both orally and in writing.

STIN300 Statistical Programming in R

Credits: 5 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: Upon completion of the course the student should be capable of performing statistical analyses using a programming approach in R. The course will provide the necessary knowledge to let the students master standard statistical analyses. The students should also be able to make their own functions utilizing/modifying available functions in order to solve specific statistical problems. The student should also be able to present the output from statistical analyses in an accessible and scientific form using text and graphics.

THT280 On-Site Wastewater Treatment - Planning, Design and Impact Assesment

Credits: 15 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: The students shall have an overview of on-site systems for wastewater treatment and reuse, understand how to utilize natural processes in wastewater treatment. Students should be able to identify and explain important parameters useed for design and choice of treatment

system. Should be able to do a complete design of an on-site treatment system, as well as evaluate the impact on health and environment.

THT281 Design of Decentralized and Small Scale Water and Sanitary Systems

Credits: 5 **Language:** English
Start term: August block
Terms: August block
Learning outcomes: The students shall be able to design small water supply systems based on groundwater or rainwater harvesting and select an appropriate solution for a given situation as well as design and implement small decentralized and source separating wastewater treatment systems.

THT282 Introduction to Sustainable Water and Sanitation

Credits: 10 **Language:** English
Start term: Autumn parallel
Terms: Autumn parallel
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. The students will be aware of the challenges of working in the field of water and sanitation in a variety of situations, including developing countries and disaster situations. The training will enable the student to view alternative technical solutions and their impact on natural surroundings, society and health when approaching a problem.

THT283 Sustainable Sanitation - Decentralized, Natural and Ecological Wastewater Treatment

Credits: 10 **Language:** English
Start term: June block
Terms: June block

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
Start term: Autumn parallel
Terms: By demand
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
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Knowledge: students should have a deeper theoretical understanding of the main treatment processes, best practices and how to optimize the operation of a treatment plant. They should possess the basic understanding of the state-of-the-art techniques on process control and optimization; Professional skills: students shall be able to understand the capabilities and limitations of various treatment methods and their compatibilities when integrating the systems. They should be able to select suitable treatment process combinations and to evaluate their performances; General competence: students should be able to identify operational errors/ weaknesses of a treatment plant and their basic troubleshooting. They should also have competence about the capabilities of simulation programs and control systems in general. They should also

have competence on Norwegian and European legal requirements on water supply and wastewater treatment.

THT311 Water Resources Management and Treatment Technologies

Credits: 10 **Language:** English
Start term: June block
Terms: Autumn parallel June block
Learning outcomes: Knowledge: students should have an understanding of the basic principles in modern water resources management, European water legislations, theoretical understanding of the main treatment processes and, operational aspects a treatment plant. They should possess basic understanding of state-of-the-art techniques on process control and optimization; they must have an understanding of the modern simulation and design tools available for treatment plants and their capabilities. Professional skills: students should be able design modern river basin structures using best practices and to understand the composition of a treatment plant and identify and improve general operational problems. They should be able to carry out basic water quality analysis and how to utilize the water quality data in WRM and operational improvement of treatment plants. They should be able to carry out a literature review using modern scientific databases and internet and to prepare a well-structured project report. General competence: students should have an understanding of the development trends in the European water legislation and practices, be able to identify the advantages/weaknesses in a WRM setup and to propose improvements based on modern practices. They should also have a general process optimization knowledge using lab- and full scale experiments and possibilities with simulation programs.

VANN200 Hydrology

Credits: 10 **Language:** English upon request
Start term: Spring parallel
Terms: Spring parallel
Learning outcomes: During the course, students will get basic introduction to hydrology and how water resources is distributed in Norway and globally. After exam, the students will be able to

quantify average water balance for Norway given pre-calculated datasets; and be able to specify the most significant uncertainties of the water balance. Part of the learning goal is to get basic knowledge of physical and chemical quantities of water, and a understand the basic principles on mathematical estimation of physical variables in hydrology.

VANN300 Water Pollution I

Credits: 15 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: Good insight into the most central water pollution problems and factors such as diffuse pollution, eutrophication, acidification and hazardous substances and a bit about countermeasures against these. Understand important models in the mentioned fields and have knowledge of the natural variation in water quality with emphasis on the hydrological reasons and the uncertainties in the measured and estimated effects of pollution sources that is caused by this and also knowledge of measures that may be taken.

ZOOL300 Ecological Entomology

Credits: 10 **Language:** English upon request
Start term: Autumn parallel
Terms: Autumn parallel
Learning outcomes: The students will gain new scientific knowledge within several topics of ecological entomology. The students should acquire a critical attitude towards published results in ecological entomology. 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.

ZOOL310 Behavioural and Population Ecology

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

Start term: Autumn parallel
Terms: Autumn parallel
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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