Course Catalog 2011/2012
Courses and Programmes Offered in English
Norwegian University of Life Sciences

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Study Programmes Bachelor

Bachelor of Science 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 developing countries and North-South cooperation. The problems faced by developing countries are multifaceted, and require solutions that draw on a wide range of approaches. The programme's unique combination of natural and social science approaches is tailored to meet this need.

Degree awarded: Bachelor of Science

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

The Bachelor's Degree provides the graduates with the opportunity to work in international organisations, with development aid. Candidates may also work in primary schools with additional pedagogical education. The Bachelor's Degree also provides opportunities for further education, including the master programmes Development Studies (DS), International Environment Studies (IES), International Relations (IR) and Agroecology (AE), offered at UMB. It also provides a foundation for applying to similar programmes at other higher education institutions in Norway or abroad.

Internationalisation:

An international focus is an integral part of the programme, both thematically and institutionally. Most courses offered are concerned with international issues, most will be offered in English. Students may spend one semester at a partner university in a developing country. The programme also attracts a significant number of international students.

Cooperation with other institutions:

Noragric has broad international competence and this is reflected in the programme. UMB has established institutional cooperation with several universities in developing countries. Students will be offered an exchange opportunity for a semester at one of our partner universities. It is also possible to take parts of the programme in other European countries.

Possibilities for study abroad:

As an integral part of the programme, the students may spend one semester at a university in a developing country. Student exchange to other parts of the world is also possible. It will also be possible to extend the stay abroad to two semesters.

Learning outcomes:

Students will acquire an overview of the basic problems facing developing countries and the factors influencing development processes. Students should become knowledgeable about both social and natural science approaches to the study of environment and development, and be able to combine different approaches. The programme gives students a basis for critical and academic thinking. Students should also acquire skills in collecting and analysing information, and presenting findings orally and in writing.

Learning and teaching methods:

The programme utilises a wide range of teaching and evaluation 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.

Student Assessment:

The bachelor programme consists of courses offered by Noragric and other departments at UMB. The courses offered utilise a wide range of teaching, learning and evaluation approaches.

Contents:

The programme consists of mandatory and elective courses. The compulsive courses constitute 125 ECTS, including a bachelor thesis worth 15 ECTS. The elective courses constitute 55 ECTS, which may be taken at UMB or on exchange. The elective courses may be within areas such as economics, international relations, ecology, organisational theory and resource management. All mandatory courses are taught in English, and it is possible to compose a study plan with all courses in English. We recommend that you take one semester abroad where you may take courses that are not offered at UMB.

Student guidance:

Students will receive guidance from staff at Noragric. Supervision will be given in connection with semester assignments and the final thesis. Each student must tailor his or her own study plan, stating which courses will be included in the degree. The plan has to be approved by Noragric within the first two months of the programme.

Quality assurance:

The programme adheres to UMB policy and evaluates all courses anonymously after completion. Results from the evaluations will play a major role in future revisions of the programme.

Study Programmes Master of Science 2 years

Master of Science 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 demonstrate English language ability in accordance with the UMB regulations for programmes taught in English. Applicants must hold a Bachelor's degree or equivalent qualification from university-level studies in agriculture, ecology, biology or a relevant social science. 5-20 students are admitted per year.

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 of Science

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

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

Internationalisation:

The programme has an international profile and most of the students are non-Norwegian. The programme is Nordic (NOVA University network) and international by nature and is taught in English. Teachers from NOVA member institutions and the USA contribute in the first semester. There is also cooperation with other UMB departments and other Norwegian institutions.

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. In 2003 the programme underwent an external programme evaluation by an international expert committee.

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. The Network for Agroecology and Ecological Agriculture (NOVA and Socrates) 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 education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: Competence: - Has knowledge of farming and food systems. - Has the ability to handle complexity and change and to deal with ethics, and cultural values. - Has personal attitudes such as being open-minded, critical, spirited, determined, approachable and exploring. - Is a good communicator and facilitator. - Understands the importance of lifelong learning, autonomous and free thinking. Knowledge: - Has advanced knowledge about agroecosystem/food system structure and functioning. - Is able to use methods for dealing with complex issues in agriculture and the wider food system, including systems analysis and assessment of overall system sustainability. - Knows the distinctive features of ecological agriculture (organic farming). Skills: - Is able to transform knowledge into action and link theory to practical situations to handle complexity and change. - Is able to learn autonomous and lifelong, and to cooperate in team when it is rational.

Learning and teaching methods:

The programme starts with a semester introducing the 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 an integral part of the learning process. The 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) (from 2011 PAE302,previous PAE302 and PAE303). Five ECTS at 100 level in foreign language is accepted in the degree for students at the M-AE program 'European master'.

Student guidance:

The courses in the first autumn semester are based on facilitated project work. Students are advised regarding future courses and thesis work. Later these issues are followed up during seminars about every two weeks (for students who stay on the UMB campus) or by e-mail (students who choose to continue elsewhere).

Quality assurance:

You can find general information on evaluations of study programmes at UMB here: http://www.umb.no/quality-assurance/article/umbs-evaluation-of-study-programmes The department and teachers make active use of the students' feedback from the UMB web-based course evaluation system to improve the courses, and they report on actions taken. In addition, regular evaluation meetings are held between students and teachers in the first semester, and a written evaluation report is produced.

Master of Science 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 at the EM-ABG co-ordinator (Wageningen) are established. Students that meet the following formal admission conditions 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:

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

Degree awarded: Master of Science

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

The degree gives opportunities for positions within the field of animal and aquaculture breeding. The degree qualifies for Ph.D studies within quantitative or/and molecular genetics.

Internationalisation:

The study programme is open to both Norwegian and international students.

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 EM-ABG course is supported by the Erasmus Mundus programme of the European Union.

Possibilities for study abroad:

Students can choose their own universities of preference among the five partner universities for the first and for the second year of the EM-ABG. The candidates will receive a double Master`s degree (one for each of the universities the individual student attended), if they satisfy and meet the requirements on minimum contributions from each university.

Learning outcomes:

You will bridge the gap between quantitative and molecular genetics which is needed competence in the future.

Learning and teaching methods:

Teaching methods are varied and inculde 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:

Non compulsory courses are required, but students have to fulfil at least 60 ECTS at UMB, minimum 30 ECTS for thesis under (joint) supervision of UMB and one of 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:

The programme has a student adviser.

Quality assurance:

Approval of all alterations and rules are done in the Study committe. Final course evaluations are also considered by the Study committee.

Master of Science in Aquaculture

Language of instruction: English.

Credits: 120

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

Admission requirements:

Bachelors degree that includes minimum: 10 credits mathematics, 10 credits chemistry/physics, 10 credits statistics and 60 credits biology 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 develops fast with an annual increase of 5-10%. Productions are etsimated to be doubled within 2020-2030. The industry requires leading knowledge of breeding, nutrition, engineering, product quality and economics at the Master

Degree awarded: Master of Science

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

The degree gives opportunities for positions within the field of Aquaculture and related areas like the feed production industry. The degree qualifies for Ph.D. studies within Aquaculture.

Internationalisation:

The study programme is open to both Norwegian and international students.

Cooperation with other institutions:

Nofima, Department of Economics and Resource Management, 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:

For Norwegian students the Master of Science in Aquaculture consists of: Compulsory courses: Aquaculture breeding and genetics (10 credits) 200 level, Special course in Aquaculture (5 credits) 300 level. 25 compulsory credits at the 300 level can be selected within fish breeding, fish nutrition and planning and design of aquacultural plants. 40 credits are optional courses within aquaculture related courses at 200-level, and 10 credits are optional

from all selectable courses at UMB. Master thesis is 30 credits. For international students the Master of Science in Aquaculture consists of: 50 credis compulsory courses in aquaculture at 200 level within fish health, breeding and nutrition, and Spescial course in Aqauculture (5 credits) at 300 level. 25 credits at 300 level within fish breeding, fish nutrition and planning and design of aquacultural plants. 10 credis are optional coureses, and master thesis is 30 credits.

Student guidance:

The programme has a student adviser.

Quality assurance:

Approval of all alterations and rules are done in the Study Committe. Final course evaluations are also considered by the Study committee.

Master of Science in Development and Natural Resource Economics

Language of instruction: English.

Credits: 120

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

Admission requirements:

A Bachelor's degree or equivalent degree with a major or specialisation 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 from 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 the students get knowledge, training and practical experience in using economic methodologies, as a bridge between theories and real-world problems.

Degree awarded: Master of Science

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.

Internationalisation:

This is an international Masters programme with students from many parts of the world. Many students will go on field work in a developing country during their Master studies. Students can also choose to study abroad for one semester as a part if their degree.

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. We intend to continue a close cooperation with these universities and other universities in developing countries.

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 if 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, Micro Economics, 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's thesis and elective courses.

Student guidance:

The students will have access to departmental advisors regarding administrative, social, practical and academic affairs. An academic advisor is assigned to each student in connection with the master's thesis and larger assignments.

Quality assurance:

This programme adheres to the UMB quality assurance system. In addition, the close dialogue between the students and the departmental staff motivates for constant feed back throughout the semesters.

Master of Science 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.

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 of Science

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:

This is an English taught Master's programme with students from many countries. All courses in this programme are taught in English, and focus on general questions in ecology and natural resource management. Ecological effects of environmental change, e.g. deforestation and climate change, are global. The program provides a fine opportunity to study ecological processes in an international perspective.

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: - Have an in-depth knowledge about ecological theory and the factors that determine ecosystem structure and diversity. - Develop good skills in communicating original scientific ecological research to scientists, managers of natural resources, and the general public. Knowledge: - Be able to understand and recognise the complexity of ecosystems. - Have an understanding of the ecological and evolutionary processes that have formed biological diversity. - Have an up-to-date knowledge about global change and its impact on organisms and ecosystems. Skills: - Be able to plan and execute a scientific field study independently. - Be able to acquire new knowledge within the field of study and evaluate it in a critical and objective manner. - Be able to use ecological principles and knowledge in an applied perspective; such as in nature conservation and the management of natural resources. Tropical Ecology and Management of Natural Resources: Competence: - Have an in-depth knowledge of ecological processes. - Have developed good abilities in the communication of scientific results to the scientific community, to natural resource management authorities, and to the general public. Knowledge: - Has in depth knowledge of interactions between humans and ecosystems. - Has an understanding of current ecological challanges for tropical ecosystems. - Has knowledge of the importance of biodiversity for ecosystems and the underlaying causes for loss of biodiversity Skills: - Are able to plan and conduct scientific field work in tropical areas, as well as analyse and synthesize collected data. - Are able to evaluate results from scientific studies and area ble to utilise such material in practical management. - Are able to use biological principles in the restoration of terrestic and aquatic ecosystems. - Are able to develop operational mamangement plans balancing human use and conservation of natural resources.

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 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 Community Based Natural Resource Management.

Student guidance:

Students receive supervision in the programme from a study advisor employed by the Dept. of Ecology and Natural Resource Management. A scientific employee at the university is responsible for guidance throughout the entire Master's thesis process, such as project planning, field work, data analysis, writing of the thesis and potential publishing of the results.

Quality assurance:

Students evaluate the courses through UMB's web-based system. These evaluations are processed annually by the teachers and by the department's Curriculum Committee. The teacher must write comments on the evaluations

with suggestions for improvement. These must be approved by the Curriculum Committee. Both external and internal evaluations of the program are carried out at regular intervals. The last such evaluation was carried out in 2006-2007. A curriculum group at the Department is responsible for the programme and works continuously to maintain the programme's quality and professional relevance.

Master of Science 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 set by the TOEFL test or similar, with results approved by the International Student Office of UMB. Applicants must have university level courses with a total of 180 credits in basic knowledge in nutrition, chemistry and physics.

Relevance for society:

Feed manufacturing is an enormous global industry. The industry needs expertise of feed manufacturing technology for maximum use of limited feed resources.

Degree awarded: Master of Science

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:

The programme of study is open to Norwegian and international students.

Cooperation with other institutions:

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:

The programme has a student adviser.

Quality assurance:

All courses are evaluated by students at the end of the semester. The evaluations are assessed by the Study Committee. The entire study programme is evaluated every second year.

Master of Science 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:

The programme looks at global and local problems related to poverty, environment and social conflicts. The programme offers a broad understanding of social science perspectives in societies, development, and change, as well as more specialised approaches to poverty reduction, conflict avoidance, and sustainable resource management.

Degree awarded: Master of Science

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.

Internationalisation:

This is an international programme, and many if not most students are international. Most students spend their third semester abroad at a cooperating university in a developing country, such as the University of Makerere in Uganda or the Tribhuvan University in Nepal. This is a programme within the field of international development studies, and all students write Master's theses on international problems. Most students also do fieldwork in a developing country.

Cooperation with other institutions:

15 credits are normally taken at a co-operating university in a developing country.

Possibilities for study abroad:

Field course in a developing country is compulsory. Most students do their field work in a developing country.

Learning outcomes:

A basic aim of the programme is to enhance the students' understanding and appreciation of social and cultural differences that are important for development. General learning outcomes are: - understanding an interdisciplinary approach to global and local development issues; - cross-cultural and interdisciplinary communication competence; - knowledge of relationships between technological challenges and social factors; - understanding of learning as change and change as a learning process. Students will also: be capable of identifying and analysing causal relationships between social conditions and events related to conflict, economic development, poverty, and rights; possess knowledge of key elements of different development theories and their associated literature; indentify policy instruments and measures that have been applied to development and poverty challenges and the results these have generated in the past.

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.

Student guidance:

During the introduction course in August, students will be given introduction to the programme and guidance concerning their academic progression. In their final year, the students will be assigned a supervisor who will assist in the development and completion of the master thesis.

Quality assurance:

The main basis for programme evaluation is the student evaluations of the different courses. These will be discussed in the Noragric Education Committee. In addition, informal evaluations are undertaken for most of the courses. Finally, both formal and informal input will be sought from external examiners associated with the various courses.

Master of Science 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, 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 of Science

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.

Internationalisation:

By nature, this programme has an international profile, and the great majority of students are international. The study programme deals with global development problems related to natural resource management. The students focus their thesis on global problems in these fields and do their fieldwork in southern countries. During the third semester (1 August to 30 September), the students take a 15-credit course at Noragric's regional partner institutions, for example Makerere University in Uganda and at Tribhuvan University, Institute of Forestry, Pokhara, Nepal.

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 developing countries. During the third semester (Aug.-Sep.), students attend a 15-credit field course at partner institutions in Africa and Asia (with an option to study in Latin America).

Learning outcomes:

The programme educates graduates who can contribute actively to sustainable development processes both locally, nationally and globally. The ability to implement changes is seen as a result of their combined understanding of natural and social systems as well as good communication skills. Graduates shall develop the capacity to link theoretical analyses to practical actions. To obtain this, students must learn about relevant concepts, analytical approaches and gain in-depth knowledge about causes and effects of global environmental problems related foremost to climate change, loss of biodiversity, desertification, and water and land degradation. The program must moreover facilitate the creation of an in-depth understanding of how governance structures and power relations influence present trends and engage in analyzing how urgent problems can be solved through various strategies. Poverty alleviating and health issues are also core aspects of sustainable development with strong links to environmental qualities. Hence, the issue of empowering marginalized poor people, justice and rights-based approaches, conflict and conflict resolution represents core issues. Similarly, students shall aquire insights into the functioning of key global environment and development organisations, policy arenas and processes, international conventions and agreements. Understanding the linkages between challenges at global, national and down to local levels of governance and natural resource management is important.

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 required and elective course work, one semester of field study (for most students at a co-operating university in a developing country), and writing of an individual, 30- or 60-credit research thesis. Mandatory courses are EDS235 Political Economy-Institutions and the Environment (10 cr.), EDS212 Research Methods I, EDS312 Research Methods II and choice between EDS386 Environmental Governance at the Local Level (Uganda) and EDS388 State and Civil Society in Environmental Governance in India. Students can be exempted from mandatory courses if they can document similar qualifications.

Student guidance:

The students have access to advisers regarding administrative, social, practical and academic affairs. Concerning research, each student is assigned a relevant academic supervisor during the second semester of the programme, and the supervisor advises the student throughout this year.

Quality assurance:

The administration has regular meetings with students throughout the semester and IES students participate in the electronic student evaluations carried out by the UMB central administration at the end of each semester. Teaching staff and study administration analyse the student evaluations and agree on relevant actions. The programme follows up the intentions of the Quality Reform by utilizing varied learning- and evaluation methods, utilizing the entire academic year, providing a semester of study in a relevant foreign country and giving students a high degree of flexibility in constructing their study plans. The programme has been revised in 2006/07 to remain in the forefront of current issues and to further increase the students' flexibility in choice of courses. The programme maintains the 60-point thesis option for students with strong backgrounds. The recent changes complete the recommended revisions provided in 2005 by an external evaluation of Noragric's master programmes.

Master of Science 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.

Degree awarded: Master of Science

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:

The programme will be taught in English to accommodate international students wishing to study in Norway. This makes it possible to offer seats for students from collaborating universities. Some optional courses will be taught in Norwegian. International students may take Norwegian language as part of their degree. It will be possible for guest students to take optional and core courses.

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 broad and deep knowledge of: - International relations theory and the philosophy behind international structures. - International organizations and cooperation/ collaboration - Different epistemological approaches to social sciences. - Practical understanding of international interaction through placements in organizations, language experience and through active participation in an international/ multicultural student environment. - Analytical and well founded approach to the use of sources of information.

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 required and elective course work, one semester of field study (for most students at a cooperating university), and writing of an individual, 30- or 60-credit research thesis. Mandatory courses are EDS325 Global Political Economy, EDS374 International Relations Theory, EDS360 Conflict and Development, EDS212 Research Methods I, and EDS312 Research Methods II. Students can be exempted from mandatory courses if they can document similar qualifications.

Student guidance:

The students have access to advisers regarding administrative, social, practical and academic affairs. Concerning research, each student is assigned a relevant academic supervisor during the second semester of the programme, and the supervisor advises the student throughout this year.

Quality assurance:

The administration has regular meetings with students throughout the semester and IR students participate in the electronic student evaluations carried out by the UMB central administration at the end of each semester. Teaching staff and study administration analyse the student evaluations and agree on relevant actions. The programme follows up the intentions of the Quality Reform by utilizing varied learning- and evaluation methods, utilizing the entire academic year, providing a semester of study in a relevant foreign country and giving students a high degree of flexibility in constructing their study plans.

Master of Science 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.

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, but others help to protect us and the food we eat. Many microorganisms have characteristics that to an increasing degree are utilised by different industrial processes and within medicine and health. Application of microorganisms to solve different environmental problems is expected to increase in the future. 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 the different natural ecosystems. Since microorganisms are important in a number of different fields, a Master's degree in microbiology will provide opportunities for an exciting career within many different professions.

Degree awarded: Master of Science

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:

The study programme has an international content and level. Courses at the 300 level will be taught in English upon request. Most of the course literature is in English. Supervision of the Master's thesis can be offered in English, and the thesis may be written in English.

Cooperation with other institutions:

The Master's degree programme includes courses from other departments at UMB.

Possibilities for study abroad:

There are good opportunities to take parts of the study abroad at chosen 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 the education is expected to have achieved the following learning outcomes, defined in competence, knowledge and skills: Competence: - Has an objective understanding of scientific literature, and is able to present scientific themes and results both orally and in writing. - Is able to reflect over central ethical and scientifical challenges, regarding others and his/her own work. - Has the ability to contribute to innovative processes within the field of study and related fields. Knowledge: - Has thorough knowledge to the field's terminology and theories, and be able to use these. - Is able to analyse scientific problems in microbiology, reflecting the history, traditions, distinctive character and position of the field of study in the society. - Has a very good competence in microbiology, and is prepared for research, teaching and other emplyment needing microbiological, biological, biochemical or biotechnological competence. Skills: - Is able to analyse scientific data, and work independently in the laboratory. - Can perform surveys independently; collect, edit and analyse data, as well as evaluate and present methods and sourses of error, before giving an objective conclusion.

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:

The study advisor for microbiology can give more details about the programme. studieveileder-ikbm@umb.no

Quality assurance:

Engelsk:The programme will be under constant evaluation with regards to programme content and relevance. Current societal questions connected to the use of microorganisms will be dealt with during the study. The students will evaluate all courses, and the results of the evaluations will be important in the further development of the scientific and pedagogical content. Each study programme has its panel of dedicated students and university teachers which continuously assure the quality of the programme content. The study programmes at the Department of Chemistry, Biotechnology and Food Sciences are all evaluated regularly by internal and external evaluators. The Master's programme in microbiology obtained positive review in the last evaluation.

Master of Science 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 (BSc) or equivalent education in any field relevant to the environment (e.g. chemistry, ecology, biology, environmental sciences etc.), but with proper 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 the competence within the nuclear field is consistent with the EU aim to produce an educated workforce that is able to meet the 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, and 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. 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 working permission related to the use of open, ionising radiation sources in their future work.

Degree awarded: Master of Science

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, the use of radioactive tracers and simple measurement methods as well as radiation protection. The programme prepares the students for a wide range of positions related to 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:

Four course modules will be held in Norway, using the best European teachers within their field of expertise. Two of the course modules will be held in France, if necessary limit of students..

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. The first year provides a theoretical basis to start research work as well as the initiating of the research project; the second year is dedicated to specialist courses, data collection and analysis, i.e. finalizing the thesis. 1 semester: Course work at UMB, Norway. 2 semester: Course work at UMB or at collaborating universities, initiating of the research project at UMB or at the home university. 3 semester: Project work at UMB or home university. 4 semester: Project work and finalising the thesis at UMB or at the home university. Course modules will be presented by the best Norwegian and European teacher within the different fields of study, and in close cooperation with other European Universities.

Student guidance:

Students receive guidance from the study advisor team, head of education, the contact person in the study committee, plus scientific members of staff in their respective fields.

Quality assurance:

You can find general information on evaluations of study programmes at UMB here: http://www.umb.no/quality-assurance/article/umbs-evaluation-of-study-programmes In addition to UMB's central routine for course evaluations, there are plans for the evaluation of the programme (courses and programme) with partner universities in Europe. Input/feedback from students and external sources is important. The latter can be professionals in the research environment in foreign institutions.

AKA270 Aquaculture breeding and genetics

Aquaculture breeding and genetics

Credits: 5 **Language:** English
Staff/institute: Hans Magnus Gjøen/ IHA
Teachers: Øyvind Andersen and Dag-Inge Våge
First time the course is offered: SPRING 2012
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: HFA200 or HFA220
Type of course: 24 hours of lectures + colloquium
Contents: The students will learn about the major principles underlying the design of breeding schemes, the biological restrictions for species involved, tagging methods and economical considerations. Also breeding strategies, breeding methods and breeding goals, genotype by environment interactions and the application of modern DNA tools in aquaculture will be covered.
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.
Methods of examination: Final Written exam **Grading:** A-F
Examination aids: No calculator, no other examination aids

AKA350 Optimisation of Fish Breeding Programs

Optimisation of Fish Breeding Programs

Credits: 10 **Language:** English
Staff/institute: Hans Magnus Gjøen/ IHA
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Other - --
Mandatory activities: Submission of case work.
Prerequisites: HFA200 or HFA220
Type of course: 40 hours of structured group work + 12 hours lectures.
Contents: Interpretation of various simulation methods for optimisation of breeding schemes for aquaculture species will be covered. A larger case study on consequences of concrete options at hand when planning a breeding program will be a major part of the course.
Learning outcomes: The student will be able to understand and evaluate various simulation software and optimisation of breeding schemes for aquaculture species.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: In addition to the compulsory semester assignment, there will be emphasis on contributions during the group work.

AKE251 General Aquaculture - Nutrition

General Aquaculture - Nutrition

Credits: 10 **Language:** English
Staff/institute: Trond Storebakken/ IHA
Teachers: Mette Sørensen, NOFIMA and from Aquaculture Protein Centre. Guest lecturers
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Demonstrations and exercises.
Prerequisites: BSc in life science or third year BSc studies at UMB.

Credit reduction: Overlapping with HFE200.
Type of course: Structured teaching time will be roughly divided as follows: Lectures: 4 hours per week (total 44 hours). Group tutorials: 2 hours per week (total 30 hours). Demonstrations: Total 10 hours.
Contents: This course is an introduction to animal nutrition with special emphasis on fish, constituting a platform enabling the student to specialize in monogastric nutrition of both aquatic and terrestrial animals. It also formulates the platform for further studies of specific feed types and feed technology. The course is broad in this sense, and may be divided into 3 sub-topics: 1. Nutrients: (Macro and Micro nutrients). 2. Feed evaluation and digestibility: (Feed composition, Digestion and Feed utilization). 3. Intermediate metabolism: (Energy partitioning, Catabolism and Anabolism of macro nutrients). Particular emphasis is placed on understanding relationships between the different sub-topics.
Learning outcomes: The aim of the course is to provide students with a basic understanding of nutrition with emphasis on monogastric animals and in particular fish. The student should gain an understanding of the main components of the diet and their interrelationships and importance for the animal. The student will be brought up to date in the area of aquafeeds and in addition be given an introduction to feed composition, feed evaluation and calculation of feed rations for fish.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: During the course there will be three sub-exams (1 hour each) based on the questions of the exercises of the three sub-sections, nutrients, digestion and intermediate metabolism. Each sub-exam will receive grades and each account for 15% of the total grade. The course will end with a final written examination, focusing on the interrelationship between the three sub-sections. This final examination will contribute 55% to the final grade. Passed in all examination-parts and registered participation at the demonstration are compulsory in order to be allowed to sit the final examination (3 hours).

AKE310 Aquaculture Nutrition

Aquaculture Nutrition

Credits: 10 **Language:** English
Staff/institute: Trond Storebakken/ IHA
Teachers: Trond Storebakken, Mette Sørensen, guest lecturers may be invited as appropriate.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in all parts of the practical feed project including written and oral group presentation. Personal project including written and power point presentation.
Prerequisites: General nutrition at 200 level (HF200) or Introduction to Aquaculture Nutrition (AKE251) or equivalent.
Type of course: 2-4 hours of lectures and theoretical exercises per week. 4-10 hours of practical projects per week. The remaining time is spent on the individual project, literature preparation etc. Activity level: 50 % of full time.
Contents: Lectures on relevant subjects. Workshops including introduction to written presentation and use of computer-based calculation programme for feed management. Case study where the students have to write a semester assignment and make a power Point presentation of the assignment. Practical and longitudinal project including formulation, feeding and biological and chemical evaluation of the diet in a feeding experiment. The group project can either focus warm water (tilapia) or cold water (salmonids) fish species.
Learning outcomes: Students will gain both theoretical and practical experience of feed formulation and biological feed evaluation. The student will also obtain a theoretical understanding of the principles behind feed formulation and nutrition physiology, thus allowing an understanding of the economical, technical and biological challenges of today□ s and tomorrow \'s aquaculture industry from a feed management perspective.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written presentation of individual project: 35 %, Oral examination: 40 %, activity in whole and carrying out of subsection of group project 25%.

AKX251 General Aquaculture - Anatomy and Health in Farmed Fish

General Aquaculture - Anatomy and Health in Farmed Fish

Credits: 10 **Language:** English
Staff/institute: Trond Storebakken/ IHA
Teachers: Teachers from UMB, Norwegian School of Veterinary Science, Faculty of Life Sciences at Copenhagen University.
Start term: August block
Terms: August block Autumn parallel June block
Mandatory activities: Exercises, demonstrations, field weeks and project.
Prerequisites: BSc in life science.
Credit reduction:
Type of course: The course starts during the August block with a full-time lecture session combined with short exercises and a personal literature project. The literature project relates to the aquaculture of different countries and regions. This introduction block is followed by a one-week field course early in the autumn semester. The variation in time depends on that the field week is synchronized with the other partners of the NOVA network. The field week is followed by a weekly lecture session ended with a written examination. During the second lecture period, 2-4 hours of lectures are expected per week. The course will not have lectures during the January block and Spring semester. Teaching will resume in the spring semester with a project assignment. A field week in late May/early June, again synchronized with the other partners of the NOVA network, will end the course. The project will be finalized during the last field week.
Contents: The course consists of a theoretical part with lectures and demonstrations with the aim to give the student basic knowledge in the subject. The student gets to practice his or her theoretical knowledge in small assignments or projects during the field weeks. In the final project, the student has to actively seek knowledge outside that given in lectures and demonstrations.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: The requirement to pass the written examination is set to 60 %.

AKX253 Product Quality in Aquaculture

Product Quality in Aquaculture

Credits: 5 **Language:** English
Staff/institute: Magny S. Thomassen/ IHA
Teachers: Anders Kiessling, Hans Magnus Gjøen, Turid Mørkøre, Mia Rørå, Kjell-Arne Rørvik, Ingrid Olesen, Bente Ruyter.
Start term: June block
Terms: June block
Mandatory activities: Approved excursion report.
Prerequisites: Basic knowledge of chemistry and biochemistry.
Type of course: Lectures: 45-50 hours. Excursion: 4 days.
Contents: Central and current topics on quality of aquaculture products are presented during lectures. The industry\'s focus on product quality, problems and improvements will be addressed during excursions and visits to applied research institutions. The student is expected to present her/his impressions in the excursion report which has to be approved before the examination.
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.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Written multiple choice examination.
Examination aids: No calculator, no other examination aids

AKX300 Aquaculture, Special Course

Aquaculture, Special Course

Credits: 5 **Language:** English
Staff/institute: Kjell-Arne Rørvik/ IHA
Teachers: Several.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: All student projects are compulsory.
Prerequisites: Bachelor\'s degree in Aquaculture.
Type of course: 2-4 hours per week
Contents: The course starts with the identification of areas of current interest for the fish farming industry. Based thereupon, topics are decided for student-prepared discussions, lectures given by teachers or guest lectures from the industry.
Learning outcomes: Students will acquire an interdisciplinary understanding and technical independence in the area of aquaculture.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral presentation of project counts 100%.

AOS233 Strategiske prosessar og avgjerdetaking

Strategiske prosessar og avgjerdetaking

Credits: 10 **Language:** English
Staff/institute: Carl Brønn/ IØR
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years
Prerequisites: General knowledge of economics and organisation theory concepts.
Credit reduction: AOS232: 10 credits.
Type of course: Approx. 50 hours.
Contents: Definition and characteristics of wicked problems. Processes for working with wicked problems. Cognitive influences on perception and issue definition. Stakeholder analysis. Modelling dynamic resource systems and the strategic architecture. Alternate futures, scenarios and flight simulators. Implementation - politics and negotiations.
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—product designers, planners, program managers and policy makers. All warn that traditional methods of problem solving are not working and no apparent alternatives are in sight. Wicked problems have the following characteristics: 1) there is no agreement about “the problem;” the formulation of the problem IS the problem. 2) There is no agreement on a solution. Stakeholders put forward many competing “solutions” none of which have stopping rules to determine when the problem is solved. 3) The problem solving process is complex because constraints, such as resources and political ramifications, are constantly changing. 4) Constraints also change because they are generated by numerous interested parties who come and go, change their minds, fail to communicate, or otherwise change the rules by which the problem must be solved. Upon completion of the course, students will be able to properly characterize complex problem situations and apply a range of methodologies for effectively working with relevant stakeholders in the problem context.
Methods of examination: Final **Grading:** A-F
Assessment methods: The assessment is based on a semester assignment: 100%.

AOS332 Strategy Dynamics

Strategy Dynamics

Credits: 10 **Language:** English
Staff/institute: Carl Brønn/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities:
Type of course: The course will be organised as 4 hour weekly sessions over 13 weeks.
Contents: Fundamental principles of dynamic systems; mapping of stock-and-flow structures; connecting feedback to stock and flow structures; the dynamic resource perspective on strategy, interactions between operations, strategy, and human resource policy, managing instabilities in supply chains; applications - scenarios and management flight simulators.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: 3 deliverables (50% total) and a final written examination (50%)

APL405 Framing the PhD

Framing the PhD

Credits: 5 **Language:** English upon request
Staff/institute: Caroline Hägerhäll/ ILP
Teachers:
Start term: Autumn parallel
Terms: By demand
The course is offered: Other - Emnet tilbys ved behov
Mandatory activities:
Prerequisites: Accepted as PhD student
Type of course:
Contents: Assignments and exercises with subsequent seminars where the students take an active part in giving each other feedback. This is complemented by key lectures. Specific focus is given to the use of literature and an understanding of the relationship between research questions, theory and method in the students own thesis topic. The need of the individual students is in focus and hence the course maintains some flexibility to adjust the content and time spent on each theme in dialogue with the participating students. The following themes are addressed in the course: Personal strengths and challenges including expectations and models for supervision. Information retrieval and reference management How to read scientific papers Different uses of a literature review Theory in relation to method. Research topic in relation to research questions Writing as a thinking tool Communicating your thesis topic
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

APL406 Academic writing

Academic writing

Credits: 5 **Language:** English upon request
Staff/institute: Inger-Lise Saglie/ ILP
First time the course is offered: SPRING 2012
Start term: January block
Terms: January block
Mandatory activities: 70 % attendance, exercises, presentation
Prerequisites: Enrolled as PhD student
Type of course:
Contents: The course is tied to the students\' own work with their thesis and will be directed to their practical needs. The course is structured around lectures and seminars. Emphasis is placed on practical exercises.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

BIN300 Statistical Genomics

Statistical Genomics

Credits: 10 **Language:** English
Staff/institute: Theo Meuwissen/ IHA
Teachers: Odd Arne Rognli (IKBM), Åsmund Bjørnstad (IPM).
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: All independent assignments.
Prerequisites: STAT200 or HFX300.
Type of course: 52 hours.
Contents: - Mapping of single genes and markers, - mapping of Quantitative Trait Loci (QTL), - fine scale mapping of QTL based on linkage disequilibrium, - genomic selection.
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.
Methods of examination: Final Written exam **Grading:** A-F
Examination aids:

BIN310 Models and Algorithms in Bioinformatics

Models and Algorithms in Bioinformatics

Credits: 10 **Language:** English upon request
Staff/institute: Lars-Gustav Snipen/ IKBM
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years

Mandatory activities: A report will be written on a topic announced at the start of the course. There will also be an oral presentation of the report.
Prerequisites: Introduction to bioinformatics equivalent to BIN210. Programming knowledge equivalent to INF120. Statistics equivalent to STAT250.
Type of course: Lectures: 2 hours per week. Computer lab exercises: 4 hours per week.
Contents: There are weekly lectures and supervised exercises in the computer lab. It is important that students try to solve the exercises prior to attending the supervised computer lab. The computer lab can then be used to clarify difficult topics.
Learning outcomes: Knowledge, 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 should 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.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral exam.

BIN350 Genome Analysis, Methodology

Genome Analysis, Methodology

Credits: 5 **Language:** English upon request
Staff/institute: Dag Inge Våge/ IHA
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Yes.
Prerequisites: BIN210. In addition at least one of the courses: BIO210, HFM200 or BIO220
Type of course: Weeks 36-49: 2 hours per week (28 hours total).
Contents: Lectures linked to the knowledge goals of the course are given in combination with practical exercises where the students learn to find and use different tools to analyse information in databases. Technical contents: Overview of genomic resources in the form of publicly available databases. Actual areas of usage for this information. Important tools for working with such information. Practical exercises covering the use of these tools.
Learning outcomes: Students shall be able to give an overview of important genome resources, explain how these are organised in information databases, and on an individual basis be able to evaluate which of these resources are most relevant in real-life cases.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Two approved hand in assignments and one final exam (evaluation: A-F). The final exam will take place at a data-room with access to internett.

BIO220 Eucaryot Molecular Biology

Eucaryot Molecular Biology

Credits: 5 **Language:** English upon request
Staff/institute: Hilde-Gunn Opsahl Sorteberg/ IPM
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Study groups and semester assignment presentations (at least 80% attendance).
Prerequisites: BIO120.
Type of course: Lectures: 22 hours. Work in study groups and a presentation: 15 hours.
Contents: Theory with elements of problem-based learning, oral presentation of parts of the material and regular lectures. The course covers how gender is decided genetically, a survey of genome sequencing and the use of organisms\' DNA. Gene

regulation including GMO and the genetic component of cancer. The students will also gain an increased understanding of how genes determine the resulting organism, including food quality.
Learning outcomes: Here, we will guide the students from a genetic understanding to application of their genetic knowledge (theory and practical experience from laboratory experiments) and analysis. The knowledge they are to gain is on eucaryote genetics and on the understanding of genes and genomes. This course provides a basis for further studies in biotechnology, livestock breeding, food, plant breeding, bioinformatics and medicine. Students should also learn how to use literature for solving problems, with elements of problem-based learning in colloquia. This is to repeat the basis of molecular biology as well as opening up for increased current learning. Optionally, a term paper can be written for 5 extra credits individual work in addition to BIO220. This requires a thoroughly written paper using primary litterature according to scientific standards for publications.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The written exam counts 70% and the semester assignment presentation counts 30 %. Both must be passed.

BIO243 Biotechnology in Plants

Biotechnology in Plants

Credits: 15 **Language:** English upon request
Staff/institute: Trine Hvoslef-Eide/ IPM
Teachers: Åsmund Bjørnstad Odd Arne Rognli Magnor Hansen
First time the course is offered: SPRING 2011
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Particiaption in laboratory exercises and hand-in of the report from these exercises is obligatory
Prerequisites: Basic knowledge of genetics (BIO120) and plant physiology (BOT130)
Credit reduction: none
Type of course: There will be some variation in the amount of work each week, since laboratory exercises are more frequent at the beginning of the semester, in order for the plants to develop far enough to show results by the end of the semester.
Contents: The course is offered through lectures and laboratory exercises (part A & B). The students will have somewhat uneven hours in the laboratory exercises depending on the theme of the week. The lab exercises will be in smaller student groups. We expect the students to have read the chapter in the lab exercise book on the goal and methods prior to the lab. The students follow their own cultures through the semester and can take their own plants homw at the end (except GM plants). A: DNA extractions, PCR, interpretation of gels,genetic markers used for marker assistant breeding (MAS). The plant genome: construction, polyploid plants, mutations, alternative methods of mutation (TILLING), genetic maps, quantitative and qualitative characters, theory on selection based on geno- and phenotype, the genetic foundation for resistance, quality etc. (Lecturer: Åsmund Bjørnstad). B: Celle- and tissue culture: In vitro propagation through adventitious and axillary propagation (different tissues), disease elimination through meristem cultures, chimeras and their importance in propagation, somatic embryogenesis, double haploids, gene modifications, reverse genetics, gene expression. (Lecturers: Trine Hvoslef-Eide and Magnor Hansen) C: Genetically modified crops: Current and potential role in plant production, potential and limitations of different types of transgenes, risk assessments, laws and regulations in Norway (and EU), internationally related to genetically modified (GM)crops. (Lecturers: Trine Hvoslef-Eide, Åsmund Bjørnstad og Odd Arne Rognli). There will be the possibility for the students to expand the course with a thematic essay on a chosen topic.
Learning outcomes: The course will introduce the students to the different biotechnological methods used in plants and their role in modern research in biology as well as in the production of food, feed and other plant products. The students should be able to understand how biotechnology may supplement or replace traditional methods in propagation and breeding. The course consists of both lectures and laboratory exercises, the themes covered are: A: DNA extractions, PCR, interpretation of gels,genetic markers used for marker assistant breeding (MAS). The plant genome: construction, polyploid plants, mutations, alternative methods of mutation (TILLING), genetic maps, quantitative and qualitative characters, theory on selection based on geno- and phenotype, the genetic foundation for resistance, quality etc B: Celle- and tissue culture: In vitro propagation through adventitious and axillary propagation (different tissues), disease elimination through meristem

cultures, chimeras and their importance in propagation, somatic embryogenesis, double haploids, gene modifications, reverse genetics, gene expression. C: Genetically modified crops: Current and potential role in plant production, potential and limitations of different types of transgenes, risk assessments, laws and regulations in Norway (and EU), internationally related to genetically modified (GM)crops.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written exam counts 50% and jounal counts 50%. Both parts have to be passed.

BIO300 Microscopy Techniques

Microscopy Techniques

Credits: 10 **Language:** English upon request
Staff/institute: Elin Ørmen/ IPM
Teachers: Elin Ørmen, Hilde Kolstad and Trine Hvoslef-Eide
Start term: January block
Terms: January block Spring parallel
Mandatory activities: Exercises, demonstrations.
Type of course: Lectures: 10-12 hours per week. Demonstrations: 2-3 hours per week. Training: 10-12 hours per week Exercises: 10-15 hours per week. Additional lectures: Internet-based individual study and journals. Practical work ends with a review of the exercises/journals. Summary and discussion of the course readings.
Contents: Lectures on general optics covering the following topics: Electromagnetic radiation, resolution ability, magnification, refractive index, diffraction, phase shifting, interference. Special optics: The general ray paths in LM, CLSM, SEM and TEM, various depiction methods and optical methods for increasing the contrast in LM, SEM, CLSM and TEM. Sample treatment: general methods in LM, SEM, CLSM and TEM (fixation methods, dehydration, castings, drying, cryomethods) general and special colouration methods. Demonstrations, teaching and exercises give a thorough introduction to the use of the microscopes and their various depiction techniques. Exercises where the students are to learn to make critical evaluations of the most appropriate methods to apply based on the problem and the nature of the sample.
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).
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The following will be evaluated: An approved journal: 1/3 of final grade. An written examination: 2/3 of final grade. Both parts have to be passed. The students\' qualifications are tested through: a) results of every exercise, b) course journal. Student\'s theoretical knowledge and understanding are tested by a final written examination. The journal must be approved before one can take the final examination.

BIO301 Advanced cell biology

Advanced cell biology

Credits: 10 **Language:** English upon request
Staff/institute: Tor Erling Lea/ IKBM

Teachers: Charlotte Kleiveland, Trine Nilsen, Lene Therese Olsen Hult
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Cell biology corresponding to BIO100. Biochemistry corresponding to KJB200.
Type of course: Lectures 4 hrs per week. Colloquia 8 hours.
Contents: The main focus of the course will be on the understanding of mechanisms for cell communication, different receptor groups, principles for intracellular signal transduction including adapter proteins, scaffolding proteins and activation of central transcription factors. The course will also give the students an introduction to central concepts of stem cell biology.
Learning outcomes: After completing the course, students should have a thorough understanding of molecular mechanisms of eukaryotic cell biology and important concepts of stem cell biology. Understanding the principles of cell communication, cell interaction and intracellular signal transduction will be given priority. The students should acquire knowledge about central signaling pathways controlling cell growth and differentiation processes, how these signaling pathways are regulated and which transcription factors that are affected. These learning aims should contribute to the students\' development of skills, enabling them to acquire relevant literature on the subject and to formulate scientific problems within cell biology.
Methods of examination: Final Written exam **Grading:** A-F
Examination aids: No calculator, no other examination aids

BIO320 Development Biology

Development Biology

Credits: 5 **Language:** English upon request
Staff/institute: Hilde-Gunn Opsahl Sorteberg/ IPM
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course will be given again spring 2012, then 2015 and every odd numbered year from then again.Kurset vil også gå våren 2012, våren 2015 og deretter igjen hvert oddetallsår.
Mandatory activities: Presentation of one\'s own semester assignment and the presentation of the other semester assignments (students must be present at at least 70 % of the presentations).
Prerequisites: BIO220 or equivalent.
Type of course: 12 lectures, writing and presentation of own semester assignment, and attendance at the presentations of the other semester assignments
Contents: Examples of model organisms in development biology are covered, with emphasis on the fruit fly and Arabidopsis. Principles of development and the significance of genetic regulation are illustrated by these examples. Two semester assignments, one of which is of the students\' own chioce, as well as a project where students go in-depth into a particular area (project title selected in collaboration with teacher), make the course up-to-date and varied through the use of recent primary research articles.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The semester assignments make up 40% of the grade, while the oral examination (ca. 25 minutes) makes up the other 60%. Both parts must be passed.

BIO321 Population Genetics and Molecular Evolution

Population Genetics and Molecular Evolution

Credits: 10 **Language:** English
Staff/institute: Odd Arne Rognli/ IPM

Teachers: Siri Fjellheim, Simen Rød Sandve
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities:
Prerequisites: BIO120 - Introduction to Genetics, MATH100 - Introductory Mathematics, STAT100 - Statistics.
Type of course: Lectures: 2 hours per week for 12 weeks. Student presentations: 2 hours per week for 12 weeks.
Contents: Topics: Genetic Variation; The Hardy-Weinberg Principle; Recombination, Linkage and Disequilibrium; Basic Models for Natural Selection; Mutation; Genetic Drift; Inbreeding and Non-random Mating; Population Subdivision and Gene Flow; Molecular Population Genetics; Molecular Evolution and Phylogenetics; Advanced Models for Natural Selection; Quantitative Genetics.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Oral examination that counts 60% towards the final grade. Examination based on the complete syllabus, i.e. textbook chapters and selected articles. Grading of the presentation of articles in the class and compulsory assignments counts 40% towards the final grade.

BIO322 Molecular Genomics

Molecular Genomics

Credits: 10 **Language:** English upon request
Staff/institute: Dag Inge Våge/ IHA
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Yes.
Prerequisites: BIO210/211, BIO220 or HFM200.
Type of course: Weeks 36-49: Lectures/Student presentations of review papers.
Contents: The course content is the construction and regulation of complex genomes including techniques used to study these. More specifically, this includes central methodology on functional genome research, comparative genome analysis, genetic and physical mapping of genomes, genome sequencing, gene expression and methods for proteome analysis. Lectures related to the learning goals are held during the whole semester.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Approved semester assignment and written exam.

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

Evolution in Host-Pathogen Systems; Plant Breeding for Resistance

Credits: 10 **Language:** English
Staff/institute: Åsmund Bjørnstad/ IPM
Teachers: Morten Lillemo.
Start term: January block
Terms: January block Spring parallel
The course is offered: Even years
Mandatory activities: Prestentations must be passed.
Prerequisites: BIO221 (introductory Plant Breeding, PLV220 (Introductory Plant Pathology)/PLV200 Diseases, pests and weeds in crop plants or courses at similar level.
Type of course: The course is divided in greenhouse experiments and group discussions/lectures.
Contents: Host-pathogen interaction is characterized by rapid evolutionary adaptation, particularly in man-made environments. It was discovered that resistance in plants follow Mendel\'s laws, opening the door for homogeneous resistant variants. Such resistance has in many cases proved short-lived because it has triggered a selection benefiting virulence in the pathogen. There are, however great variations in host/pathogen systems. Incomplete resistance or the use of heterogenity can be more stable, but is the farmer or the consumer ready to accept this? How can we control the resistance in natural resources in a sustainable manner? The course will use review articles and on-line resources to draw the line from Mendel to molecular genetics and genetic modification.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination counts 100%. Presentations must be passed.
Examination aids: No calculator, no other examination aids

BIO324 Adaptation of plantes to climate

Adaptation of plantes to climate

Credits: 10 **Language:** English upon request
Staff/institute: Åshild Ergon/ IPM
Teachers: Jorunn Olsen, Odd Arne Rognli, Sissel Torre, Åsmund Bjørnstad
First time the course is offered: SPRING 2012
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Presentations in colloquia
Prerequisites: Basic knowledge of genetics (BIO120), plant physiology (BOT200)
Credit reduction: .
Type of course: 2-4 hours per week
Contents: Climatic factors and distribution of plant species. Effects of climatic factors and climate change on plants: direct effects and physiological responses - temperature, water, light, carbon dioxide, other conditions affected by climate change (e.g. changes in nutrient availability and plant pest situation). Phenotypic plasticity. Genetic flexibilty of plant populations - evolutionary adaptation to climate change. Plant breeding in a climate change context.
Learning outcomes: The course will provide broad knowledge on how plants respond and adapt to climate and other environmental conditions. This includes adaptation in the short term (how plants perceive seasonal and other environmental cues and adapt phenotypically) and 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.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Final oral exam counts 100%.

BIO330 Environmental Microbiology

Environmental Microbiology

Credits: 10 **Language:** English upon request
Staff/institute: Åsa Helena Frostegård/ IKBM
Teachers: Lars Bakken
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: 8 seminars (2 hours each). Must attend at least 7 of the 8 seminars. Written report from one seminar.
Prerequisites: Basic Microbiology equivalent to BIO130, Microbial Physiology, Genetics, and Systematics equivalent to BIO230.
Type of course: Lectures: 2 hours, 2 times per week (40 hours in total). Study groups where questions related to the course readings will be discussed: 2 hours every other week. Seminars: 2 hours per week.
Contents: Taking a series of environmental problems of current interest as the point of departure, central topics in aquatic and terrestrial microbial ecology are dealt with: The interaction between micro-organisms and between eucaryotes and micro-organisms; Interaction of micro-organisms with their surroundings; Kinetics of microbial growth and nutrient uptake, starvation; Transport; Biogeochemically relevant functional groups; Molecular methods in microbial ecology. Applied topics: the bioremediation, spread and establishment of pathogens, genetically modified microorganisms, biological control. The course is based on lectures on selected topics, literature seminars and group discussions related to the curriculum. The lectures cover the most central topics in the textbook. Primary scientific articles are used for the literature seminars. The students are to comment on these and discuss them in plenary.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Contribution to seminars is evaluated during the semester. Final written exam that has to be graded E or better. Grade weight for seminars: 3/10. Grade weight for written exam: 7/10 . The written exam is 3.5 hours.

BIO332 Experimental Molecular Microbiology

Experimental Molecular Microbiology

Credits: 10 **Language:** English upon request
Staff/institute: Åsa Helena Frostegård/ IKBM
Teachers: Sigve Håvarstein, Ingolf Nes
Start term: January block
Terms: January block Spring parallel
Mandatory activities: Lectures, seminars and laboratory exercises.
Prerequisites: Biochemistry equivalent to KJB200. General microbiology equivalent to BIO230. Molecular biology equivalent to BIO210.
Type of course: January block: three weeks (120 hrs) laboratory course, with some lectures. Spring parallel: 2 seminars / lectures per week in the first half of the parallel, will be announced by the course responsible. Submission of written report: week 9; Oral exam: week 11 or 12.
Contents: The course is an intensive laboratory course during weeks 1-3. A few lectures will be given. In addition, a number of scientific primary articles relevant for the experimental work will be discussed in seminars during the first part of the spring semester. The students write a report from the laboratory exercises, in which relevant scientific literature is referred. The laboratory exercises cover methods used for: - measurement of gene expression and biological diversity in various ecosystems - characterisation and identification of bacteria - horizontal gene transfer - genetic regulation - micro array analyses. Interpretation of results and discussions on the various methods. Students write an individual, final report.

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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The lab. report will be evaluated internally. The students write an extensive report from the laboratory exercises which should include introduction, materials and methods, results and discussion, plus references to relevant scientific articles. Each student hands in an independent assignment. In addition, there will be an oral exam where the student is asked questions concerning the written report and a curriculum consisting of a set of scientific articles on related topics. An external examiner will participate at the oral exam. Grades A-F will be given for both the written report and the oral exam (contributing 50% each to the final grade), and both parts have to be approved.

BIO333 Mycology

Mycology

Credits: 10 **Language:** English upon request
Staff/institute: Arne Tronsmo/ IKBM
Teachers: Linda Hjeljord
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Mandatory activities: Active participation in at least 80 % of the seminars and the laboratory exercises.
Prerequisites: General microbiology equivalent to BIO130. General genetics equivalent to BIO120. Microbial physiology equivalent to BIO230. Molecular biology equivalent to BIO210
Type of course: Lectures: 4 hours per week. Seminars or experimental work: 4 hours per week.
Contents: The course covers modern fungal systematics, cell biology, metabolism and genetic regulation. The sexual and asexual propagation of lower and higher fungi will also be covered. In addition, a thorough introduction to fungal physiology is given. Interactions between fungi and the use of fungi in biological control of fungal diseases, as well as fungal biotechnology are focused upon.
Learning outcomes: The students will have an overview over basic fungal systematics, -genetics, -physiology and -ecology. Students will have acquired knowledge of industrial uses of fungi, their applications in the biological control of plant diseases. The students should be able to consider possible positive and negative effects of fungi, suggest actions to limit any possible risks, and be able to classify fungi using morphological techniques.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Continuous evaluation of performance during the seminars and report from the experimental work count 4/10, and the oral exam counts 6/10.

BIO340 Bioethics

Bioethics

Credits: 5 **Language:** English upon request
Staff/institute: Sissel Rogne/ INA
Teachers: Deborah Oughton.
Start term: January block
Terms: January block

Mandatory activities: Participation in lectures is compulsory.
Prerequisites: General bio- and gene technology or solid competence in general biology.
Type of course: Lectures and discussions: 20 - 30 hours.
Contents: Lectures will be held intensively for the first week of the course with the following topics: 1: Legislation. 2: Risk assessment and consequence analyses. 3: Ethics and ethical evaluations. During the rest of the course, the students will write a semester assignment on a subject of their own choice.
Learning outcomes: Students should get acquanted with the legislation in the field and know the central participants that researchers work with. Since the legislation requires consequence and risk evaluation as well as ethical argumentation, this must also be known to the students. Students are to be capable of holding a discussion on the ethical and social consequences of the use of modern biotechnology in the way it is required in cases of applications for exposing or performing field experiments on genetically modified organisms or for conducting clinical research on genetic engineering.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Semester assignment.

BIO350 In Situ RNA Hybridisation Techniques

In Situ RNA Hybridisation Techniques

Credits: 5 **Language:** English upon request
Staff/institute: Trine Hvoslef-Eide/ IPM
Teachers: Tone Melby
Start term: January block
Terms: January block
Mandatory activities: Practicals in the laboratory and journal
Type of course: There will normally be activities from 9am-4pm each day, with some modifications depending on how much time is spent.
Contents: The course consists of lectures to give the theory, but mostly practicals to illustrate the whole process. The students can bring their own biological material to the first day of class, in agreement with the teacher, so that preparations can be made. The students have to hand in a lab journal that has to be approved.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Submitted laboratory report counts 100%.

BIO351 Geneticallly Modified Plants - Case Study

Geneticallly Modified Plants - Case Study

Credits: 5 **Language:** English upon request
Staff/institute: Trine Hvoslef-Eide/ IPM
Teachers: Odd Arne Rognli.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation when the student groups present their cases and the evaluation of the case by the \'authorities\' (i.e. the student group who evaluated the case)
Type of course: 2 lecture hours each week, either lecture or self-study depending on the students\' needs.

Contents: The course is focused on problem-based learning, where only a few lectures will be given. The students will spend most of their time working in pairs using material supplied through Classfronter and web links. The first part of the course will be spent writing a proposal to the authorities for deliberate release of a particular GMO. Then the students swap cases and evaluate each other s proposals, as if they were the authorities. Two reports will be made during the course, one of which will also be given as an oral presentation to the class.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: 2 reports: the first (application for deliberate release) accounts for 70% and the second (evaluation by the competent authority) counts 30%. Presentation for the class. Both parts have to be passed.

BIO420 Advanced Developmental Biology

Advanced Developmental Biology

Credits: 10 **Language:** English upon request
Staff/institute: Hilde-Gunn Opsahl Sorteberg/ IPM
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course is offered spring 2012, spring 2015 and then every odd years. Kurset vil også gå våren 2012, våren 2015 og deretter igjen hvert oddetallsår.
Mandatory activities: The students are required to attend at least 50% of the presentations and discussion groups.
Prerequisites: BIO220.
Credit reduction: BIO320 - 5 credits.
Type of course: 20 lectures, semester assignment, discussion groups for presentations and writing of semester assignment.
Contents: Model organisms in developmental biology are covered, i.e. the fruit fly and Arabidopsis. Principles of development and the significance of genes in controlling this. The project gives the students depth in one topic and ensures that the syllabus changes every year due to updated primary articles, which act as a point of departure for assigned projects.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The semester assignment counts 33%. Continuous assessment for the student and the oral examination make out the rest of the evaluation. The oral examination is expected to last 25 minutes. Evaluation of activities in the course, presentation and semester assignment, and a final oral examination.

BIO421 Population Genetics and Molecular Evolution

Population Genetics and Molecular Evolution

Credits: 15 **Language:** English
Staff/institute: Odd Arne Rognli/ IPM
Teachers: Siri Fjellheim, Simen Rød Sandve
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities:
Prerequisites: BIO120 - Introduction to Genetics, MATH010/MATH100 - Introductory Mathematics, STAT100 - Statistics.
Credit reduction: Credit reduction in relation to BIO321: 10 credits.
Type of course: Lectures: 2 hours per week for 12 weeks. Student presentations: 2 hours per week for 12 weeks.Presentation and discussion of semester assignment: 3 hours.
Contents: Topics: Genetic Variation; The Hardy-Weinberg Principle; Recombination, Linkage and Disequilibrium; Basic Models for Natural Selection; Mutation; Genetic Drift; Inbreeding and Nonrandom Mating; Population Subdivision and Gene Flow; Molecular Population Genetics; Molecular Evolution and Phylogenetics; Advanced Models for Natural Selection; Quantitative Genetics.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Oral examination that counts 75% towards the final grade. Examination based on the complete syllabus, i.e. textbook chapters and selected articles, and in addition the term paper. Grading of the presentation of articles in the class and compulsory assignments counts 25% towards the final grade.

BIO422 Nordic Postgraduate Course in Plant Breeding

Nordic Postgraduate Course in Plant Breeding

Credits: 5 **Language:** English
Staff/institute: Åsmund Bjørnstad/ IPM
Teachers: Nordic teachers and invited teachers.
Start term: January block
Terms: January block
Mandatory activities: Colloquia on literature, submission of abstract of assigned talk.
Prerequisites: Basic courses in genetics and plant breeding, preferably also at 300-level. To have costs covered the student should have the course as part of the Ph.D. study plan (not restricted to students having plant breeding as the major topic).
Type of course: Lectures/colloquia: 2-4 hours/week on a 500-page long compendium of selected papers. Intensive course week.
Contents: Compendium with original literature. Topic given before lecture. Participation in the course week.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Intensive course, 1 week. Abstract and 45 minute lecture on an assigned topic within the course agenda. Active participation in discussions. Abstract and lecture count 100%.

BOT200 Plant Physiology

Plant Physiology

Credits: 10 **Language:** English upon request
Staff/institute: Jorunn Elisa Olsen/ IPM
Teachers: Engineer Linda Ripel, IPM personel
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Approved laboratory course with approved participation and approved reports.
Prerequisites: BOT130, KJM100.
Type of course: Lectures: 26 hours. Laboratory course: 30 hours. Colloquia are given at the end of the course.
Contents: The topics of the course are the metabolism and regulation of growth and development in plants as well as the effects of environmental and climatic factors in these respects. The experimental nature of the field is emphasised by experimental work related to the topics of the course as well as by reporting experimental results.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination
Examination aids: No calculator, no other examination aids

BOT201 Physiology of Plant Production

Physiology of Plant Production

Credits: 5 **Language:** English upon request
Staff/institute: Marina Azzaroli Bleken/ IPM
Teachers: Knut Asbjørn Solhaug (INA), Sissel Torre
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: A number of laboratory exercises and exercise in the class. Delivering og the laboratory journal and written exercises. Attendance at first lecture. Precise information will be given at the beginning of the course.
Prerequisites: BOT130,BOT200
Type of course: Altogether 40 teaching hours: 16 lecturers, 14h laboratory exercises, and 10 hours with exercises in the class
Contents: Analysis and modelling of plant growth. Effect of light, temperature and other climatic factors. Phenological and morphological development. Leaf area index, light interception, photosynthesis and net radiation use efficiency. Potential plant growth, water limited and nitrogen limited plant growth. Allocation (root, shoot/leaf, storage organs) and translocation of assimilates to different plant organs through the growing season.
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
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam counts 100%. The laboratory journal and a given number of written exercises must be approved before the student has access to the examination
Examination aids:

BOT230 Plant Ecology and Diversity

Plant Ecology and Diversity

Credits: 10 **Language:** English upon request
Staff/institute: Mikael Ohlson/ INA
Teachers: Manfred Heun
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Participation in exercises and in class presentation of results.
Prerequisites: BOT100 and ECOL100.
Type of course: Exercises and demonstrations in the field: 40 hours. Lectures: 10 hours. Seminars and in class presentation of results from the field-exercises: 40 hours.
Contents: Field demonstrations, field teaching, independent field work exercises, oral presentations, lectures, and writing of an individual term paper.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: The examination consists of approval of field reports and result presentations. In addition the candidate has to deliver an approved term paper. All parts must be approved to pass the course.

BOT240 Plant Ecophysiology

Plant Ecophysiology

Credits: 10 **Language:** English upon request
Staff/institute: Knut Asbjørn Solhaug/ INA
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Even years
Prerequisites: BOT130.
Type of course: There will be approximately 24 hours of lectures, 24 hours of group study and 40 hours of laboratory work. In addition, students can get individual supervision in, for example, the writing of lab journals.
Contents: The main emphasis of the lectures is on the physiological adjustment of the photosynthesis, mineral nutrition and water balance of plants in response to different and varying external conditions. Much emphasis will be placed on the effects of climate changes. Experimental laboratory exercises will go more thoroughly into the lectures and parts of the syllabus will be discussed in colloquia.
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.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: A final written exam, 3 hours, counts 2/3 of the grade. Laboratory report counts 1/3 of the grade. All of the evaluated elements in the course must be passed to pass the course.

BOT320 Advanced Course in Plant Developmental Physiology

Advanced Course in Plant Developmental Physiology

Credits: 15 **Language:** English
Staff/institute: Christiaan van der Schoot/ IPM
Teachers: Rinne, Päivi L.H
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: A 30 minute ppt seminar on 1-2 recent scientific publications.
Prerequisites: BOT200 or similar, middle level plant physiology of plant biology.
Credit reduction: .
Type of course: Lectures: 30 hours. (or: lectures 20 hours. Colloqia 12 hours. Labclasses 50 hours)
Contents: The course focuses on the growth and organisation of higher plants, including plant developmental physiology and cell biology. Particular attention is given to organisation of life processes, including transport and signalling processes.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Continuous assessment: -Oral examination counts 50 % of the grade. -An assignment counts 25 % of the grade. -An oral presentation counts 25 % of the grade. All parts must be passed.

BOT340 Photobiology

Photobiology

Credits: 10 **Language:** English upon request
Staff/institute: Knut Asbjørn Solhaug/ INA
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Prerequisites: BOT130 and BOT240.
Type of course: The will be approximately 20 hours of lectures, 30 hours of seminars/study groups and 50 hours of laboratory work. In addition, the students receive individual guidance in presenting their results in the form of a poster/oral presentation/research article.
Contents: In the lectures, photosynthesis will be thoroughly covered and emphasis will be put on plants\' adaptation to UV-radiation. The laboratory exercises will be arranged as a project where the students, under guidance, learn how to use modern photosynthesis measurement equipment and present the results as a scientific article, a poster and a short lecture. Parts of the syllabus will be presented in groups/colloquia. The contents and the arrangement of the course can, to a certain extent, be adapted to the interests of the students.
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.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The oral exam (40 minutes) counts 2/3 of the grade. Presentation of the lab results counts 1/3 of the grade. The presentation of results will consist of an oral presentation, a poster and a scientific article. All of the evaluated elements in the course must be passed to pass the course.

BUS230 Operation Research

Operation Research

Credits: 10 **Language:** English upon request
Staff/institute: Marie Steen/ IØR
Teachers: Teaching assistants. Guest lecturers.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Introductory courses in mathematics, statistics and micro economics.
Credit reduction: BUS231 - 10 credits, BUS232 - 5 credits.
Type of course: Lectures: 2 hours per week. Class hours for exercises: 2 hours per week.
Contents: Introduction to modelling, extensive use of spreadsheets in quantitative decision making models, linear programming, integer programming, network modelling, non-linear modelling, goal programming.
Learning outcomes: To give students a solid basis for using quantitative decision-making methods, where linear programming will be central, in solving economic problems. The main focus of the course will be on formulating and solving different problems. As well, the economic significance of the results will be central. There will be focus on discussing the strengths and weaknesses of the different methods and the fact that models will always be a simplification of reality. The course will to a certain degree focus on issues connected to agriculture and resource management.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written examination counts 100%.
Examination aids: Simple calculator, no other examination aids

BUS233 Management Information Systems

Management Information Systems

Credits: 5 **Language:** English
Staff/institute: Kjell Gunnar Hoff/ IØR
Teachers: Joe Valacich is the George and Carolyn Hubman Distinguished Professor of MIS at Washington State University. His teaching interests include systems analysis and design, IT project management, and the management of information systems. He has conducted numerous corporate training and executive development programs for organizations, including: AT&T, Boeing, Dow Chemical, EDS, Exxon, FedEx, General Motors, Microsoft, and Xerox. He previously served on the editorial boards of MIS Quarterly (two terms) and Information Systems Research, and is currently serving on the boards at Decision Science and Small Group Research. His primary research interests include technology-mediated collaboration, human-computer interaction, mobile and emerging technologies, e-business, and distance education. He is a prolific researcher, with more than 60 journal publications in numerous prestigious journals. He is also the co-author of several best-selling textbooks and is a leader in designing national curricula and accreditation standards for the information systems discipline.
Start term: June block
Terms: June block
The course is offered: Even years
Prerequisites: BUS133 - Excel for Business
Contents: We will examine how organizations choose technological innovations and investments, manage and design the information system architecture, enable commerce using Internet technologies as well as gain business intelligence by acquiring, designing, and securing their information systems investments. In addition, the course will examine how

information systems influence numerous ethical issues facing organization and society such as data privacy and ownership as well as how information systems are enabling computer crime and cyber terrorism.
Learning outcomes: Today, information systems are an integral part of all business activities and careers. This course is designed to introduce students to contemporary information systems and demonstrate how these systems are used throughout organizations. Most notably, the course will extensively examine how information systems are fueling globalization making the world smaller and more competitive in virtually every industry and at an ever-increasing pace. We will focus on the key components of information systems; people, software, hardware, data, and telecommunications, and how these components can be integrated and managed to create competitive advantage.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Multiple choice, more details will be available on the ClassFronter.

BUS305 Strategy Analysis and Strategy Development

Strategy Analysis and Strategy Development

Credits: 5 **Language:** English
Staff/institute: Silja Korhonen-Sande/ IØR
Teachers:
Start term: August block
Terms: August block
Mandatory activities: This course requires intensive studying. The participants will be organized in small groups and each group will deliver a case report. Accordingly, the participation in classroom activities and groups is obligatory.
Prerequisites: AOS 130 (Introduction to organization theory) or similar knowledge, and AOS 237 (Introduction to business strategy) or similar knowledge
Type of course: The course will be organized in august with 4-8 hours structured activities per day (approx. 30 hours of structured activities, and in addition work in small groups).
Contents: The course has two main themes. Strategic positioning in relation to the analysis of industry, company resources and stakeholders, and strategic choice in relation to competitive advantage and the boundaries of the firm. The linkages between entrepreneurial and strategic thinking are discussed.
Learning outcomes: Based on the analysis of strategic action in various industry contexts, this course will give an understanding of why some firms succeed in competition and others do not. The students will deepen their knowledge of external and internal factors that influence firm strategy, and understand the antecedents and consequences of various strategic choices. The course will give the students 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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The assessment is based on case analysis assignment (40%) and written exam (60%). A retake exam is organized in the following semester for those students who passed the assignment but failed the individual exam. The grade for the semester assignment is valid only for the semester when the assignment was written.

BUS311 Environmental Accounting and Management

Environmental Accounting and Management

Credits: 5 **Language:** English upon request
Staff/institute: Ståle Navrud/ IØR
Teachers: Carl Brønn.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: ECN170 or ECN270, or an equivalent introductory course in environmental and resource economics.

Credit reduction: Overlap with ECN373
Type of course: 40 hours.
Contents: The course consists of three main parts: i) Environmental accounting: The course begins with a model of the environmental requirements that private and public enterprises are faced with and the alternative strategies that they may follow in order to fulfil these requirements from various stakeholders. Basic concepts such as sustainable development, ecological efficiency, eco-efficiency are reviewed, as well as the three bottom lines: economics, environment and corporate social responsibility, CSR. Social responsibility implies that existing and new enterprises take into consideration the rights and needs of the local population and that employees work under safe conditions with regards to health, environment and security. Then various methods for environmental accounting, life cycle assessment (LCA), environmental product declarations as well as systems for environmental labelling and certification are described, criticised and exemplified. ii) Environmental management: Environmental management for sustainable development of public and private enterprises is a dynamic and complex organisational challenge which requires adaptation and a willingness to think in new ways. Therefore, management methods for working with environmental cases must be sensitive to the social as well as to the technical consequences that this has for the organisation. Systems thinking is an analytic framework for understanding complex organisational structures as systems. In this way, the course gives an introduction to the method for thinking in systems, and shows how this can be applied to an organisation using the Balance Score Card (BSC) method. iii) Sustainable development for private and public enterprises: The course seeks to show how knowledge of environmental accounting, systems thinking, the Balanced Score Card (BSC) method and Corporate Social Responsibility (CSR) can be used as management tools for environmentally friendly and sustainable public and private enterprises.
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.
Methods of examination: Final **Grading:** A-F
Assessment methods: The semester assignment counts 100 % of the grade.

BUS314 Corporate Governance

Corporate Governance

Credits: 5 **Language:** English upon request
Staff/institute: Jonas Gaudernack/ IØR
Teachers:
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Brief written assignments
Prerequisites: Basic business, primarily financial accounting, cost accounting; finance
Type of course: Approx. 30 hours
Contents: The course will consist of traditional lecturing as well as classes, guest lectures and written assignments.
Learning outcomes: There are numerous laws and regulations related to corporate governance/risk mangagement/internal control in Norwegian companies. The course will deal with important concepts, rules and regulations, and also highlight the roles of different agents such as the borad, auditing board, administrative leadership, auditor, risk management and complience functions.
Methods of examination: Final Written exam **Grading:** A-F
Examination aids: No calculator, no other examination aids

BUS320 Empirical Analyses of Financial and Commodity Markets II

Empirical Analyses of Financial and Commodity Markets II

Credits: 5 **Language:** English upon request
Staff/institute: Ole Gjølberg/ IØR
Teachers: Ole Gjølberg, Atle Guttormsen
Start term: Autumn parallel
Terms: Autumn parallel

Prerequisites: BUS321.
Type of course: Group and individual guidance.
Contents: The students are expected to invest a significant amount of individual work in the semester assignment.
Learning outcomes: The aim of the course is to develop the students ability to conduct econometric analyses of financial and commodity markets.
Methods of examination: Final **Grading:** A-F
Assessment methods: Semester assignment.

ECN150 Introduction to Development Economics

Introduction to Development Economics

Credits: 5 **Language:** English
Staff/institute: Mette Wik/ IØR
Teachers: Ragnar Øygard, Arild Angelsen and Stein Holden.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years
Mandatory activities: Writing of one semester assignment. The paper must be approved but is not part of the final course grade.
Prerequisites: ECN110, ECN111, or EDS140.
Type of course: Lectures: 2-4 hours per week.
Contents: Who are the poor? What is growth and development? Why are some countries poor and some rich? Classical and recent theories on growth and development. Poverty and dissimilarities. Population growth. Urbanisation and migration from the countryside. Education and health. Agriculture and developments in the countryside. Environment and development. Globalisation, poverty and environment.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5 hour written examination.
Examination aids: No calculator, no other examination aids

ECN201 Econometrics

Econometrics

Credits: 10 **Language:** English
Staff/institute: Kyrre Rickertsen/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities:
Prerequisites: Mathematics (MATH100), statistics (STAT100), and microeconomics (ECN210).
Credit reduction: The course partly overlaps with ECN202 and STAT200. There is reduction in credits for ECN202 (5 credits) and STAT200 (5 credits).
Type of course: There are four hours of lectures and/or exercises per week or a total of about 50 hours of structured time. The lectures will take about 60% of the structured time and the exercises about 40% of the structured time.
Contents: The lectures in ECN201 cover two- and multiple-variable regression analysis, OLS, hypothesis testing, violations of OLS assumptions, GLS, dummy independent variables, and the use of the econometric program SHAZAM. In addition, there are problem sets, computer exercises, and a term paper.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: 60% of the final grade will be based upon a 3.5 hour written examination. 40% of the final grade will be based on a term paper. Students must have a passing grade (A-E) on both the term paper and the written examination to get a passing grade in this subject.

ECN230 International Economics

International Economics

Credits: 10 **Language:** English
Staff/institute: Roberto J. Garcia/ IØR
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities:
Prerequisites: Basic knowledge in macro- and microeconomics ECN120 and ECN210. The course is intensive in basic microeconomic principles.
Type of course: There are 20 2-hour lectures sessions with 4 lecture hours per week. There will also be 4 2-hour exercise sessions scheduled with a teaching assistant who will help with the problem sets.
Contents: This course is designed to bridge international economic theory and applied agricultural economics, providing a review of issues in development, policy, trade, and welfare.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3 hour written examination.
Examination aids: No calculator, specified other examination aids

ECN270 Resource and Environmental Economics

Resource and Environmental Economics

Credits: 5 **Language:** English
Staff/institute: Arild Angelsen/ IØR
Teachers: Caroline Rohde Wang
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Four out of five exercises approved.
Prerequisites: Microeconomics at the level of ECN212 or ECN210/211.
Credit reduction: ECN170, ECN273 and EDS240 reduced respectively with 3, 2 and 3 credits.
Type of course: 2-4 hours per week (18 * 2 hours with lectures, and 5 * 2 hours with exercise review)
Contents: Lectures and exercises will address the following issues: Economy - ecology interactions, sustainable development, cost-benefit analysis, optimal management of renewable and non-renewable resources, pollution, biodiversity conservation, land degradation and deforestation, valuation of environmental resources and accounting for the environment, international environmental agreements. The course will also emphasise issues, cases and perspectives of relevance to developing countries.

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 managment of renewable and non-renewable resources, optimal pollution, biodiversity conservation, land degradation and deforestation, valuation of environmental resources and accounting for the environment, and international environmental agreements.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written examination, 3 hours: 100 %.
Examination aids: Simple calculator, no other examination aids

ECN271 Project Evaluation and Environmental Valuation

Project Evaluation and Environmental Valuation

Credits: 10 **Language:** English upon request
Staff/institute: Ståle Navrud/ IØR
Teachers: Yohei Mitani
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: ECN170 (or ECN270)or similar introductory course in environmental and resource economics; and ECN210 or similar introductory course in microeconomics.
Type of course: 28-30 hours plus supervision of the group assignments.
Contents: The course gives an overview of theory and methods for economic appraisal of projects, in terms of cost-benefit analysis (CBA) and theory and methods for economic valuation of environmental goods; including the damage function approach, environmental and health valuation methods and benefit transfer techniques. Applications to environmental impacts from renewable and non-renewable energy investments (e.g. wind farms, hydro power plants, gas-fired power plants), noise and other impacts from transportation projects, air and water pollution policies, landscape aesthetics, biodiversity preservation, recreational fishing and hunting, marine oil spills, and health impacts from air pollution. Environmental valuation in developing countries. Laws and guidelines for CBA in Norway, EU, USA and developing countries. Welfare theoretic basis for CBA and the value judgements/assumptions made in CBA. A stepwise approach to CBA, with special emphasis on risk/uncertainty, distributional impacts, economic valuation of environmental impacts, and treatment/ presentation of non-valued impacts.
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.
Methods of examination: Final **Grading:** A-F
Assessment methods: A semester assignment (100 %), which is prepared by groups of 2-4 students. In the semester assignments the students will apply what they have learned about theory and methods to a case of their own choice, i.e. an economic analysis of a project with environmental impacts. In the semester assignment, the students will also have to answer questions from a check list, which covers the curriculum of the course.

ECN301 Econometric Methods

Econometric Methods

Credits: 10 **Language:** English
Staff/institute: Olvar Bergland/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory exercises and project work involving econometric analysis using computers. (Approved work is valid for two - 2 - years.)
Prerequisites: An introductory course in econometrics (ECN201) (or regression analysis), statistics (STAT100), microeconomics (ECN210), and linear algebra at the level of ECN302.
Credit reduction: This course replaces ECN300. A student can not be given credit for both ECN300 and ECN301.
Type of course: Class lectures: 45 hours. Laboratory work: 25 hours.

Contents: This course focuses on modern econometric methods for the analysis of economic data - both cross-sectional and time-series data. The following topics are covered: estimation and testing of linear regression models with stochastic and possibly endogenous regressors, panel data models, systems of equations, models with limited dependent variables, models of sample selection and program evaluation, and time-series models for stationary or non-stationary processes, cointegration and error correction models.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 4 hour final examination.
Examination aids: Simple calculator, specified other examination aids

ECN302 Mathematics for Economists

Mathematics for Economists

Credits: 5 **Language:** English
Staff/institute: Kyrre Rickertsen/ IØR
Teachers: Kyrre Rickertsen and Dadi Kristofersson.
Start term: August block
Terms: August block
Prerequisites: Mathematics on the level of MATH100.
Credit reduction: There are the following reductions: MATH111, 1 ECTS; MATH112, 1 ECTS; MATH130, 2 ECTS.
Type of course: There are four hours of lectures and exercises per day. About half the time will be allocated to lectures and the remaining time will be allocated to exercises.
Contents: The course covers mathematical tools that will be assumed known in courses such as, for example, ECN311 (Microeconomics) and ECN301 (Econometrics). The course is a required course for the M.Sc. degree in Economics at IØR. Topics covered in matrix algebra include: Summation operators, types of matrixes, matrix operations, Gauss-Jordan elimination, determinants, the inverse of a square matrix, matrix differentiation, Cramer\'s rule, and the matrix approach to regression. Topics covered in optimization include: Elasticities, the chain rule, unconstrained optimization, equality contrained optimization (Lagrange), inequality contrained optimization (Kuhn Tucker), implicit funtion theorem, and envelope theorem.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Three problem sets must be completed within the deadline for each set and graded as passed to pass this course.

ECN303 Impact Assessment Methods

Impact Assessment Methods

Credits: 5 **Language:** English
Staff/institute: Stein Terje Holden/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory participation in exercises
Prerequisites: Econometrics (ECN201), Statistics (STAT100), basic knowledge of STATA
Type of course: 2 hours per week, combining lecture and exercise.

Contents: Basic introduction to Impact Assessment and Overview of Methods: Establishment of causality vs. correlations. Impacts of what on what? How far can the results be generalized? Introduction and exercise in use of Matching methods, Instrumental variable methods, Control function methods, Difference-in-Difference methods, Panel data methods, Pipeline and experimental methods.
Learning outcomes: An introduction to modern impact assessment methods for quantitative assessment of impacts of changes in policies, projects, shocks and other changes. An overview of the most relevant methods, their strengths, weaknesses and areas of application. An exercise is given for each of the main methods to give students as experience with their application.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5 hours written exam
Examination aids: No calculator, no other examination aids

ECN304 Behavioral and Experimental Economics

Behavioral and Experimental Economics

Credits: 5 **Language:** English
Staff/institute: Stein Terje Holden/ IØR
Teachers: Yohei Mitani
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory exercises
Prerequisites: Econometrics (ECN201), Statistics (STAT100), Micro (ECN311)
Type of course: Two hours per week, combining lectures and exercises
Contents: Topics in behavioral economics: Rational vs. irrational behavior, uncertainty and expected utility, prospect theory, time preferences and discounting, risk preferences and responses to risk, altruism, fairness, trust. Topics in experimental design: Basic design issues, implementation of laboratory experiments, field experiments
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
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours.
Examination aids: No calculator, no other examination aids

ECN311 Microeconomics

Microeconomics

Credits: 10 **Language:** English
Staff/institute: Kyrre Rickertsen/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Five problem sets must be graded as passed before taking the examination.
Prerequisites: Microeconomics on the level of ECN210/ECN211. Mathematics on the level of ECN302 (Mathematics for economists).
Credit reduction: ECN310, 5 ECTS.
Type of course: There are four hours of lectures and exercises per week. About 60% of the time will be allocated to lectures and 40% to exercises.
Contents: The course extends the material covered in intermediate courses in microeconomics. Special emphasis is put on duality theory in economics. The lectures cover the theory of the consumer, welfare measures, the theory of the producer, and behavior under uncertainty.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: The grades will be set on the basis of a 3.5 hour written examination.
Examination aids: Simple calculator, no other examination aids

ECN312 Industrial Organisation

Industrial Organisation

Credits: 5 **Language:** English
Staff/institute: Olvar Bergland/ IØR
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Intermediate microeconomics (ECN211). Mathematics at the level of ECN302.
Credit reduction: This course replaces ECN213, a student cannot receive credits for both ECN213 or ECN312.
Type of course: Lectures: 25 hours. Group discussions: 15 hours.
Contents: The following topics are covered: partial and general equilibrium, welfare theory, non-cooperative game theory, market power, monopoly, oligopoly, horizontal and vertical relations, and strategic behavior towards entry deterence.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final examination, counts 100%, 3 hours.
Examination aids: No calculator, no other examination aids

ECN320 Macroeconomics III

Macroeconomics III

Credits: 10 **Language:** English
Staff/institute: Ragnar A. Øygard/ IØR
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Students will be assigned three individual written assignments, two of which must obtain a pass grade. Passed compulsory activities will be valid for 1.5 years.
Prerequisites: Bachelor\'s degree in economics or an intermediate course in macroeconomics at the level of ECN220.
Credit reduction: ECN352: 10 ECTS.
Type of course: 4 hours per week for lectures and exercises.
Contents: Topics in the course include: 1. Growth theory. 2. The relationship between economic growth and development. 3. Poverty and inequality. 4. Stabilization policy. 5. Current issues
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: A written examination (3.5 hours)
Examination aids: Simple calculator, no other examination aids

ECN330 Economic Integration and Trade Liberalization

Economic Integration and Trade Liberalization

Credits: 10 **Language:** English
Staff/institute: Roberto J. Garcia/ IØR
Start term: Autumn parallel

Terms: Autumn parallel
Mandatory activities: There are exercises (problem sets) and a semester project.
Prerequisites: Microeconomics, International Economics, ECN211/ECN212, ECN230, ECN 331, ECN201.
Type of course: Class will meet 6 hours per week and 42 hours total (seven weeks). This will allow time for students to work on the semester project.
Contents: The course is designed with two objectives: to complete the student\'s understanding of the basic economics of trade through a formal treatment of the macro economy and its relation to exchange rates, exchange regimes and policy; and to provide a practical understanding of economic integration and the importance of the multilateral trading system (the WTO in particular) as a platform to address issues or voice concerns related to trade in goods and services (with special emphasis on the Agreements on Agriculture, Sanitary and Phytosanitary measures, Technical Barriers to Trade). Finally, trade policy and agricultural programs in selected importing and exporting countries are discussed in terms of their compliance with WTO Agreements.
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).
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final written examination, 3.5 hours, 60%. Oral examination and semester project, 40%. The student mus pass both parts of the exam.

ECN331 International Economics and Finance

International Economics and Finance

Credits: 5 **Language:** English
Staff/institute: Roberto J. Garcia/ IØR
Start term: August block
Terms: August block
Mandatory activities: 3-4 exercises or problem sets.
Prerequisites: ECN230.
Type of course: 21 lecture hours and exercise sessions; there are seven 3-hour sessions. There is flexibility to slow down or increase the pace of meetings. Can either meet in morning sessions (09.15-12.00), afternoon sessions (14.15-17.00) or both.
Contents: Macroeconomic analysis and international trade. - Balance of payments. - Balance of trade. - Capital account. - Reserves. Exchange rates. - Law of one price, terms of trade, and purchasing power parity. - Forecasting, speculation, hedging and arbitrage: equilibrium exchange. - Modelling currency markets. Money markets and interest rate determination. - Money demand and money supply. - Interest parity and exchange rates. - Capital markets. Fiscal policy, goods market equilbrium. Monetary policy and asset market equilibrium. Alternative exchange regimes and central bank operation. Capital controls. Monetary union.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours.
Examination aids: No calculator, no other examination aids

ECN350 Development and Environment Economics

Development and Environment Economics

Credits: 10 **Language:** English
Staff/institute: Stein Terje Holden/ IØR
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory exercises. Group work/presentations.
Prerequisites: Basic knowledge in economic theory (microeconomics, macroeconomics, development economics, resource economics, econometrics, operations research. ECN200/201, ECN230, ECN353, ECN270.
Credit reduction: ECN450, 10 credits.
Type of course: Lectures: 2-4 hours per week. Exercises: 0-2 hours per week. Total: 4 hours per week (lectures and exercises).
Contents: Quantitative Development Policy Analysis. Economics of rural organisation. Natural resource economics, poverty and development.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination (3.5 hours).
Examination aids: Simple calculator, no other examination aids

ECN351 Research in Development Economics

Research in Development Economics

Credits: 5 **Language:** English
Staff/institute: Arild Angelsen/ IØR
Teachers: Stein Holden and Mette Wik
Start term: January block
Terms: January block Spring parallel
Mandatory activities: Students must attend lectures and exercises and pass compulsory assignments in order to pass the course.
Prerequisites: ECN212 Microeconomics or ECN210/211 Microeconomics II and ECN220 Economics II, ECN201 Econometrics.
Credit reduction:
Type of course: Two hours of lectures plus two hours of exercises per day for two weeks during the January block. One workshop to present the first draft of research proposals in March.
Contents: The course will cover the following topics: - How to find good research questions; - How to write a thesis and research proposal; - General writing rules; - Field research methods; - Social surveys, including sampling, questionnaire design and analysis; - Impact studies; and - Introduction to the STATA statistical package. - Introduction to literature search
Learning outcomes: In this course, students should be able to find and present a researchable topic within development economics and to write a research proposal for their thesis. In order to write a research proposal they need to be able to: - demonstrate command of existing knowledge within their research topic; - use existing knowledge to explore the issue of interest; formulate researchable research questions and/or hypotheses; - locate economic data and/or plan how to collect their own field data; and understand the methods used to compile and analyse the data.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

Assessment methods: The semester assignment (research proposal) is due late March, and makes up 100 percent of the final grade.

ECN353 Development Economics, Micro

Development Economics, Micro

Credits: 5 **Language:** English
Staff/institute: Mette Wik/ IØR
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory assignments.
Prerequisites: Intermediate Microeconomics (ECN210)
Credit reduction: With ECN251, 5 ECTS.
Type of course: Four hours of lectures and exercises per week. A more thorough lecture plan will be handed out at the beginning of the semester.
Contents: The course studies how microeconomic theory can be used for the study of developing countries. The focus is on the economics of farm households. We especially emphasise the difference between farm-household economics and conventional economics of the firm. The course will also study rural organisations (institutions), including market and non-market institutions.
Learning outcomes: The students should understand and be able to elaborate on: - how rural households and rural institutions adapt in developing countries; - why the behaviour of rural households and rural institutions in developing countries are different from the behaviour of firms and markets in developed countries.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: A 3.5 hour sit-in examination counts as 100 percent of the final grade. This examination arrangement might be changed.
Examination aids: No calculator, no other examination aids

ECN354 Issues in Development Economics; Poverty Analysis

Issues in Development Economics; Poverty Analysis

Credits: 5 **Language:** English
Staff/institute: Arild Angelsen/ IØR
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course is given every third year (2011, 2014), and rotates with ECN 356 (institutions) and ECN 358 (aid).Kurset gis hvert tredje år (2011, 2014), og roterer med ECN 356 (institusjoner) og ECN 358 (bistand)
Mandatory activities: Presentation in class.
Prerequisites: Intermediate knowledge (200 level) of micro and development economics.
Type of course: Lectures: 12 x 2 hours per week.
Contents:
Learning outcomes: Give insights into key issues in poverty analysis: definition, methods and main results.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Home exam (2 days).

ECN355 Research in Development Economics II

Research in Development Economics II

Credits: 5 **Language:** English
Staff/institute: Ragnar A. Øygard/ IØR
Teachers: Arild Angelsen, Stein Holden, Mette Wik.

Start term: January block
Terms: By demand
Mandatory activities: Submission of dataset and report
Prerequisites: ECN212 Microeconomics or ECN211 Microeconomics II and ECN220 Economics II, ECN200 Econometrics or ECN201 Econometrics, ECN351 Research in Development Economics (ECN351 may be taken in the same semester as ECN355).
Credit reduction:
Contents: The course is based on completing data collection through field work in a developing country and reporting on the process.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: A data set collected through own field research in a developing country must be submitted together with a report on the data collection process.

ECN356 Issues in development economics: Institutions

Issues in development economics: Institutions

Credits: 5 **Language:** English
Staff/institute: Arild Angelsen/ IØR
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course is given every third year (2012, 2015), and rotates with ECN 354 (poverty) and ECN 358 (aid).Kurset gis hvert tredje år (2012, 2015), og roterer med ECN 354 (fattigdom) og ECN 358 (bistand).
Mandatory activities: Presentation in class.
Prerequisites: Intermediate knowledge (200 level) of micro and development economics.
Type of course: 12 x 2 hours per week.
Contents: The course will review 12-15 key articles within institutional analysis. The class will meet once a week (2 hours) to present and discuss that article. The course ends with a 3-day written take home exam.
Learning outcomes: Give insights into key issues in institutional analysis. The course focuses on three main areas: (i) what are institutions? (ii) institutions and economic growth, (iii) institutions and natural resource management
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Home exam (2 days).

ECN371 Environmental Economics

Environmental Economics

Credits: 10 **Language:** English upon request
Staff/institute: Eirik Romstad/ IØR
Teachers: Eirik Romstad.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Work on and presentation of case studies.
Prerequisites: Microeconomic analysis at the advanced/MSc level equivalent to ECN 311. Environmental and resource economics courses at the introductory level (ECN 170 or equivalent). For students without any previous courses in environmental and resource economics from their BSc, ECN270 is recommended.
Type of course: About 50 hours, together with considerable guidance in connection with the case studies. There will be additional seminars where student assignments will be presented.

Contents: The course contains three elements. A) Advanced theory concerning systems analysis, resource allocation mechanisms, risk, control, information handling, behavioural assumptions, preference changes, transaction costs, rights, effects of different policy instruments with relation to various types of environmental problems and different behavioural assumptions. B) Studying concrete environmental economic problems - application of the theories. C) Case studies, where students in groups will discuss suitable policy instruments for the environmental issue in focus.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3 hours (100%). To qualify for taking the examination, students must have participated in the case studies.
Examination aids: No calculator, no other examination aids

ECN372 Climate and Environmental Economics

Climate and Environmental Economics

Credits: 10 **Language:** English upon request
Staff/institute: Eirik Romstad/ IØR
Teachers: E. Romstad, A. Angelsen, S. Navrud, O. Bergland
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Hand-ins. Seminars with presentations.
Prerequisites: ECN 210 or an equivalent course in microeconomics
Credit reduction: ECN370: 10 credits.
Type of course: 28-30 hours
Contents: The course consists of two main parts: i) GLOBAL CLIMATE REGIME AND NEGOTIATIONS Here we will provide the background to understand the global climate negotiations, and also to assess the different options currently being discussed in the UNFCCC process , leading up to the main climate meeting (COP15) in Copenhagen in December 2009. Topics include: - the science of climate change, how to value the future and deal with risk? - main principles for a global climate regime: tradable emission quotas or a global carbon tax? - what is a fair distribution of quotas (distribution of costs and benefits) between countries? - how much should rich countries pay for emissions reduction in developing countries, and how much should developing countries bring to an agreement? - What is the climate game? What happening at the negotiation table and in the corridors? - what is Norway\'s role? - how to assess the economic costs of climate change ii) NATIONAL POLICIES AND IMPLEMENTATION - what policies are available for implementing climate targets in Norway? - can technological development solve the problem? - what co-benefits can greenhouse gas emission reductions produce? - policies for implementing Reduced Emissions from Deforestation and forest Degradation (REDD) in developing countries
Learning outcomes: The course will give the students a theoretical overview, using environmental economics and game theory, and learn them to apply this to current international negotiations and national policy discussions. The aim is to show how economic tools yield insights into the current debate, and can also be used to assess different options being discussed. While the combination of theoretical overview and application is focussed on the climate issues, the integrative part of the course will also be useful to many other environmental issues.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral exam counts 100% of the grade. The students must have passed on all hand-ins.

ECN374 Dynamic Optimisation

Dynamic Optimisation

Credits: 5 **Language:** English
Staff/institute: Olvar Bergland/ IØR
Start term: January block
Terms: January block
Prerequisites: ECN302, ECN311, STAT100.
Type of course: About 25 hours of class-room lectures and 15 hours of group discussions.
Contents: The following tools for dynamic optimization will be covered: non-linear programming, optimal control theory, and deterministic and stochastic dynamic programming. These tools will be applied to such topics as capital, time, and interest rate; efficient intertemporal resource allocation; optimal investment programs; economic growth; extraction of non-renewable resources; harvesting of renewable resources; and irreversibility and uncertainty. Computer models will be used extensively.
Learning outcomes: The students should state, solve and interpret common dynamic optimization problems encountered in economics; and apply this knowledge and skills to independent economic analysis.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written examination, 3 hours.
Examination aids: Simple calculator, no other examination aids

ECN380 Energy Markets and Regulation

Energy Markets and Regulation

Credits: 10 **Language:** English
Staff/institute: Olvar Bergland/ IØR
Teachers: Torstein Bye, Ole Gjølberg.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Approved project report. An approved project report is valid for two - 2 - years.
Prerequisites: BUS220, ECN201/ECN202, ECN211, ECN280.
Type of course: About 30 hours of lectures, and 10 hours of organized project work.
Contents: The course covers central issues concerning energy markets and economic regulation in the energy sector. Specific topics include: 1) regulation of network providers through dynamic yardstick competition, 2) measuring efficiency with DEA (data envelopment analysis) and SFA (stochastic frontier analysis), 3) organization of energy markets, 4) modeling of energy markets, 5) stochastic production planning in hydropower systems, 6) investments under uncertainty.
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.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination. (Note: Students have no right to complain against the marking of oral tests/ examinations, in accordance with the University and College Act § 5-3).

ECN450 Development Economics: Methods and Policy Analysis

Development Economics: Methods and Policy Analysis

Credits: 20 **Language:** English
Staff/institute: Stein Terje Holden/ IØR
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel January block
The course is offered: Other - --
Mandatory activities: Exercises, group work, presentations.
Prerequisites: Master\'s degree in Economics or Agricultural Economics.

Credit reduction: ECN350 - 10 credit units.
Type of course: Lectures: 2-4 hours per week. Exercises: 0-2 hours per week. Writing of paper.
Contents: Teaching is combined with ECN350. Quantitative Development Policy Analysis: - Economic model building. - Production analysis and natural resources. - Demand analysis. - Household models. - Economy-wide models. - Supply response. - Econometric estimation with limited dependent variables. Economics of rural organisation. - New Institutional Economics and development. - Theories of collective action. - Market failures and externalities. - Food security and price stabilisation. - Land reforms and impact assessment. Environment and development. - Market imperfections and the environment. - Poverty and land degradation. Choice of own topic for paper
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final written examination: 1/2, Scientific paper: 1/2. Final written examination joint with ECN350.

ECN452 Topics in Development Economics I

Topics in Development Economics I

Credits: 5 **Language:** English
Staff/institute: Arild Angelsen/ IØR
Teachers: Gerald Shively
Start term: June block
Terms: By demand
The course is offered: Even years
Learning outcomes: Topics vary from year to year, but will generally be within applied microeconomics for development analysis.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

ECN454 Topics in Development Economics II

Topics in Development Economics II

Credits: 5 **Language:** English upon request
Staff/institute: Ragnar A. Øygard/ IØR
Teachers: Arild Angelsen, Gerald Shively, Ian Coxhead.
Start term: Spring parallel
Terms: By demand
The course is offered: Odd years
Mandatory activities:
Prerequisites: Graduate level economics.
Type of course: Varies from year to year.
Contents: Course contents vary from year to year.
Learning outcomes: Course content will vary from year to year, depending on demand and supply.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Exercises and home-examination/semester assignment. All assignments/semester assignment/ examinations must receive a \'pass\' grade.

ECN480 Electricity Economics

Electricity Economics

Credits: 5 **Language:** English
Staff/institute: Frode Alfnes/ IØR
Start term: August block
Terms: August block Autumn parallel
The course is offered: Other - Not given in 2011Gis ikke i 2011.
Contents: Course description, lecture plan, detailed course outline and course materials (web-based readings, homework assignments and handouts) are available on the web at the following site: http://athene.umb.no/emner/
Learning outcomes: This course will show how economic analysis has been, and is being, applied to electricity industry. Key theses will include the relationship between costs and market prices, methods of regulating monopolies, and the desirable level of investment. Ways of internalising environmental effects. Such as carbon emission. Will be considered at length during the course.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Term paper

ECOL110 Tropical Ecology and Biology

Tropical Ecology and Biology

Credits: 10 **Language:** English
Staff/institute: Fred Midtgaard/ INA
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Lab work and student presentations.
Credit reduction: Overlap with BOT100, ZOOL100, ECOL100. Reduced study-points for students who have: BOT100: -1 credit, ZOOL100: -1 credit, ECOL100: -3 credits.
Type of course: Lectures: ca. 50 hours. Lab work: ca. 20 hours. Student lectures: ca. 20 hours. Colloquia: ca. 15 hours.
Contents: Seedless vascular plants, gymnosperms, angiosperms, pollination, seed dispersal. The systematic organization of tropical animals, mode of living, and adaptations. Population genetics and natural selection, population dynamics, life-history strategies, interactions, (competition, predation, herbivory, mutualism), trophic interactions, succession, biodiversity, landscape ecology. All topics will focus on tropical ecosystems.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The exam consists of three tests given throughout the semester and one student presentation. Each part counts 25% of the grade. All parts must be passed to pass the course.

ECOL200 General Ecology

General Ecology

Credits: 10 **Language:** English upon request
Staff/institute: Knut Asbjørn Solhaug/ INA

Teachers: Jon Swenson
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Laboratory experiment with written report
Prerequisites: ECOL100/ECOL110, BOT100 and ZOOL100.
Type of course: Lectures: 4 hours per week for 10 weeks = 40 hours. Laboratory experiment 6 hours
Contents: The course is presented through lectures that thematically describe different subject fields. The lectures will to a large extent be based on Scandinavian examples from our own research activity. The candidates will read and study the syllabus through independent work and laboratory experiment with writing of report.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination (3 hours) at the end of the course.
Examination aids: No calculator, no other examination aids

ECOL201 Ecology Essay

Ecology Essay

Credits: 5 **Language:** English upon request
Staff/institute: Knut Asbjørn Solhaug/ INA
Teachers: Jon Swenson.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: ECOL100/ECOL110, BOT100 and ZOOL100.
Type of course: Introductory lecture of 2 hours.
Contents: Independent study.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The course\'s evaluation is based on one independent work (semester assignment).

ECOL300 Methods in Natural Sciences

Methods in Natural Sciences

Credits: 5 **Language:** English
Staff/institute: Jon Swenson/ INA
Teachers: John Wirkola Dirksen Cathrine Glosli Ørjan Totland Ole Hofstad
Start term: Spring parallel
Terms: Spring parallel

Mandatory activities: Computer exercises.
Prerequisites: Completed Bachelor\'s degree and approved admission to a Master\'s degree programme in Natural Sciences.
Type of course: Lectures: 15-20 hours. Exercises: 10-20 hours.
Contents: The various phases of the work on a Master\'s thesis will be covered in weekly lectures. Weekly computer exercises with teachers present will assure that the students are acquainted with the use of the statistical program \'R\'. Towards the end of the course, the students will have a basis to work independently with the individual projects.
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.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: Project assignment.

ECOL310 Global Change Ecology

Global Change Ecology

Credits: 10 **Language:** English
Staff/institute: Mikael Ohlson/ INA
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Oral presentation of scientific original publications, written reports and participation in seminars.
Prerequisites: BOT100, BOT130, ZOOL100 and ECOL200.
Type of course: Lectures: 1 hour per week for 10 weeks = 10 hours. Seminars and discussion groups = 20 hours.
Contents: The course consists of 10 different topics. Each topic is introduced through an introductory lecture. The candidates then independently read two original, scientific publications on the topic, and every candidate must submit a written report for each of the scientific publications. The contents of the works are presented and discussed in a seminar. The candidates will have the main responsibility for this presentation.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: An oral examination (30 min) at the end of the course accounts for 3/5 of the course grade. The performance, as regards to the presentation and discussion of original scientific publications, accounts for 2/5 of the course grade. All of the evaluated elements in the course must be passed to pass the course.

ECOL320 Tropical Field Ecology

Tropical Field Ecology

Credits: 10 **Language:** English
Staff/institute: Fred Midtgaard/ INA
Teachers: Seif Madoffe (SUA) and other teachers at SUA.
Start term: January block
Terms: January block Spring parallel
Mandatory activities: It is neccessary that the students prepare themselves for the course and follow the orientations which will be given before the course starts. The field course is compulsory.
Prerequisites: Ecology courses at 200 level.
Type of course: Lectures 10 hours, exercises 30 hours, excursions 100 hours, student presentations 30 hours, group work 50 hours, project 80 hours.
Contents: The course consists of a 4 weeks field course in Tanzania. The first few days will consist of orientations and introductions followed by a field trip of 2 1/2 weeks to different forest types (mist forest, lowland rainforest, miombo) and savannah. The last week will be used for group work on the project tasks and lectures, as well as supervision of projects at SUA.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The students must hand in their project reports for evaluation by May 15th.

ECOL330 Tropical rainforest ecology and conservation

Tropical rainforest ecology and conservation

Credits: 5 **Language:** English
Staff/institute: Torbjørn Haugaasen/ INA
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Completed bachelor degree and ecological knowledge at the ECOL200 level
Type of course: Lectures: 2h per week
Contents: The course will give students insights into the origin and evolution of tropical rainforests and provide a bio-geographical comparison of all the major tropical rainforest regions. Important ecological concepts in evolution and speciation, and theories of maintenance of species diversity, will be explored in a rainforest setting. Key aspects of community and landscape ecology and dynamics will also be examined. The course will further address tropical rainforest conservation in a global and regional perspective, in conjunction with contemporary and future threats to biodiversity through human impacts. Key aspects include forest conversion, fires and fragmentation.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination (3 hours) at the end of the course.
Examination aids: No calculator, no other examination aids

ECOL350 Restoration Ecology

Restoration Ecology

Credits: 5 **Language:** English
Staff/institute: Torbjørn Haugaasen/ INA
Teachers: Jonathan Colman
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Presentations.
Prerequisites: Ecology courses at intermediate level.
Type of course: Lectures, presentations and group work: 30 hours.
Contents: The global problems on degradation of ecosystems are increasing. The course is based on both botanical and zoological examples in order to show how ecosystems may be restored. The course will also place these problematic issues in an economical and social context. In addition to focusing on restoration of ecosystem processes and characteristics, the course will deal with measures in connection with larger infrastructure projects.
Learning outcomes: The goal of the course is to teach how degraded ecosystems may be developed into self-functioning systems once again.
Methods of examination: Final **Grading:** A-F
Assessment methods: The course is evaluated based on a term paper assignment.

ECOL380 The Ecology and Management of Rivers and Lakes

The Ecology and Management of Rivers and Lakes

Credits: 10 **Language:** English
Staff/institute: John Edward Brittain/ INA
Teachers: Reidar Borgstrøm (INA), Tharan Fergus and Anja Skiple Ilbrek (NVE).
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Field trip and laboratory work.
Prerequisites: Preferably ECOL200, VANN210, NATF240 or equivalent
Type of course: Lectures: 30 hours. Seminars: 8 hours. Video presentations and discussion: 2 hours. Field work: 1 day. Laboratory work: 1 day.
Contents: The course covers the most important physical and chemical environmental variables in running waters, followed by topics such as energy flows and other major processes in freshwaters, seasonal variations and life histories of aquatic invertebrates, glacial rivers, climate change, interactions between fish and invertebrates, freshwater radioecology, invertebrates as pollution indicators, environmental impacts and remedial measures in lakes and rivers and finally watercourse management, including the EU Water Framework Directive. The students give a seminar on selected parts of the syllabus, along with a written summary. A field excursion followed by laboratory exercises provide a practical introduction to watercourse investigations.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Seminar/report: 20%; group report: 10%; oral exam: 70%. The seminar and the report are evaluated, as is the group report from the field trip/laboratory exercise. A final oral exam (30 minutes). All of the evaluated elements in the course must be passed to pass the course.

EDS201 Introduction to Development Studies

Introduction to Development Studies

Credits: 5 **Language:** English
Staff/institute: John Andrew McNeish/ Noragric
Teachers: Several teachers at Noragric will participate.
Start term: August block
Terms: August block
Mandatory activities: Group work and oral presentation in class.
Credit reduction:
Type of course: The course will run from Monday-Friday during the three weeks of the August block period.
Contents: The course introduces the analysis of current issues in development studies seen in a global perspective. Working with oral and written communication is a central part. Focus will be placed on developing interest and skills in further work in development studies in an interdisciplinary environment.
Learning outcomes: Students will be introduced to current development issues. They will become motivated for further studies through exposure to a range of literature. They will acquire skills in group work, presentation, computer work and the learning platform ClassFronter. Students will get an understanding of what is expected of them as a master student at UMB. They will learn about UMB libraries and the use of English as a language of study. Students will meet with advisors and develop an individual plan of study.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Essay (in English)

EDS202 Introduction to Environmental Studies

Introduction to Environmental Studies

Credits: 5 **Language:** English
Staff/institute: Ian Bryceson/ Noragric
Teachers: Jens Aune, Kjell Esser, Thor S. Larsen, Arild Vatn, Siri Eriksen
Start term: August block
Terms: August block
Mandatory activities:
Credit reduction:
Type of course: 18 hours lectures and 20 hours group work and 37 hrs colloquia
Contents: Engelsk:Discussions of the students\' different backgrounds, interests and expectations. Presentation of the ideas behind the IES programmme and its progression. Linkages between main global environmental challenges (climate change, biodiversity and land degradation). Introduction to global environmental changes and challenges. Fundamentals of ecology/ ecosystem dynamics.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Exam in ENGLISH ONLY. One group assignment plus final exam

EDS203 Introduction to International Relations

Introduction to International Relations

Credits: 5 **Language:** English
Staff/institute: Stig Jarle Hansen/ Noragric
Start term: August block

Terms: August block
Prerequisites: Batchlelor
Type of course: The course will go over 3 weeks and include 2-hour lectures as well as writing seminar. The first two weeks will consist of four 2-hour lectures, while the third week will consist of writing seminars and group presentations, 3 x 2 hours per week.
Contents: The course give a simple introduction to the various approaches to international relations, Realism. Liberalism, Marxism, Constructivism, as well as to international history.
Learning outcomes: The course provide a very simple introduction to international relations, as well as contemporary history. (EDS 203 is not intended for students with a deedper background in International relations, as for example a bachelor). It also functions as an introduction to accademic writing skills.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Group work

EDS212 Research Methods I

Research Methods I

Credits: 5 **Language:** English
Staff/institute: Stig Jarle Hansen/ Noragric
Teachers: Håvard Strand and others
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Bachelor or equivalent
Type of course: 40 hours of lectures and discussions - two double lectures per week spread over 10 weeks
Contents: The course will include discussions on the following topics: Theoretical underpinnings of research methods, research strategy and design, qualitative and quantitative methods of data collection, analysis and interpretation, use of secondary data, interdisciplinary research, research ethics, introduction to a statistical package and so on
Learning outcomes: The students are expected to gain an understanding of the theory and application of qualitative and quantitative research methods in interdisciplinary contexts. The students should be able to conduct simple regressional analysis, bi-variat and multivariat analysis, qualitative methods as well as understand and know the major approaches within the philosophy of science
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Final writte exam counts 100%
Examination aids: No calculator, no other examination aids

EDS220 Statistical Analysis

Statistical Analysis

Credits: 10 **Language:** English
Staff/institute: Ellen Sandberg/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory assignments/exercises.
Prerequisites: MATH100, MATH111 or equivalent (may be taken the same semester).
Credit reduction: STAT100, 10 credits (ECTS).
Type of course: Lectures: 2 hours per week. Exercises: 2 hours per week. Computer exercises: 2 hours per week.
Contents: Basic concepts, descriptive statistics, probability, statistical distributions, expectations and variance, binomial and normal distributions, estimation, confidence intervals and hypothesis-testing, regression, T-tests, one-way and two-way analysis of variance, chi-square tests.
Learning outcomes: Students will acquire knowledge of basic statistical models and methods that are used in applied research.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. A midsemester multiple choice test counts 25% of the total mark. A final written 3.5 hours examination counts 75% of the total mark.

EDS234 Environmental economics - the role of institutions

Environmental economics - the role of institutions

Credits: 5 **Language:** English
Staff/institute: Arild Vatn/ Noragric
Teachers: Pål Vedeld
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The students are asked to write two short papers. For the student to pass the course, these papers must be graded \'pass\'
Prerequisites: Some basic competence in micro economics and/or social sciences
Credit reduction: Credits are not given for both EDS234 and EDS235
Type of course: Lectures and seminars: 18 double hours
Contents: 1) The theory of institutions and institutional foundation of economic systems, including core concepts like systems theory, rights, conflict, cooperation, transaction costs, rationality, values and power. Different positions within institutional theory. 2) How do institutions influence perceptions and behavior and thereby the use and misuse of environmental resources. 3) The state and its role in the management of environmental resources. 4) How are institutions formed as a response to human needs, interests, values and power relations? 5) What characterizes different economic spheres? 6) How can we evaluate institutions? 7) Which institutional structures govern the use of environmental resources and how can we study these institutions and the problems they create? 8) Resource regimes. 9) Institutional perspectives on environmental valuation.10) Environmental policy measures.
Learning outcomes: This course covers the theoretical part of EDS235. Students shall acquire insight into core aspects of the functioning of the economy as a system of institutions, social relations and power. The students will learn how economic and social institutions and the political environment are structured and influence each other. Students shall also acquire insights about how the economy and other institutional structures influence the use of environmental resources. They shall specifically acquire insight into the institutional conditions for human behavior and learn to apply this knowledge to understand behavior related to use and preservation of environmental resources. The aim is finally to support the students in their understanding of important ethical questions linked to the use and protection of environmental resources.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY.
Examination aids: No calculator, no other examination aids

EDS235 Political economy - institutions and the environment

Political economy - institutions and the environment

Credits: 10 **Language:** English
Staff/institute: Arild Vatn/ Noragric
Teachers: Pål Vedeld
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Presentation of paper in seminar.
Prerequisites: The course is adapted to the background of the students enrolled in the M_IES program. For those that have not yet completed a bachelor, it is recommended to have some background in social sciences/economics/environmental economics.
Credit reduction: Students cannot get credits for both EDS235 and EDS234
Type of course: Lectures: 20 double hour lectures. Seminars: 8 double hours. Group work with supervision

Contents: The course is split in two parts: a theoretical part and the study of a concrete case. The theoretical part covers the following elements: 1) The theory of institutions and institutional foundation of economic systems, including core concepts like systems theory, rights, conflict, cooperation, transaction costs, rationality, values and power. Different positions within institutional theory. 2) How do institutions influence perceptions and behavior and thereby the use and misuse of environmental resources. 3) The state and its role in the management of environmental resources. 4) How are institutions formed as a response to human needs, interests, values and power relations? 5) What characterizes different economic spheres? 6) How can we evaluate institutions? 7) Which institutional structures govern the use of environmental resources? How can we study these institutions and the problems they create and how can we make them better? 8) Resource regimes. 9) Institutional perspectives on environmental valuation and policy. 10) Environmental policy measures. The case study will be organized as group work where the focus is on writing a paper. The groups will choose topics themselves within the focus of the course.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Term paper counts 40 %. Written exam counts 60 %. Students must pass both.

EDS250 Agriculture and Development

Agriculture and Development

Credits: 10 **Language:** English
Staff/institute: Trygve Berg/ Noragric
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Bachelor\'s degree or equivalent.
Type of course: 5 lecture hours/week for 14 weeks = 70 hrs.
Contents: Understanding the farm as a production system depending on interactions with and management of the natural resource base, and also characterised by internal interactions within the system. (1) Agro-ecology and cropping systems, applying ecological principles in the analysis of an agricultural system. Cropping systems in semi-arid, sub-humid and humid tropics. (2) Livestock systems, overview of livestock systems including both mixed farming and nomadic systems. Fodder resources including fodder quality and use. Crop-livestock interaction. (3) Genetic resources for food and agriculture, genetic erosion, conservation of genetic resources ex situ and in situ, utilisation of genetic resources, international treaties and agreements on management of genetic resources, and intellectual property rights and policies. (4) Sustainable agriculture, integrated management of soil fertility, integrated pest management, integrated resource management for sustainable agriculture, and sustainable intensification.
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).
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Written exam.
Examination aids: No calculator, no other examination aids

EDS255 Health, Environment and Development

Health, Environment and Development

Credits: 10 **Language:** English
Staff/institute: Cassandra Bergstrøm/ Noragric
Teachers: Ingrid Nyborg
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Students must particpate actively in group work to be eligible for a final grade in the course. Each of the groups will determine whether its own members have particpated activlely in the group work. Students must receive a pass from their groups to complete this compulsory activity. All group work assignments must receive a passing grade. All students must also sign an non-plagiarism contract.
Type of course: The scheduled teaching time is five hours (5 X 45 minutes) per week. This is tentatively distributed between 3 hours of lectures and 2 hours of teacher-led discussion approximately six weeks of the semester. In addition, students will work within teams outside of the classroom during three weeks (3 X 1 week). Facilitators will be available for consultations during this time. In each of the weeks following the collection and analysis of data, groups will present their findings.
Contents: The course is comprised of three blocks: 1. Introduction to Health and sustainable development; 2. Environment and health; and 3. Global health. Cross-cutting themes are: how are environmental health and public health inter-related, how are international policy and local realities linked - or not, and how do different values and intersts of different stakeholders affect policy and practice. Chosen problem areas will be analyzed by student groups with respect to ecological, social and political dimensions. Each of the groups will determine whether their own members have particpated activlely in the group work. Students receive a pass from their groups to be eligible for a grade in the course. The three group work projects will be documented in some way. Students will choose one of these projects for grading. This will represent 40% of the student \'s grade. In addition, each student will write a final essay for the course demonstating his/her understanding of the course material and methods. This take-home exam will comprise 60% of the final grade.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Each of the group work projects will be documented in some way. Groups choose one of these projects for grading. This will represent 40% of the students grade. In addition, each student writes a final essay for the course demonstating his/her understanding of the course material and methods. This essay/take-home exam comprises 60% of the final grade.

EDS260 Global Environmental Changes

Global Environmental Changes

Credits: 5 **Language:** English
Staff/institute: Bishal K. Sitaula/ Noragric
Teachers: Jens B. Aune, Lars Kåre Grimsby
Start term: Autumn parallel
Terms: Autumn parallel
Type of course: 22 hr lectures
Contents: Definition of terms, introduction to earth system science, anthropogenic global change (systemic and cumulative), land degradation, ecosystem processes, potential impacts of climate change on food and agricultural systems, climate

change impacts on biodiversity, linkages of global environmental issues, global responses and local actions, negotiations and agreements, conventions on desertification, conventions on biodiversity, compliance with climate change conventions, international treaties, adaptation and mitigation options, initiatives to address global change issues, case studies, prospects of sustainable future with emphasis on agriculture adoption and mitigation options,
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam. Exam in English only.
Examination aids: No calculator, no other examination aids

EDS270 Development Aid and Politics

Development Aid and Politics

Credits: 10 **Language:** English
Staff/institute: Simon Pahle/ Noragric
Teachers: Covener/lecturer: Simon Pahle (simon.pahle@umb.no)
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities:
Type of course: Engelsk:12 two-hour lectures and 12 two-hours seminars during the autumn parallel (in all 48 contact hours)
Contents: The first part of the course provides an overview of aid and the aid industry, exploring its main actors and institutions; historical trajectories and debates; and the volumes and destinations of aid (in terms of recipients, purposes and themes etc). The second part interrogates the approaches and tools in aid, focusing on four main strands: Project aid; policy conditionality (associated with adjustment lending); process conditionality (associated with debt forgiveness and poverty reduction strategies); and aid geared towards rights and the environment. The third part of the course explores whether, when and for whom aid works, interrogating perspectives on effectiveness, dependency, accumulation and social change. The final part focuses on emerging actors, themes and approaches and features guest speakers from the aid industry offering their perspectives on the future of aid.
Learning outcomes: 1: A successful course graduate is well versed with the history, rationale and modalities of development aid. S/he is furthermore well acquainted with central actors, institutions and processes in the aid industry and the differing views on the merits of aid. 2: S/he has required additional skills in searching-managing literature and in making written and oral presentations of an argument. 3: Her/his ability to engage in debates on development and aid in an informed and critical manner is improved.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Final grade is determined by seminar assignment (30%), term paper (40%), final oral exam (30%)

EDS275 Writing Seminar

Writing Seminar

Credits: 5 **Language:** English
Staff/institute: Jens Bernt Aune/ Noragric
Teachers: William S. Warner
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel

The course is offered: Other - Separate courses in the autumn and spring parallelSeparate kurs i høst- og vårparallell
Mandatory activities:
Prerequisites: Eligibility for university admission
Type of course: Lectures and discussions: 26 hours. In addition, the students complete several writing assignments.
Contents: This course covers the basics of academic writing. The first half concentrates on structure; specifically, how to outline expository, argumentative and analytical papers. The second half focuses on style: how to write clearly, cohesively, and concisely. Re-writing is emphasized. The students will receive comments on their writing assignments. Class attendance weekly writing assignments are mandatory.
Learning outcomes: The objective is to help undergraduate students develop writing skills for term papers.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Term papers. Exam in ENGLISH ONLY.

EDS305 Development Theory and Policy

Development Theory and Policy

Credits: 10 **Language:** English
Staff/institute: Ingrid Nyborg/ Noragric
Teachers: Contact teacher Ingrid Nyborg (ingrid.nyborg@umb.no). Medvirkende: Darley Kjosavik, Lyla Mehta, John McNeish, Kassim Kulindwa
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in group work and submission of individual assignments. An approved group project assignment is compulory (pass/fail). 80% attendance in lectures and seminars.
Prerequisites: BSc/BA or equivalent.
Type of course: The scheduled teaching time is 6 hours per week. This is tentatively distributed between 2 hours lectures; 2 hours teacher-led discussion or student presentations in class; min 2 hours of work in groups. This is subject to variation, for example when guest lectures or other special events take place.
Contents: Introduction to Development Studies (historical background, values and policy challenges). Exploration of selected theories and policies related to: Economic development, poverty and distribution; environment, livelihoods and health; social justice and human rights. Conclusions, connections and discussion.
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. 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 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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. The examination is based on a portfolio of individual writing assignments. All the assignments are mandatory. Selected assignments from the portfolio are given a grade (A-F). To pass the course, one must get a passing grade (E or better) in each of the graded assignments. The overall grade is set in the following manner: Two smaller, individual written assignments: (1) Letter to the editor, and(2) essay, combined count 30%. The individual term paper counts 60%. Participation and overall assessment counts 10%. Grades on the smaller individual assignments (1-2) will be set during the semester (a maximum of three weeks after submission). Grades on/approval of the group project, term paper and participation/overall assessment will be set during the exam period following the general rules. Individual assignments shall be defended orally after appointment with the teacher.

EDS312 Research Methods II

Research Methods II

Credits: 10 **Language:** English
Staff/institute: Stig Jarle Hansen/ Noragric
Teachers: Darley Jose Kjosavik, Stig Jarle Hansen, and other internal and external teachers will be drawn upon to give lectures and discussions in their own specialised fields of research related to Environment and Development
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Participation in group assignment
Prerequisites: EDS212 or equivalent
Type of course: Lectures (30 hr) and practical data analysis (20 hr). In addition the students do independent study and a group assignment, totaling about 250 hours. The total work load for the students will be 300 hours.
Contents: The course will include discussions on the following topics: experiences from specialised fields of research in environment and development studies - such as political economy of development, globalisation studies, conflict and development, climate change and development, health and development, livelihood research, research on property rights, agro-ecological research, pastoral research, coastal ecosystems and fishery research, gender and development research, migration studies, environmental impact assessment and project evaluation studies, conservation research, corruption research, discourse analysis and so on. It will also include introduction to a statistical package.
Learning outcomes: The students are expected to gain an advanced understanding of the theory and practice of research methods in specific fields of environment and development studies in interdisciplinary contexts. The course also aims at developing practical skills of the students regarding sample survey, data entry, analysis and writing. The students should be able to create their own research proposals after finishing the course.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Individual paper on problem identification and objectives (15 %), individual literature review (20 %) and individual research proposal (65 %). In addition, a group presentation on research methods must be approved. All parts must be approved to obtain a passing letter grade.

EDS315 Management of Genetic Resources: Law and Policy

Management of Genetic Resources: Law and Policy

Credits: 5 **Language:** English
Staff/institute: Trygve Berg/ Noragric
Start term: June block
Terms: June block
Mandatory activities: Participation in seminars and submission of weekly exercise
Prerequisites: General knowledge about biodiversity and the use of biodiversity in agriculture.
Type of course: Every week two days of combined lectures/seminars, one compulsory exercise, and one day of seminar (reviewing and discussing the week\'s exercise).
Contents: Origin, diffusion, exchange and ownership of genetic resources through history. National and international structures and laws for managing and governing genetic resources. How the \'system\' works: Access, exchange and sharing of benefits.
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.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods:

EDS325 Global Political Economy

Global Political Economy

Credits: 5 **Language:** English
Staff/institute: Simon Pahle/ Noragric
Teachers:
Start term: January block
Terms: January block
The course is offered: Odd years
Mandatory activities:
Prerequisites: Open only to students enrolled in Master programmes
Type of course: The scheduled teaching time is 6 lecture and 6 seminar hours per week, through 3 weeks (36 hours in total) Participants are expected to spend an additional 24 hours/week on reading, preparation for presentation etc.
Contents: First, the course explores the main theoretical perspectives relevant to the study of the global political economy. Second, it considers the global financial system with emphasis on the debt relief and management offered by the World Bank and the IMF, including the critiques these have elicited, and recent responses of the institutions. Thirdly, the course examines the politics of international trade, centering on the World Trade Organization (WTO): Its emergence; the substance of its agreements; procedures for agenda-setting, rule-making, and dispute-settlement. Fourth, it examines the increasing power exercised by private corporations through resource scrambles and globalized production systems, and the attending debates on corporate (mis)conduct and regulation.
Learning outcomes: 1. A successful course graduate is familiar with major theories about the exercise of power and distribution of wealth in the global system, and with actors, institutions and processes of particular relevance to development. Furthermore, she is capable of employing and assessing theory in relation to substantive case problems, and to discern connections across theoretical and substantive issue areas. 2: She has required additional skills in the following fields: Teamwork; searching-managing-sharing information; presentations. 3: She has attained increased self-reflexivity, and is more aware of different normative approaches to challenges in the global political economy.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Evaluation is based on i) final 48 hrs take-home exam (60%); and ii) a seminar assigment(40%). Further information is provided by the start of the course.

EDS330 Political Ecology

Political Ecology

Credits: 10 **Language:** English
Staff/institute: Tor Benjaminsen/ Noragric
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: All students must participate in a presentation at the group seminars. Students must participate in a minimum of 80% of these seminars
Type of course: There will totally be approximately 40 hours of lectures. In addition, there will be 12 hours group seminars.
Contents: Political ecology originated in the 1970s, but its real expansion occurred in the 1980s and 90s. Today, political ecology is a leading source of innovative research on issues linked to poverty and the environment. The framework of the analysis in political ecology is centred on the idea of a politicised environment. It explores the main actors involved in this management and their interests, aims, norms and narratives. This again leads into an investigation of power and power relations in environmental management. Lectures and discussions will deal with topics such as the the theoretical roots and history of political ecology, discourse and narrative analysis, winners and losers of global environmental change, land reform, and community-based conservation and its critique.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Two individual term papers of five pages each (counting 50%) based upon course lectures and readings and a final oral exam. The oral counts ca 50 % of the total grade. Results from the term papers will be available in Classfronter two to three weeks after submission. Students must pass all three exam activities to pass the course.

EDS335 Advanced Readings in Development Studies

Advanced Readings in Development Studies

Credits: 5 **Language:** English
Staff/institute: Tor Benjaminsen/ Noragric
Teachers: Knut Nustad
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Presentation of one book chosen from the reading list.
Type of course: Seminars: 5 times 2 hours.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Exam in ENGLISH ONLY. Each student writes 1000 words about 4-5 of the books chosen

EDS346 National Environmental Governance: Politics, Policy and Conflict Resolution

National Environmental Governance: Politics, Policy and Conflict Resolution

Credits: 10 **Language:** English
Staff/institute: John Andrew McNeish/ Noragric
Teachers: Arild Vatn, Pål Vedeld
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Term Paper/Digital Story Excursion, 4 days Students are expected to attend a minimum of 60% of the classes offered by the course.
Prerequisites: EDS235 (Political Economy - Institutions and the Environment). EDS260 (Global Environmental Change). EDS234 (Environmental Economics - the Role of Institutions) is an alternative to EDS235.
Type of course: Lectures 30 h, Group Discussion/ Student Presentation 12 h, Film 6 h, Supervision 4 h, Excursion 4 days.
Contents: In this course we look at the complexities and specific contexts of environmental and resource-based conflicts. Study is furthermore made in the course of the politics and possibilities to respond to, manage and solve these problems. The course encompasses national and local environmental politics with cases from both developing and developed countries. In the first part of the course examination is made of key issues and themes in environmental governance including concepts of the state, power, bureaucracy, institutionalism, the resource curse and the political economy of resource conflict. Discussion is furthermore made of the basis and operation of different regulatory tools. In the second part of the course examination is made of particular globally traded commodities, the history of power relations and political economies that shape their exploitation and extraction, and contemporary efforts to moderate, protect and/or commercialize them. During the course students are expected to produce an individually produced term paper in which theory is used to analyse a particular resource context or problem. Students are also expected to participate in \'problem-based\' group discussions in the class. The course includes 4 days of mandatory excursion.

Learning outcomes: Knowledge: During the course students acquire insight into the theories and contextual dynamics of national environmental governance. Skills: Drawing on this basis of knowledge, students will develop the capacities needed to undertake interdisciplinary analyses of different resource situations and learn to explain the interplay between resource and ecosystem dynamics and the workings of different governance structures. Students shall moreover acquire the skills needed to both study, evaluate and operate various management strategies for the use and maintenance of various environmental resources. Ethical Reflction (Holdninger): Students will develop the knowledge and skills sets needed to both critically and reflexively analyse resource contexts and decide on appropriate approaches to governance and conflict resolution.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Term paper/Digital Story: 40 %; Written exam 60 %. The teacher can arrange oral defense of the term paper.

EDS347 International Environmental Governance

International Environmental Governance

Credits: 5 **Language:** English
Staff/institute: Kassim Athumani Kulindwa/ Noragric
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Group presentation
Prerequisites: EDS235 (Political Economy - Institutions and the Environment) and EDS260 (Global Environmental Change). EDS234 (Environmental Economics - the Role of Institutions) is an alternative to EDS235.
Type of course: Lectures: 17 double hours Seminars: 3-4 double hours (dependent on tthe number of students taking the course)
Contents: 1) The concepts of governance and resource regimes; 2) The governance system: The role of the state, the multilateral system (UN, WB/IMF, WTO), NGOs; 3) The forming of international agreements and conventions, the logic of games, negotiations and deliberation; 4) The study of specific international environmental agreements and conventions: Climate change (The UN Framework Convention on Climate Change; the Kyoto Protocol), biodiversity (the Convention of Biological Diversity, the Plant Treaty, TRIPS), land degradation (the Convention on Desertification), fisheries (the Convention on the Law of the Sea and various regional treaties); 5) Seminar presentations (groups) where the theory is applied to concrete cases.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY.
Examination aids: No calculator, no other examination aids

EDS355 Climate Change and Development

Climate Change and Development

Credits: 10 **Language:** English
Staff/institute: Siri Eriksen/ Noragric

Teachers: Jens Aune, Lars Kåre Grimsby
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: One term paper. Selected seminars, excursion and lectures are mandatory.
Type of course: 4 hours lectures per week. Term paper.
Contents: The Kyoto mechanism and beyond Kyoto, the Clean Development Mechanism and the quota market, problems and prospects for developing countries to take part in the Clean Development Mechanism, options for sequestering and preserving greenhouse gases in land-use systems, energy problems in developing countries, causes of vulnerability to climate change, adaptation,powerty,multile stressors, responding sustainablilty to climat change. Biofuels and GHG emissions. Biofuels and food security.
Learning outcomes: Engelsk:Understand the relationship between climate change and development with emphasis on tropical countries.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Written exam (100 %).
Examination aids: No calculator, no other examination aids

EDS360 Conflict and Development

Conflict and Development

Credits: 10 **Language:** English
Staff/institute: Espen Olav Sjaastad/ Noragric
Teachers: Stig Jarle Hansen, N. Shanmugaratnam.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Participation in group work and group presentations is compulsory.
Type of course: A rough estimate of time allocation is as follows: Lectures: 44 hours Group work: 12 hours Individual work: 26 hours
Contents: The course addresses three thematic areas: 1. Perspectives on conflict, development & peace 2. Conflict and natural resources 3. Conflict management and post-conflict development & peacebuilding The thematic areas involve lectures and group work.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. One term paper (40%) and a final oral exam (60%) constitute the continuous evaluation.

EDS365 Coastal, Marine and Aquatic Resource Management

Coastal, Marine and Aquatic Resource Management

Credits: 10 **Language:** English
Staff/institute: Ian Bryceson/ Noragric
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: One term paper (group work)
Type of course: The class will meet for two hours per week (one double hour). Most weeks will be devoted to lectures and class discussions, but three weeks will be set aside for group-work and writing a mid-term paper.
Contents: Course contents - Integrated coastal zone management- Integrated aquatic resource and watershed management - Resilience and vulnerability in coastal ecological and social systems - Tropical coastal ecosystems: coral reefs, mangroves, seagrasses, etc. - Coastal fisheries: small-scale artisanal and large-scale industrial - Coastal aquaculture systems: integrated polycultures and monocultures - Coastal tourism developments: rights and distribution of benefits - Coastal pollution: impacts and control- Temperate and polar coastal and marine ecosystems - Temperate fisheries crisis and aquaculture issues - Tropical lakes, rivers and wetlands: resource use and management - Freshwater aquaculture systems- Freshwater fisheries management - Effects of globalisation on coastal and aquatic resources - Effects of climate change and vulnerability to disasters - Traditional ecological knowledge and coastal/aquatic resource management - Resilience of livelihoods, institutions and adaptive management approaches - Analytical approaches to studying ecological-social coastal and aquatic systems - A range of international case studies - Examples of MSc research projects addressing coastal and aquatic issues
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Written exam.
Examination aids: No calculator, no other examination aids

EDS370 Gender and Development

Gender and Development

Credits: 5 **Language:** English
Staff/institute: Ingrid Nyborg/ Noragric
Start term: January block
Terms: January block
Mandatory activities: Participation in group work and group assignment and class discussions.
Type of course: Ca. 60 hours, about 40 % lectures and 60 % individual work.
Contents: Engelsk:The course will include the following topics (can vary from year to year): Historical development of concepts of gender. Gender in agriculture. Gender in resource management. Gender in development discourse. Gender and economics. Gendered methodologies and analyses.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. The grade in the course is set on the basis of an individual term paper assignment. The teacher can arrange oral defense of the term paper if needed for grading.

EDS372 Current Topics in Security Studies

Current Topics in Security Studies

Credits: 5 **Language:** English
Staff/institute: Stig Jarle Hansen/ Noragric
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Prerequisites: General knowledge of international issues, preferably undergraduate courses in relevant social sciences
Type of course: The course will go over 12 weeks and include 2 hours lectures per week.
Contents: The course deals with contemporary themes and issues such as security communities, “securitization,” the political economy of conflicts, state collapse and reconstruction, and migration and societal security. The course will deal with traditional security studies and strategic studies, but this will be introduced to create a foundation for critical approaches to security.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Written examination (2 hours) will count 30 % and essay (15 pages) on chosen topic (to be approved by the course responsible) will count 70 %.

EDS374 International Relations Theory

International Relations Theory

Credits: 10 **Language:** English
Staff/institute: Benjamin de Carvalho/ Noragric
Teachers: Contact teacher and main lecturer: Benjamin de Carvalho (NUPI) (bdc@nupi.no). Supporting lecturer: Halvard Leira (NUPI)
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: General knowledge of international issues, preferably undergraduate courses in relevant social sciences
Type of course: The course will go over 12 weeks and include 2 hours lecture and 2 hours seminar per week
Contents: These perspectives will include realism and neo-realism(s), liberalism and neo-liberalism(s), the so-called English School of International Relations, constructivism, reflectivism, post-structuralism and historical sociology. The course will also address the history of International Relations Theory, as well as normative theory.
Learning outcomes: The aim of the course is to give students an understanding of different perspectives in International Relations theory, and how different perspectives conceive of the nature of international politics.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Written examination (2 hours) will count 30 % and essay (15 pages) on chosen topic (to be approved by the course responsible) will count 70 %. The teacher can arrange oral defense of the term papers.

EDS375 State Formation: Historical Issues and Contemporary Debates

State Formation: Historical Issues and Contemporary Debates

Credits: 10 **Language:** English
Staff/institute: Iver Brynild Neumann/ Noragric

Teachers: Contact teacher: Benjamin de Carvalho (NUPI) (bdc@nupi.no). Supporting staff: Iver B. Neumann, Ole Jacob Sending
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years
Prerequisites: Undergraduate background in the social sciences
Type of course: The course will go over 12 weeks and include 2 hours lecture per week.
Contents: What is the state? How did the most central political institution of our time emerge? Is a state ever complete? And how do we study the state? These are all questions which the course seeks to answer. The course will begin with addressing the state in historical perspective, before looking at state-formation today. Finally, it will discuss the state and its formation in contemporary debates and through different disciplines.
Learning outcomes: The aim of the course is to give students the necessary conceptual tools and perspectives to understand the state from different perspectives and disciplines.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Exam in ENGLISH ONLY. Written examination (2 hours) will count 30 % and essay (15 pages) on chosen topic (to be approved by the course responsible) will count 70 %. The teacher can arrange oral defense of the term paper.

EDS384 Development and Environment in Practice, Tanzania

Development and Environment in Practice, Tanzania

Credits: 15 **Language:** English
Staff/institute: Kassim Athumani Kulindwa/ Noragric
Teachers: Academic staff from UMB and SUA, local guest lecturers
First time the course is offered: AUTUMN 2011
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Participation in seminars, execises and field trips. One individual term paper.
Prerequisites: BA/BSc in Social- or environmental science
Type of course: Approximately; lectures; 100 h, seminars, exercises and field; 200 h, individual studies; 150 h
Contents: Classes aim to develop students’ country specific knowledge and practical field and project skills. During the course students will be required to define their own research project and to test out methodological approaches to the problems inherent in these studies. Relevant readings from books, journals and other scientific materials will be drawn on in order to enhance students’ understanding. Students will also be sent for field work and tours to nearby field stations where it will be possible to observe ongoing conservation and management of natural resources, and also undertake interviews. These will include selected villages in Kilosa and Mvomero Districts, Mikumi National Park, Udzungwa National Park, Wami Mbiki Game Reserve and Saadani National Park
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
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Student presentations and final individual term paper

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

State and Civil Society in Development and Environmental Governance in India

Credits: 15 **Language:** English
Staff/institute: Darley Jose Kjosavik/ Noragric
Teachers: Surjit Singh, Kanchan Mathur, Varsha Joshi, Mohana Kumar, K.N. Joshi, Kanchan Mathur, Purnendu S. Kavoori, Shobhita Rajagopal, Sunny Jose and other teachers at the Institute of Development Studies, Jaipur (IDSJ).
Start term: August block
Terms: August block Autumn parallel
Mandatory activities:
Prerequisites: Master level in environment and development studies
Credit reduction: EDS388 - 10 credits
Type of course: Information will be given at start of the course
Contents: The students will be exposed to lectures by a wide range of experienced staff from IDSJ, University of Jaipur and other universities, from relevant state agencies, and civil society organisations. Several field trips to rural and urban areas will give students the opportunity to interview and have discussions with farmers, pastoralists, slum dwellers, street vendors, women, local level village functionaries, politicians, state officials, civil society officials and activists. The course will cover political, social and economic framework of India, the shifts in development paradigms and shifts in development policy and practice of the Indian state, the state-civil society interface in development, the role of NGOs and other civil society movements in development, equity and social justice, the Millenneum Development Goals and its implementation and monitoring process, the state programmes for social sector development, the Panchayati Raj institutions (institutions for decentralised governance), development issues of marginalised social groups such as oppressed castes, indigenous peoples and women, child labour and development, gender and development issues, micro-credit programmes and development, Indian economy within a globalised world, the problems and prospects for India’s development in the context of the increasing economic growth. The course will also include global and local environmental challenges, the impact of international environmental policies/governance institutions on national and local environmental policies and practices, the shifts in environmental policies and practices of the Indian state in response to global governance agendas, climate change as an issue at the environment-development interface, Indias climate change policy and practices, the role of state agencies, NGOs and other civil society organisations and social movements in addressing questions of environment and development in the complex socio-economic and political milieu of India, environmental justice issues, MDGs and the environment, Panchayati Raj institutions (institutions for decentralised governance) and local environmental management, the challenges of management of common property and open access regimes in the midst of private property regimes, the problems and prospects of Indias environment in the context of the recent unprecedented growth of the Indian economy and the energy demands, and the threats posed by climate change. Students may choose to do their field work for the master thesis in projects linked to these issues.The students may choose their field work in projects linked to these issues.
Learning outcomes: Knowledge and skills to work with environmental and development issues in both rual and urban areas in developing countries, with particular reference to linkages between local and global governance. Advanced understanding of the theory and practice of development and environmental policies and programmes undertaken by state agencies and civil society organisations. The course also aims at developing skills in research methods and project management.Skills in qualitative and quantitative research methods and project management. Tools and techniques relevant for analysing environmental projects and their impact on natural resources, poverty and livelihoods of local communities. The course emphsizes the acquisition of skills and knowledge necessary for planning and implementing environment and development related projects from the perspective of the state agencies and civil society organisations including grassroots level movements. Since the course is conducted in Jaipur, India, the students will gain knowledge of the arid to semiarid environmental issues associated with pastoralism, agriculture and forestry.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Groupwork (pass/fail), presentation (pass/fail), field reports (pass/fail), final written exam (A-F; 100%).

EDS410 Doctoral Course in Environment and Development Studies

Doctoral Course in Environment and Development Studies

Credits: 15 **Language:** English
Staff/institute: Nadarajah Shanmugaratnam/ Noragric
Teachers: Staff at Noragric and invited lecturers.
Start term: Autumn parallel
Terms: Autumn parallel January block Spring parallel
Mandatory activities: Compulsory term paper and course participation in 2/3 of the lectures.
Prerequisites: Participants should hold a Master\'s degree or equivalent.
Type of course: The course will be based on lectures and seminars. It will be rather intensive for 8 weeks, then the rest of the semester will be available to write a term paper and for other seminars and discussions if required.
Contents: The course has two main components: 1. Environment-Development Relations (One module - 1/3) 2. Development Theory and Policy (Three modules - 2/3) a. Development theories in historical perspective b. Globalisation, Development and democracy: Current debates and the Global-Local Nexus c. Development policies and practices: Critical review and Case studies The module on Environment-Development relations introduces the student to political ecological analyses and interpretations of society-nature interaction, resource appropriation and degradation, and marginalisation. Module 2.a. traces the origins of the more influential ideas of development and presents the main theories inspired by them from a critical and historical perspective. Module 2.b. deals with the current debates on globalisation with reference to development, democracy and global power relations. It focuses on a wide range of issues including the nature and role of multilateral organisations; globalisation-poverty relations; state building, liberalisation, democracy and governance; post-conflict development, and the global-local nexus. Module 2.c. critically addresses the question of development policies and what happens in practice with the aid of real world examples. Development performance, resource rights and distributional issues, resource conflicts and poverty are among the key issues covered.
Learning outcomes: International environment and development studies is an evolving multi- and inter-disciplinary field of study. Characterised by normative and policy concerns, this field of study examines processes of development and change in ways that illuminate the dynamics of power relations and states of human well-being and the environment in particular contexts from different perspectives. The PhD course is aimed at providing the students with a sound interdisciplinary understanding of environment-development relations and a critical knowledge of development theories, policies and practices with due regard to the diversity and complexity of the real world. Given its multi- and inter- disciplinary nature, the course draws on knowledge from social and natural sciences and present approaches that integrate the political economic, cultural and ecological aspects of change at macro, meso and micro levels.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Exam in ENGLISH ONLY. Oral exam

EDS415 Research Methodology in Development Studies

Research Methodology in Development Studies

Credits: 5 **Language:** English
Staff/institute: Randi Kaarhus/ Noragric
Teachers: Randi Kaarhus, Arild Vatn, Pål Vedeld, and external lecturers: Kjersti Larsen and Svein S. Andersen
Start term: January block
Terms: January block
Mandatory activities: The students must submit a preliminary paper before the first lecture and participate in at least 80 % of the lectures.
Prerequisites: Participants should hold a Master\'s degree or equivalent. They should also have been admitted to a PhD programme, and have formulated a research proposal which can be further developed.
Credit reduction: No
Type of course: 16 hours of lectures and 10 hours group work
Contents: Engelsk:The main objective of the course is to provide course participants with a basic understanding of some of the key challenges of research design in development studies, with an emphasis on the use of qualitative research methods. This also involves addressing the challenges of research design in development studies as an interdisciplinary field. The

course aims to provide a link between general methodological principles and challenges, and the selection and use of a set of research methods and tools for data collection in a PhD research project. In mono-disciplinary research within a traditional academic discipline, the methods of data collection are often given. In development studies, as an interdisciplinary field, many of the methodological choices in a research project do not have a standard answer, and need to be made explicit, discussed and reflected upon. The course will offer an opportunity for such discussions, and will also address the relationship between epistemology, theoretical perspectives, research questions, and tools of data collection and analysis. In concretising the use of research methods, the course will focus more specifically on fieldwork research, case studies and qualitative interviews.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Exam in ENGLISH ONLY. A final term paper (8-10 pages).

EDS420 Thor Heyerdahl Summer School in Environmental Governance: Institutions for sustainable development

Thor Heyerdahl Summer School in Environmental Governance: Institutions for sustainable development

Credits: 10 **Language:** English
Staff/institute: Arild Vatn/ Noragric
Teachers: -
First time the course is offered: SPRING 2011
Last time the course is offered: VÅR SPRING
Start term: June block
Terms: June block
The course is offered: Other - --
Mandatory activities: -
Prerequisites: -
Credit reduction: -
Type of course: -
Contents: -
Learning outcomes: -
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: -

EDS421 Thor Heyerdahl Summer School in Environmental Governance: International environmental governance

Thor Heyerdahl Summer School in Environmental Governance: International environmental governance

Credits: 10 **Language:** English
Staff/institute: Arild Vatn/ Noragric
Teachers: -
First time the course is offered: SPRING 2012
Last time the course is offered: VÅR SPRING
Start term: June block
Terms: June block

The course is offered: Other - Only in 2012Bare i 2012
Mandatory activities: -
Prerequisites: Master degree. Participants must be PhD students or have a PhD degree
Credit reduction: -
Type of course: -
Contents: -
Learning outcomes: -
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: -

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

Thor Heyerdahl Summer School in Environmental Governance: Governance of local resources
Credits: 10 **Language:** English
Staff/institute: Arild Vatn/ Noragric
Teachers: -
First time the course is offered: SPRING 2013
Last time the course is offered: VÅR SPRING
Start term: June block
Terms: June block
The course is offered: Other - --
Mandatory activities: -
Prerequisites: Master degree. Participants should be PhD students or have a PhD degree.
Credit reduction: -
Type of course: -
Contents: -
Learning outcomes: -
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: -

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

Individual Specialisation (literature study) in Land Consolidation and Related Subjects
Credits: 10 **Language:** English upon request
Staff/institute: Erling Berge/ ILP
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Oral presentation of own work and participation in the presentation seminars of all other students.
Prerequisites: EIE226, EIE222, EIE302, JUS311, JUS320.
Type of course: A minimum of 6 hours individual supervision per student. Compulsory participation in seminar presentations. The amount of time used for seminars depends on the number of students taking the course, as each student gets one hour.
Contents: The course consists of the following: 1. Supervisor and student discuss topic and literature 2. Writing, with supervision as needed 3. Oral presentation
Learning outcomes: a) Use literature to study a professional topic. b) Write a professional report.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F

Assessment methods: Project assignment.

FMI309 Environmental Pollutants and Ecotoxicology

Environmental Pollutants and Ecotoxicology

Credits: 10 **Language:** English
Staff/institute: Hans-Christian Teien/ IPM
Teachers: Bjørn Olav Rosseland, Brit Salbu, Deobrah Outhton , Ole Martin Eklo, Knut -Erik Tollefsen, John Einset, Per Strand, Lindis Skipperud and external lectures.
First time the course is offered: SPRING 2012
Start term: January block
Terms: January block Spring parallel
Mandatory activities: .
Prerequisites: KJM100
Credit reduction: 10 credits overlap to FMI310
Contents: Lectures: Focus on natural and man made sources that contribute to the contamination of trace metals, radionuclides and organic pollutants in air, water, sediments, soil and vegetation and how the contaminants forms and mobility effect organisms up to and including man. Focus on standard (ISO) ecotoxtesting, terminology in toxicology and how early effects can be traced back to biomarker responses. Field demonstration at Lake Årungen: Demonstration of important limnological and chemical methods, including in situ fractioning techniques for metals in water, and sampling of plants, soil, sediments, and aquatic organisms. Laboratory course: The students practice taking tissue samples for determination of contaminants in fish organs according to an international ptotocol. A certificate is issued for the sampling (voluntarily).
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Excam counts 100% of total grade
Examination aids: No calculator, no other examination aids

FMI310 Environmental Pollutants and Ecotoxicology

Environmental Pollutants and Ecotoxicology

Credits: 15 **Language:** English
Staff/institute: Hans-Christian Teien/ IPM
Teachers: Bjørn Olav Rosseland, Brit Salbu, Deborah Ougthon, Ole Martin Eklo,Knut-Erik Tollefsen, John Einseth, Inggard Blakar, Per Strand and guest lecturers.
Start term: January block
Terms: January block Spring parallel
Mandatory activities: .
Prerequisites: KJM100.
Type of course: Lectures: 58 hours. One day of field demonstration at Lake Årungen. Excursion over two days to visit the Norwegian Institute for Water Research (NIVA) in Oslo, the Norwegian Institute for Air Research (NILU) in Lillestrøm, NIVA Marine Research Station Solbergstrand and UMB\'s Gamma Radiation Source (Campus). Dissection course with fish in laboratory for sampling of organs for analyses of pollutants: 4 hours. Term paper 150 hours.
Contents: Lectures: Focus on natural and man made sources that contribute to the contamination of trace metals, radionuclides and organic pollutants in air, water, sediments, soil and vegetation and how the contaminants forms and

mobility effect organisms up to and including man. Focus on standard (ISO) ecotoxtesting, terminology in toxicology and how early effects can be traced back to biomarker responses. Field demonstration at Lake Årungen: Demonstration of important limnological and chemical methods, including in situ fractioning techniques for metals in water, and sampling of plants, soil, sediments, and aquatic organisms. Laboratory course: The students practice taking tissue samples for determination of contaminants in fish organs according to an international ptotocol. A certificate is issued for the sampling (voluntarily). Term Paper: The students are through a Term Paper to document broad knowledge on one central topic related to contaminants and ecotoxicological effects (completed individually).
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Both exam and term paper must be passed to pass the course. Term paper counts 1/3 and exam counts 2/3 of total grade.

FMI312 Environmental Exposures and Human Health

Environmental Exposures and Human Health

Credits: 10 **Language:** English upon request
Staff/institute: Yngvar Thomassen/ IPM
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: An individual semester assignment of minimum 10 pages to be submitted medio November. This assigment must be accepted before the oral examination.
Prerequisites: KJM100.
Type of course: 30 lectures: 3 hours per week for 10 weeks.
Contents: The course will deal with the connection between the most important biological, chemical and physical environmental factors and human health both in a local and global perspective. The consequences of pollution in air and water, exposure to unhealthy environmental factors at work, contaminants in nutrients and industrial discharges will be discussed.
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.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination counts 100 %.

FORN310 Bioenergy -Resources, Profitability and Solutions

Bioenergy -Resources, Profitability and Solutions

Credits: 5 **Language:** English
Staff/institute: Torjus Folsland Bolkesjø/ INA
Teachers: Erik Trømborg, Olav Høibø and others from UMB and lecturers from NTNU
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Workshops and approved term papers.
Prerequisites: FORN210 or FORN200 or similar
Type of course: Ca. 35 hours lectures, excursions and seminars

Contents: Through lectures, exercises and workshops, the students will get insights into the resource availability and biomass supply, conversion technologies and technological solutions for small-scale and large-scale facilities. Also the economics of bioenergy, both from the firm and society point of view will be addressed.
Learning outcomes: The course shall provide an in-depth understanding of technological, environmental and economic consequences related to bioenergy. Students shall be able to work with interdisciplinary problems and planning processes related to the establishment of bioenergy facilities and be able to analyse, synthesise and present knowledge from different diciplins.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3-hour written exam
Examination aids: Simple calculator, no other examination aids

FYS381 Biological Physics

Biological Physics

Credits: 10 **Language:** English upon request
Staff/institute: Gaute Einevoll/ IMT
Teachers: Gaute Einevoll.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Basic mathematics, computer science and physics.
Credit reduction: FYS380 - 10 credits.
Type of course: Lectures: 48 hours. Exercises: approximately 24 hours.
Contents: The curriculum will be presented in lectures, and problem calculation exercises will contribute to increased understanding of the topics.
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.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Final oral examination based on the course curriculum.

FYS385 Project in Biological Physics

Project in Biological Physics

Credits: 5 **Language:** English upon request
Staff/institute: Gaute Einevoll/ IMT
Teachers: Cecilia Futsæther
Start term: Autumn parallel
Terms: Autumn parallel January block
Prerequisites: Basic mathematics, computer science and physics. FYS381 must be taken before or in parallel with the course.
Credit reduction: FYS380 - 5 credits.
Type of course: Weekly discussion with teachers and/or fellow students.
Contents: Work on the project. Writing of the scientific report. Oral presentation of the report.
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.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F

Assessment methods: The project report is assessed and counts for 3/4 of the final grade. If several students collaborate on a single report, it must be possible to identify their individual contributions. Every student gives a presentation, presenting either a part of a collaborative project or an individual project. The presentation is assessed and counts 1/4 of the final grade. Both the report and the presentation must get a passing grade to pass the course.

FYS386 Mathematical Neuroscience

Mathematical Neuroscience

Credits: 5 **Language:** English upon request
Staff/institute: Gaute Einevoll/ IMT
Teachers: Gaute Einevoll.
Start term:
Terms: By demand
The course is offered: Other - Upon request, by appointment with course responsible.Gis etter behov etter avtale med emneansvarlig.
Prerequisites: Introductory courses in mathematics and information sciences.
Type of course: Discussion groups: ca. 24 hours.
Contents: Selected topics related to mathematical modelling of (i) signal processing in nerve cells, (ii) neural coding and decoding, (iii) receptive fields in the visual system, (iv) information transmission in the nervous system, (v) biophysics of nerve cells, (vi) biological neural networks, and (vii) learning and memory.
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.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Final oral examination. The student will be asked questions from the curriculum by the examiner and the course teacher.

GEN220 Genetic Basis of Biodiversity

Genetic Basis of Biodiversity

Credits: 10 **Language:** English
Staff/institute: Manfred Joachim Heun/ INA
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities:
Prerequisites: BIO120.
Type of course: Lectures: 40 hours.
Contents: General introduction, definition of biodiversity, genetic resources etc. Gradients of diversity and distribution patterns of selected species. Communities, ecosystems and biomes; Global timing and the past. DNA tools for detection/ measurement of genetic diversity/relationship. Natural selection, mutations and novelty. Neutral theory of molecular evolution.
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.
Methods of examination: Final Written exam **Grading:** A-F

Assessment methods: Written exam of 3 hours.
Examination aids: No calculator, no other examination aids

GEN320 Molecular Markers for Plant Genomics

Molecular Markers for Plant Genomics

Credits: 5 **Language:** English
Staff/institute: Manfred Joachim Heun/ INA
Teachers: none
Start term: January block
Terms: January block
The course is offered: Even years
Mandatory activities: Group work.
Prerequisites: BIO120 and GEN220.
Type of course: 10 hours lectures distributed over 3 weeks.
Contents: Understand the use of DNA marker for genome analysis with focus on plants.
Learning outcomes: The students will learn DNA marker-based approaches for understanding plant genomes.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Presentation of one scientific article (1 hour per student) accounts for 2/5. A written summary of 6-12 scientific articles accounts for 3/5. Not all individual parts have to be better than \'passed\'; the combined grading counts.

GEN401 Research School Genetics A

Research School Genetics A

Credits: 5 **Language:** English upon request
Staff/institute: Tormod Ådnøy/ IHA
Teachers: Teachers from UMB and invited seminar speakers.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Other - More than 7 PhD students should be interested before the course is given.Meir enn 7 PhD studentar bør vera interesserte før emnet blir gitt.
Mandatory activities: One presentation per student - of own research or related topic. Approximately 20 minutes + questions. Participation in at least 75% of the gatherings.
Prerequisites: 300-level in genetics, breeding or molecular genetics.
Credit reduction: No.
Type of course: Usually structured teaching time 12-16 two wednesdays per month. Last wednesday of month: lectures, exercises, group work etc lead by UMB teacher, and student presentations. First wednesday of month: lectures, exercises, group work etc lead by UMB teacher 12-14, followed by seminar by (UMB-)external invited researcher and social gathering at 14-16. For every gathering there is written material and maybe exercises that should be studied.
Contents: A choice of 4-5 of the topics will be given: molecular genetics, molecular biology, mathematical-statistic methods in genetics and breeding, bioinformatics, genomics, genome analysis, selection, prediction of breeding values, genetic resources, inbreeding and relationship, breeding plans, philosophy of science, and ethics. Teachers at UMB will give an overview of a topic - often based on a course they already teach.
Learning outcomes: - To give an overview of genetics and methods used in genetics. The overview shall be up to date concerning topics and techniques in molecular genetics and breeding. - To strengthen the cooperation of genetics and breeding workers. - After having completed the course students should be able to point out relevant methods to solve specific research tasks in the genetic fields covered.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

GEN402 Research School Genetics S

Research School Genetics S

Credits: 5 **Language:** English upon request
Staff/institute: Tormod Ådnøy/ IHA
Teachers: Teachers from UMB and invited seminar speakers.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: One presentation per student - of own research or related topic. Approximately 20 minutes + questions. Participation in at least 75% of the gatherings.
Prerequisites: 300-level in genetics, breeding or molecular genetics.
Type of course: Usually structured teaching time 12-16 two wednesdays per month. Last wednesday of month: lectures, exercises, group work etc lead by UMB teacher, and student presentations. First wednesday of month: lectures, exercises, group work etc lead by UMB teacher 12-14, followed by seminar by (UMB-)external invited researcher and social gathering at 14-16. For every gathering there is written material and maybe exercises that should be studied.
Contents: A choice of 4-5 of the topics will be given: molecular genetics, molecular biology, mathematical-statistic methods in genetics and breeding, bioinformatics, genomics, genome analysis, selection, prediction of breeding values, genetic resources, inbreeding and relationship, breeding plans, philosophy of science, and ethics. Teachers at UMB will give an overview of a topic - often based on a course they already teach.
Learning outcomes: - To give an overview of genetics and methods used in genetics. The overview shall be up to date concerning topics and techniques in molecular genetics and breeding. - To strengthen the cooperation of genetics and breeding workers. - After having completed the course students should be able to point out relevant methods to solve specific research tasks in the genetic fields covered.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

GEO220 Hydrogeology

Hydrogeology

Credits: 5 **Language:** English upon request
Staff/institute: Helen Kristine French/ IPM
Teachers: Michael Heim, Leif Vidar Jakobsen.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory assignments, excursions.
Prerequisites: GEO100.
Type of course: Lectures: 20 hours. Exercises: 25. Web searching: 4 hours. Excursion: 6 hours.
Contents: Lectures (can be followed in the classroom or as a web-based teaching in Classfronter): Properties of groundwater basins, the flow of groundwater. Exercises: 1. The use of groundwater maps. 2. Flash components in Classfronter 3. Web searches: The national well database. Excursion: One half day in the UMB area: Groundwater in surficial deposits (Frydenhaug). Other information: This course uses Classfronter for communication with the students outside of the lectures.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written examination (3 hours): 100%.
Examination aids: Simple calculator, no other examination aids

GEO222 Geology Project

Geology Project

Credits: 5 **Language:** English upon request
Staff/institute: Mona Henriksen/ IPM
Teachers: Helen French, Michael Heim, Leif Jakobsen, Jon Landvik.
Start term: Autumn parallel
Terms: By demand
Prerequisites: GEO100. Students who would like a special assignment in Quaternary Geology: GEO210. Students who would like a special assignment in hydrogeology(previous groundwater): GEO220.
Type of course: Guidance: ca. 10 hours.
Contents: The student makes a plan for the work together with the teacher and the employer. The plan is to contain the purpose of the project, a detailed plan for the conduction of the project, product and report.
Learning outcomes: Use the knowledge acquired from the courses in geology to solve applied problems or problems related to geological research projects. Through the course, the students will acquire knowledge of the practical conduction of geological investigations. He/she will have the opportunity to come into direct contact with employers and researchers in geology. The student will learn to write a report.
Methods of examination: Final **Grading:** A-F
Assessment methods: Final report.

GEO300 Avanced Hydrogeology

Avanced Hydrogeology

Credits: 10 **Language:** English upon request
Staff/institute: Helen Kristine French/ IPM
Teachers: Jan Mulder
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Submission of exercises.
Prerequisites: GEO220.
Type of course: Lectures and introductions: 40 hours. Exercises: 7 hours. Modelling: 20 hours.
Contents: 1. Lectures - theory. 2. Calculation exercises. 3. Assignments (assessment included in the final grade). 4. Introduction of groundwater models eg MODFLOW. 5. MODFLOW exercises (to be submitted and approved).
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 about geo-chemical processes, dispersion, diffusion, retardation and degradation is important with respect to evaluation of effect of human activities on the aquifer system. 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 quantitatively and qualitatively in the groundwater. This is important for an optimal management of groundwater resources. Clean groundwater is an important natural resource.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: 2 assignments: representing 40% of the final grade. Final written examination (3 hours): representing 60% of the final grade. The two assignments involve computation of transport problems in groundwater. This part will be done during the semester. All parts of the evaluation must be passed.

GEO310 Paleoenvironment and Climate Change

Paleoenvironment and Climate Change

Credits: 10 **Language:** English upon request
Staff/institute: Jon Landvik/ IPM
Teachers: Mona Henriksen.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Prerequisites: GEO100 and GEO210, or equivalent courses.
Type of course: Seminars and lectures: 24 hours
Contents: The course addresses the dramatic natural changes in the Earth\'s physical and biological environments on geological time scales. There will be a focus on the development of both low and high latitude environments. The students will learn about the forcing mechanisms and feedbacks controlling long-term climatic change, the effect of climate change on the physical and biological environments, and gain an understanding for the environments\' sensitivity to future changes. The course comprises lectures as well as seminars on up-to-date research papers addressing these topics.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Submitted papers: 50%. Final exam: 50%. Both parts must be passed.

GEO311 Geological Excursion

Geological Excursion

Credits: 5 **Language:** English upon request
Staff/institute: Mona Henriksen/ IPM
Teachers: Helen French, Michael Heim, Jon Landvik.
Start term:
Terms: By demand
The course is offered: Other - The course is given according to need, the students attend various geological excursions (usually arranged by other universities).Emnet arrangeres ved behov, studentene deltar på ulike utferder innen geologi (som regel arrangert av annet universitet).
Mandatory activities: Excursion.
Prerequisites: GEO100 and GEO210, GEO211 or GEO220, GEO221.
Contents: The course is mainly comprised of a geological excursion. The theoretical part includes selected literature and the students are to write a report that forms the basis of the assessment.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Report: 100%.

GMBB201 Image Processing in Geomatics

Image Processing in Geomatics

Credits: 5 **Language:** English upon request
Staff/institute: Øystein Dick/ IMT

Teachers: Øystein Dick
Start term: August block
Terms: August block
The course is offered: Odd years
Mandatory activities: Exercises, excursion/field exercise.
Prerequisites: GMBB100
Credit reduction: GMBB200: 5 credits.
Type of course: Lectures: 30 hours. Exercises: 40 hours. Excursion/field exercise: 16 hours.
Contents: Lectures: The geometric and radiometric properties of satellite imagery. Geometric rectification/geocoding. Single-image photogrametry with emphasis on SPOT scenes. Control of geometric accuracy. Special image enhancement techniques. Mosaic production. Classification methods with emphasis on unsupervised classification. Use of satellite images for vegetation mapping. Evaluation of classification results. Image matching and filtering. Exercises: Geometric rectificataion. Measurement of terrain elevation in oblique scene. Image matching. Special image processing methods; Pan-sharpening and mosaicing. Unsupervised classification (clustering) and field control. Excursion: Field work in the Oslo-area.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination.
Examination aids:

GMGD210 Geodetic Measurements

Geodetic Measurements

Credits: 5 **Language:** English
Staff/institute: Ola Øvstedal/ IMT
Start term: June block
Terms: Autumn parallel June block
The course is offered: Even years
Mandatory activities: Field course.
Prerequisites: GMUJ200. GMSG210.
Type of course: Field exercises: 40 hours. Lectures: 15 hours. Exercises: 50 hours.
Contents: Field course: Planning, reconnaissance and geodetic measurements. Selecting optimal observation methods (direction measurement, distance measurement, levelling as well as various GPS-based methods) for various types of geodetic measurements. Verification of observation material in the field. Lab: Groupwise calculations based on the results from the field exercises: searches for major errors, testing existing networks and reliability analysis. Relations with national standards.
Learning outcomes: Master the planning, field work and analysis of geodetic measurements. There will be great emphasis on quality assurance and connections to relevant standards.
Methods of examination: Final **Grading:** A-F
Assessment methods: Project report.

GMGD300 Geodesy Graduate Course

Geodesy Graduate Course

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

Staff/institute: Bjørn Ragnvald Pettersen/ IMT
Teachers: Oddgeir Kristiansen, Christian Gerlach, Ola Øvstedal, Jon Glenn O. Gjevestad.
Start term: Spring parallel
Terms: Autumn parallel Spring parallel
Mandatory activities: Exercises. Compulsory, submitted work must be passed in order for the student to sit for the exam.
Prerequisites: GMSG200.
Type of course: Lectures and discussion groups: 80 hours. Exercises: 80 hours.
Contents: Selected topics in classical and modern higher geodesy: global geodetic reference systems, astronomical and physical geodesy, space and satellite geodesy, height systems, geoide calculations, inertial navigation, and parameter estimation.
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).
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination: 1/1.

GMGI300 Geographical Database Systems

Geographical Database Systems

Credits: 10 **Language:** English upon request
Staff/institute: Håvard Tveite/ IMT
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Prerequisites: Geographical Information Systems (GMGI101/LAD102 and GMGI102, or equivalent). Programming courses (INF120, INF200). Databases (INF130).
Type of course: Lectures: 42 hours (3 hours per week). Work on exercises/projects (predominately undertaken by the student): 70 hours (5 hours per week).
Contents: Modelling of geographical information. Spatial data structures. Geographical database systems. Standards for modelling, storing and transferring geographical information. Database solutions for GIS. Distributes systems. Implementation of geographical information services.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final written examination (3.5 hours): 60%. Project assignment: 30%. Article presentation: 10%.

GMSG200 Satellite Geodesy

Satellite Geodesy

Credits: 5 **Language:** English upon request
Staff/institute: Bjørn Ragnvald Pettersen/ IMT
Teachers: Oddgeir Kristiansen.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises.
Prerequisites: Basic courses in mathematics and physics.
Type of course: Lectures: 28 hours. Exercises: 28 hours.
Contents: Celestial and terrestrial reference systems. Time systems. Precession, nutation and polar motion. Theory of Kepler orbits. Perturbations. Space geodetic observation techniques. International organisations and available information in electronic networks.

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.).
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination.
Examination aids:

GMSK300 Satellite Mapping

Satellite Mapping

Credits: 10 **Language:** English upon request
Staff/institute: Øystein Dick/ IMT
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises and excursion.
Prerequisites: GMBB201 (GMBB200).
Type of course: Lectures: 34 hours. Exercises: 60 hours. Excursion: 8 hours. Continuous assessment: 2 hours.
Contents: Lectures: Pixel representation and image formats. Satellite mapping and GPS. The use of GPS for control point determination. The use of matching for controlling the geometric accuracy of satellite images. Satellite image stereo-photogrammetry. Automated terrain model production. Digital terrain models in raster format. 3D-visualisation. The use of imaging Synthetic Aperture Radar (SAR). Interferometrical use of SAR. Fourier transformation of images. Exercises: Exercise 1: Determination of the structure of picture files with unknown formats. Import, processing and converting of image files. Exercise 2: GPS-based determination of ground control points and control of the result using an image-matching technique. Exercise 3: Digital terrain models in raster format. Excursion: A visit to Norwegian Defence Research Establishment Norwegian Computing Centre) and the Department of Geosciences, University of Oslo.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The continuous assessment includes a written test and a practical test. The final examination is oral.

HET401 Individual PhD Course in Ethology

Individual PhD Course in Ethology

Credits: 10 **Language:** English upon request
Staff/institute: Bjarne Olai Braastad/ IHA
Teachers: Knut E. Bøe, Inger Lise Andersen and possibly others.
Start term:
Terms: By demand
The course is offered: Other - Course given upon demand.Emnet gis etter behov.
Prerequisites: Competence at Master\'s degree level in ethology.
Type of course: The structure is to be agreed upon by the PhD student and the supervisor.
Contents: Individually planned.
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.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: The PhD student writes a semester assignment on a topic given by the teacher.

HFA220 General animal breeding

General animal breeding

Credits: 10 **Language:** English
Staff/institute: Hans Magnus Gjøen/ IHA
Teachers: Gunnar Klemetsdal
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Assignments
Prerequisites: Statistics (e.g. STAT100) Genetics (e.g. BIO120)
Credit reduction: HFA200 (100%)
Type of course: Lectures 2 hours per week and guided assignments 2 hours per week
Contents: Introduction and solid basis within quantitative genetics; genetic relationship and inbreeding, genetic parameters, breeding value estimation, selection and breeding methods.
Learning outcomes: The student shall be able to analyse the effect of various breeding decisions (within pure-breeding and crossbreeding schemes) and get the required knowledge to do further studies within the subject.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Duration: 3 hours. and exercises

HFA300 Animal Breeding Plans

Animal Breeding Plans

Credits: 10 **Language:** English upon request
Staff/institute: Tormod Ådnøy/ IHA
Teachers: Employees of animal breeding organisations may be involved.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Participation in group work and presentations. Submission of group assignment.
Prerequisites: HFA200.
Type of course: Lectures: ca. 20 hours. Exercises: ca. 20 hours. Group work: ca. 20 hours. Presentations of group work and individual assignments: 10 hours.
Contents: - Biological basis and aids for breeding work. - Definition of breeding goal and discussion of registration of needed information. - Economic value of traits in the breeding goal and calculation of economic profits of the breeding work. - Optimization of breeding plans. - Optimization of specific breeding plans for pigs, cattle, goats, poultry and fish.
Learning outcomes: Students will learn about the importance of biological, technical and economic conditions within the different animal species, and evaluate this in alternative breeding plans.
Methods of examination: Final **Grading:** A-F
Assessment methods: Grading on the basis of individual semester assignment.

HFA301 Calculation of Breeding Values

Calculation of Breeding Values

Credits: 10 **Language:** English upon request
Staff/institute: Tormod Ådnøy/ IHA
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Hand-in exercises may be assessed in order to assure good study progression throughout the semester. Presentation of own term paper for the other students, and participation at such presentations.

Prerequisites: HFA200.
Type of course: Discussion groups/lectures: 2 hours per week. Datalab: 2 hours per week.
Contents: In this course, ways of calculating breeding values in domestic animal breeding programs will be explored. Focus will be put on understanding the methods, and limitations of the methods. Small practical calculation examples and matrix notation will be used. We will go through (chapter 26 in the textbook): The general mixed effect model. Estimation of fixed effects and prediction of random effects (blup). Estimation ability. Standard errors of estimators. Animal model. Reduced animal model. Calculation of relationship matrix and inverse relationship matrix. Breeding values in models with repeated measurements on individuals. Maternal effects models. There will not be focus on computer programmes that are specialised for breeding value calculations in practical domestic animal breeding situations, but the programme matlab will be used. An alternative is R. Regarding variation component estimation (chapter 27 in the textbook), an introduction to the underlying theoretical foundation and the principles for calculation techniques will be covered.
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.
Methods of examination: Final **Grading:** A-F
Assessment methods: Semester assignment.

HFA304 Theory and Application of Inbreeding Management

Theory and Application of Inbreeding Management

Credits: 10 **Language:** English
Staff/institute: John Arthur Woolliams/ IHA
Teachers: Theo Meuwissen.
Start term: January block
Terms: January block Spring parallel
Mandatory activities: Computer practicals to be presented as evidence of effort.
Prerequisites: HFA200.
Type of course: 300 hrs.
Contents: Introduction to inbreeding, Phenomenon associated with inbreeding, Relationships, Genetic contributions, Minimizing inbreeding, Inbreeding and selection, Contribution of mating to managing inbreeding, Quantitative genetics guide to DNA markers, Using DNA markers in diversity studies, Constructing IBD matrices and their use, Managing inbreeding within genomes.
Learning outcomes: To present a unified approach to the management of inbreeding, providing supporting concepts with practical tools.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Examination: Continous assessment. Written examination at the end of January block. Semester report must be approved before the examination result is given.

HFA400 Quantitative Genetics

Quantitative Genetics

Credits: 10 **Language:** English upon request
Staff/institute: Hans Magnus Gjøen/ IHA
Teachers: The course is given when required. The supervisors of each PhD student are expected to contribute as teachers.
Start term:
Terms: By demand
The course is offered: Other - On demand.Ved behov.
Mandatory activities: Colloquia.
Prerequisites: 300 level in livestock breeding, or the equivalent.
Type of course: Discussion groups: 22 hours. (Subject to change).

Contents: Quantitative genetics with focus on inbreeding, genetic variation and breeding plans and economics in breeding. Topics may be changed.
Learning outcomes: The students should acquire a solid understanding of quantitative genetics.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Written examination, 3 hours.
Examination aids:

HFA401 Biometrical Methods in Animal Breeding

Biometrical Methods in Animal Breeding

Credits: 10 **Language:** English upon request
Staff/institute: Tormod Ådnøy/ IHA
Start term:
Terms: By demand
The course is offered: Other - When enough students.Når det er nok studentar.
Mandatory activities: Participation in colloquia.
Prerequisites: Animal breeding up to PhD level. Linear algebra.
Type of course: Approximately 30 hours colloquium and 30 hours of exercises.
Contents: We will follow the textbook RA Mrode: Linear Models for the Prediction of Animal Breeding Values, CAB Int. Some original articles on variance component estimation will also be covered. At least the two last chapters of Lynch and Walsh: Genetics and Analysis of Quantitative Traits, are relevant as a supplementary text. Another requirement is to be capable of using the software vce/pest, asreml, dmu, R, or another variance component estimation program on a data set, and predict blup breeding values.
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).
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Semester assignment: 60 %. Written 3-hour examination: 40 %. The semester assignment shall present the result of calculating breeding values on real data.

HFA404 Statistical Problems in Quantitative Genetics and Animal Breeding

Statistical Problems in Quantitative Genetics and Animal Breeding

Credits: 5 **Language:** English
Staff/institute: Daniel Gianola/ IHA
Start term:
Terms: By demand
The course is offered: Other - By demand.Etter behov.
Mandatory activities: Students will present selected topics and be asked questions about their understanding.
Prerequisites: A solid background in regression analysis, quantitative genetics, and a course in introductory mathematical statistics or probability theory.
Contents: Discussion of advanced topics in statistical genetic analysis of continuous and discrete traits including linear models, variance components, Bayesian approaches and non-parametric procedures.
Learning outcomes:
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Oral report/examination.

HFE200 General Animal- and Fish nutrition

General Animal- and Fish nutrition

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

Staff/institute: Birger Svihus/ IHA
Teachers: Øystein Ahlstrøm, Trond Storebakken.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises.
Prerequisites: Animal physiology (HFX201).
Credit reduction: AKE251 - 5 credits.
Type of course: Structured teaching time will be roughly divided as follows: Lectures: 4 hours per week (total 44 hours). Group tutorials: 2 hours per week (total 30 hours). Demonstrations: Total 10 hours.
Contents: This course is an introduction to nutrition constituting a platform enabling the student to specialize in both mono gastric and ruminant nutrition. It also formulates the platform for further studies of specific feed types and feed technology. The course is broad in this sense, and may be divided into 3 sub-topics: 1. Nutrients: (Macro and Micro nutrients). 2. Feed evaluation and digestibility: (Feed composition, Digestion and Feed utilization). 3. Intermediate metabolism: (Energy partitioning, Catabolism and Anabolism of macro nutrients). Particular emphasis is placed on understanding relationships between the different sub-topics.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: During the course there will be three part-examinations (1 hour each) based on the questions of the exercises of the three subsections nutrients, digestion and intermediate metabolism. Each part-examination will be graded and account for 15 % of the total grade. The course will end with a final written examination of 3 hours which counts 55 %. The student must pass all subsections and participate in the exercises in order to sit for the final examination.

HFE303 Nutrition and Optimisation of Diets for Monogastric Animals

Nutrition and Optimisation of Diets for Monogastric Animals

Credits: 10 **Language:** English upon request
Staff/institute: Nils Petter Kjos/ IHA
Teachers: Øystein Ahlstrøm, Birger Svihus and others.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises. The exercises will deal with calculation of digestibility/nutritive balance studies with monogastrics (roosters, mink or pigs), calculations on energy and protein value of compound feeds and feedstuffs for monogastrics, and optimising of diets for monogastrics.
Prerequisites: KJM100, HFX201, HFE200, HFE202, HFX253.
Type of course: The course includes 50 hours of lectures and 20 hours of group work.
Contents: Characteristics of the digestion and intermediary metabolism in monogastric animals. Background and construction of the energy and protein evaluation systems found in pigs, poultry and fur animals. Principles for an optimal feed composition and choice of feedstuffs based on considerations of product quality, resource utilisation and environmental concerns. Determination of standards for nutrition supply under various production conditions. When appropriate due to ongoing experiments, demonstration of digestion/nutritive balance studies in monogastric animals (roosters, minks or pigs) may be performed. Exercises on the calculation of energy and protein values in feedstuffs and compound feeds for monogastric animals.
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, fur animals). 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.
Methods of examination: Final Written exam **Grading:** A-F

Assessment methods: Written examination.
Examination aids: Simple calculator, no other examination aids

HFE305 Feed Manufacturing Technology

Feed Manufacturing Technology

Credits: 10 **Language:** English
Staff/institute: Birger Svihus/ IHA
Teachers: Ozren Zimonja, Trond Storebakken
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: Demonstrations and group work are compulsory.
Prerequisites: Basic knowledge in nutrition equivalent to HFE200, in physics equivalent to FYS100 and in chemistry equivalent to KJM110, is required.
Type of course: Approximately 40 hours of lecturing and 30 hours of demonstrations.
Contents: The following topics will be covered through lectures and demonstrations: The structure of the feed industry. Receiving, storing and transporting feed ingredients. Chemical changes during processing. Pelleting - principles and major effects. Pellet quality. Extrusion. Dosing, weighing and mixing of diets. Pelleting - technical part. Conditioning. Expander treatment. Grinding of feed ingredients. Use of liquid feed ingredients. Cooling and drying. Process quality assurance program (ISO 9001). Feed milling administration, maintenance program and flow design.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3 hour written examination.
Examination aids: No calculator, no other examination aids

HFE306 Advanced Feed Manufacturing Technology

Advanced Feed Manufacturing Technology

Credits: 5 **Language:** English
Staff/institute: Ozren Zimonja/ IHA
Teachers: Dejan Miladinovic, Trond Storebakken
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: The students must have taken HFE305.
Type of course: Lectures will be given when required.
Contents: The course will mainly be based on group work carried out at the Center for Feed Technology. The work will start in January. The group work will be carried out as complete experiments, and the group will present and hand in a report from the group work. The reports will be graded. Each student will also hand in an individual report. Topics that will be covered may include: - Grinding - Weighing and mixing - Conditioning and expanding - Pelleting - Extrusion - Cooling/drying
Learning outcomes: The purpose of this course will be to gain in-depth knowledge of how and why different key processes and equipments are installed and used in feed production plants. The objective is that the students after this course will be able to not only understand the principles used for key processes, but also to optimise these processes through discussions with factory personnel and equipment producers.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: 1-2 group assignments and one individual assignment per student. Graded group and individual reports, each counting 50% of the final grade.

HFE307 Feed Production Planning and Management

Feed Production Planning and Management

Credits: 15 **Language:** English
Staff/institute: Trond Storebakken/ IHA
Teachers: Ozren Zimonja, Dejan Miladinovic, Jovo Kosanovic.
Start term: Spring parallel
Terms: Autumn parallel Spring parallel
Mandatory activities: Lectures and demonstrations
Prerequisites: The students must have taken HFE305.
Type of course: Ca. 4 hours per week.
Contents: The course is divided into two parts: Part 1: Design and construction of a feed plant. Data production control. Product development. Feed analitics. Steam systems and use of steam as a raw material. Maintenance systems in a feed plant. Saftety and health in a feed plant. Part 2: Business management and leadership of the factory. Personnel management. Quality control and ISO 9001. Least cost formaulation, nutrition and plant management.
Learning outcomes: The goal is to gain insight into all the key processes of feed production management.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Exam is divided in two parts: Exam Spring parallel: Oral exam Exam Autumn Parallel: Oral exam

HFE308 Optimalization of Feed Processing for Different Animal Species

Optimalization of Feed Processing for Different Animal Species

Credits: 10 **Language:** English
Staff/institute: Trond Storebakken/ IHA
Teachers: Guest letcurers
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Individual asignment and presentation of this asignment is compulsory.
Prerequisites: Equivalent to one year of master\'s studies in Feed Manufacturing Technology.
Type of course: Approximately 50 hours of lecturing.
Contents: The lectures will deal with the specific needs with relevance for feed processing for common species such as ruminants, pigs, poultry and fish. In addition, lectures will cover specific interactions between feed ingredients and chemical components, and processing.
Learning outcomes: The purpose of this course is to gain knowledge about special needs of different species when it comes to feed composition and physical quality, and special needs when it comes to ingredients used. In addition, the interactions between feed components and processing will be studied.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Oral exmination

HFE309 Quantitative nutrition to prevent nutrition-related diseases

Quantitative nutrition to prevent nutrition-related diseases

Credits: 5 **Language:** English upon request
Staff/institute: Birger Svihus/ IHA
Start term: June block
Terms: June block
Mandatory activities: Group work and presentation.
Prerequisites: HFE100, KJB200 or equivalent.
Type of course: Two to three hours lecturing for 10 working days. Two hours group work/exercise work for 10 days. Ten hours attendance of student presentations.

Contents: This topic can be divided into five elements: a) important nutrients and their quantitative role; b)physiological and anatimical adaptations with relevance to diet; c)obesity and preventive quantitative nutrition; d) diabetes 2 and preventive quantitative nutrition; and e) coronary heart disease and preventive quantitative nutrition.
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 heath 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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Each student must participate in a group report, plus take part in the presentation of most important findings from one to five scientific papers. This work will be graded, and will constitute 33 % of the final grade in this course. The final 3-hour exam will contain 3 to 5 overview questions which will test the overall understanding of the topic. This exam will contribute 67 % to the final grade.

HFE400 Lipid Metabolism

Lipid Metabolism

Credits: 10 **Language:** English upon request
Staff/institute: Bente Ruyter/ IHA
Teachers: Hilde Sundvold, Magny Thomassen.
Start term: Autumn parallel
Terms: By demand
The course is offered: Other - Upon demand.Ved behov.
Prerequisites: Basic knowledge in biochemistry and physiology.
Contents: The textbook; Biochemistry of Lipids, Lipoprotein and Membranes by D.E Vance and J.E. vance, will be followed. In addition a range of new review articles within the fields of lipid metabolism in liver, muscle and adipose tissue will be part of the course. These articles will be selected individually based on each student\'s main research focus.
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.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: One hour oral examination with an external examiner present.

HFX206 Product Quality, Meat and Fish

Product Quality, Meat and Fish

Credits: 5 **Language:** English upon request
Staff/institute: Magny S. Thomassen/ IHA
Teachers: Jan Berg, Nils Petter Kjos, Anna Haug, Birger Svihus, Mia Bencze Rørå,Rune Rødbotten
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Group work must be approved before the examination.
Prerequisites: Basic knowledge in chemistry and biochemistry.
Credit reduction: MVI271.
Type of course: Lectures: 25 - 30 hours. Group work/submission of group assignments: 20 - 25 hours.
Contents: The students are expected to first acquire a general overview of Norwegian production of animal commodities, including fish, their place in the Norwegian diet and trends in consumption. Afterwards a basic understanding of quality

characteristics is developed, incl. definitions and need for measurement and control. Students are expected to acquire detailed knowledge about muscle structure, chemical composition and post mortem processes of relevance for quality and shelf life. In the last part of the course, students will aquire an overview of the important principles for control of quality through production, related to different product types (cattle, pigs, sheep, goats, poultry, fish, eggs and milk).
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination.
Examination aids: No calculator, no other examination aids

HFX207 Introduction to Animal Production and Fish Farming in Developing Countries

Introduction to Animal Production and Fish Farming in Developing Countries

Credits: 5 **Language:** English
Staff/institute: Lars Olav Eik/ IHA
Teachers: Experts in various fields.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Must attend a minimum of 80% of the lectures.
Prerequisites: Animal science introcutrory course or equivalent.
Type of course: Approximately 70 lectures, as well as semester assignment presentations (30 - 45 minutes for each presentation).
Contents: A textbook describing the various production systems, including environmental factors, breeds and breeding, feeds and feeding and management aspects will constitute the basic framework and curriculum for the course. In addition, students will have access to lecture handouts and semester assignments from fellow students.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The assessment will be based on the contents of the semester assignment (2/3) and its presentation (1/3). The semester assignment may be written individually or jointly by two students.

HFX209 Evolutionary Biology

Evolutionary Biology

Credits: 10 **Language:** English upon request
Staff/institute: Stig William Omholt/ IHA
Teachers: Stig Omholt is responsible teacher in 2012
Start term: Spring parallel
Terms: Spring parallel

Mandatory activities: Participation on seminars. Students will be divided into groups. All groups have to prepare a seminar where a central topic within the field will be presented based on selected scientific papers, followed by a discussion. To secure a fruitful discussion all students have to study one selected key paper beforehand.
Prerequisites: Students should have completed the 200 group in biology, but the course can also be taken by highly motivated students with a weaker background in biology.
Type of course: Type of course: About 2/3 lectures and the rest seminars based on student*s presentations.
Contents: All information about the course; lectures and seminars will be available on Classfronter
Learning outcomes: The students will gain insight in the following main topics: 1. A history of life on earth. 2. Conceptual structure of evolutionary theory with emphasis on genetic variation, natural selection and adaptation. 3. Speciation 4. Life history evolution 5. Sexual selection 6. Senescence in an evolutionary context. 7. Pattern and process in macro evolution. After completion, the students will be able to use the conceptual apparatus of evolutionary biology to interpret and understand biological processes.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3 hours.
Examination aids: No calculator, no other examination aids

HFX300 Experimental Design and Analysis in Animal Science and Aquacualture

Experimental Design and Analysis in Animal Science and Aquacualture

Credits: 5 **Language:** English
Staff/institute: Theo Meuwissen/ IHA
Teachers: Marie Lillehammer (Nofima)
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Knowledge of statistics in the areas of variance analysis and regression.
Type of course: 30 hours.
Contents: The course treats: the choice of statistical models, statistical designs, registration and analysis of research data, estimation of treatment effects, their interactions, how to deal with residual variation, hypothesis testing applied to animal science and aquaculture, types of hypotheses.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Duration of examination: 3 hours. The written examination has a weight of 100%. Use of course notes is allowed during the examination. An examiner is used for the examination assessment.
Examination aids: Simple calculator, specified other examination aids

HFX306 Feeding and Production Diseases in Cattle

Feeding and Production Diseases in Cattle

Credits: 5 **Language:** English upon request
Staff/institute: Harald Volden/ IHA
Teachers: Arvid Steen, Olav Reksten, Tore Sivertsen.
Start term: June block
Terms: June block
Type of course: App. 50:50 distribution between lectures and assignments.
Contents: The course will be given as a combination of lectures and assignments. The following feeding-related diseases will be treated: indigestions, ketosis, hypocalcemia, hypomagnesemia and diseases related to micro minerals.
Learning outcomes: The aim of the course it to give students basic knowledge in feeding-related production diseases in cattle and how to diagnosticate these. The students are to gain skills in the evaluation of different strategies to prevent feed-

related production diseases by using a new analytical and feed planning tool. The course is arranged in collaboration with The Norwegian Veterinary College, and the students at the two institutions will learn to utilize the comparative competence.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Semester assignment.

HFX400 PhD Course in Nutritional Biochemistry and Physiology

PhD Course in Nutritional Biochemistry and Physiology

Credits: 10 **Language:** English upon request
Staff/institute: Anna Haug/ IHA
Teachers: Odd Magne Harstad, Magny Thomassen, Ragnar Salte, Øivind Andersen, Trond Storebakken, Knut Hove.
Start term:
Terms: By demand
The course is offered: By assignment
Mandatory activities: Submission of journals from the experiments. Presentation of assignments and the submission of short description of the topics.
Prerequisites: Master\'s degree in animal science, aquaculture or similar. Sound basic knowledge in chemistry, biochemistry and physiology.
Type of course: Lectures: 3-6 hours per week. Work on experiments (sampling, sample collection and laboratory work): 8-12 hours. Discussion groups: 3 hours per week.
Contents: Topics related to metabolism in general, the digestive system and methods for measuring digestability of feed materials, blood function, lactation, temperature regulation, and metabolism changes that occur following different forms of energy and nutrient intake.
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.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Grades (passed/failed) are based on the student\'s achievement in the oral examination at the end of the course. The examination lasts for about 1 hour.

INF200 Advanced Programming

Advanced Programming

Credits: 10 **Language:** English upon request
Staff/institute: Hans Ekkehard Plesser/ IMT
Start term: Autumn parallel
Terms: Autumn parallel January block
Mandatory activities: You must have gotten mandatory programming exercises approved during the autumn parallel to be allowed to commence work on the programming project in the January block.
Prerequisites: INF110 or INF120 or equivalent programming competence.
Credit reduction: INF210: 10stp
Type of course: Autumn parallel - 52h teaching in computer lab January block – 15h colloquium
Contents: 1. Programming tools: development environment and version control 2. Repetition of basic programming in Python 3. Test-based programming and testsuites, documentation tools 4. Object-oriented programming in Python 5. Debugging and profiling 6. Increasing efficiency with Cython 7. Selv-implemented Python modules in C++ 8. Programming project

Learning outcomes: After completing the course, students 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. The student will have acquired deeper knowledge about the higher-level programming language that is used in the course. The student is able to evaluate the applicability of more complex programs and able to assert their quality. The student will have developed an insight into the programmer’s responsibility for the correct and reliable functioning of his or her own programs, their quality and documentation.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Evaluation of the programming project in three parts: 1. Presentation of project (0-20 points) 2. Individual discussion of project (0-20 points) 3. Handed-in source code and documentation (0-60 points). If two students collaborate on a project, then a joint evaluation is given for parts 1 and 3, while individual evaluations is given for part 2. The overall grade is determined based on the total point score obtained.

JORD201 Process Modelling in Soil Water and Plant Systems

Process Modelling in Soil Water and Plant Systems

Credits: 10 **Language:** English upon request
Staff/institute: Jan Mulder/ IPM
Teachers: Trine Sogn.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: MATH100, KJM100, JORD101.
Type of course: Lectures and exercises alternate and will take place in the lecture-room and computer room. Lectures: ca. 18 hours. Exercises (computer): ca. 54 hours. Independent work: 78 hours.
Contents: Lectures and practical exercises on the computer: Introduction of Model Maker; 0., 1. and 2. order reactions, use of Model Maker and analytical solutions; Model parameters; Sensitivity analysis; Effect of soil temperature and water content on reaction rate; Michaelis-Menten kinetics; Equilibrium reactions; Mineral weathering, Nutrient cycling; C and N turnover in soil; Transport of water and solutes in soil and water courses. Assignments: a) 1. order reaction b) mineral weathering and c) turnover of C and N in the soil. Assignment d) is based on an introductory lecture, background literature and data; the student have to construct a model, calibrate it and apply it given different scenarios.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: There will be four assignments for submission throughout the semester. All four must receive a passing grade. All four assignments deal with models that the students have to construct and that will be used for system analyses. Assignments 1 to 3, formulated by the teachers, are linked to reviewed data exercises, which have been discussed in the lectures (each counts 20%). The final assignment for submission is based on a model, which has to be developed by the students themselves. With support from teachers, the students must find information and necessary literature (counts 40%).

JORD221 Soil Physics, Laboratory Course

Soil Physics, Laboratory Course

Credits: 5 **Language:** English upon request
Staff/institute: Trond Børresen/ IPM
Teachers: Per Ivar Hanedalen
Last time the course is offered: HØST
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participating on the exercises is mandatory
Prerequisites: MATH100, JORD101.
Credit reduction: JORD221 will be reduced by 2 ects against JORD230
Type of course: Exercises: 52 hours.
Contents: Field exercises: Taking soil samples for physical analysis. Measurement of physical parameters of soil in the field. Laboratory exercises: Determination of volumetric conditions in soil, pore-size distribution, the conductivity of soil measured by water and air, the properties and root-lengths of soil aggregates.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written report (group work, 2-4 students) counts 50% and an oral examination at the end of the course counts 50%. Both parts of the examination must be passed.

JORD251 Soil Classification

Soil Classification

Credits: 5 **Language:** English upon request
Staff/institute: Line Tau Strand/ IPM
Start term: January block
Terms: January block
The course is offered: Even years
Mandatory activities: 1. Attendance at compulsory lectures. 2. Oral presentations or poster presentations of an assignment connected to regional soil resources. 3. 80 % of the exercises.
Prerequisites: JORD101.
Type of course: Lectures: 18-20 hours. Exercises: 20 hours. Student presentations: 4-10 hours.
Contents: The national and international history of soil classification. Principles of soil classification, diagnostic layer/ characteristics. Regional distribution. Use of information on a regional basis. Use of classification keys. Classification of soil in reference to different classification systems from standard soil profile descriptions.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The students are assessed individually based on: selected exercises 50% and the individual report which is to be submitted on the last day of the course 50%.

JORD260 Tropical Soils, Their Properties and Management

Tropical Soils, Their Properties and Management

Credits: 5 **Language:** English
Staff/institute: Bal Ram Singh/ IPM
Teachers: Line Tau Strand.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Basic knowledge in Soil Science.
Type of course: The course is conducted 4 hours per week. In all, there will be 26 lectures and 6 exercise classes.
Contents: In part one we discuss climate and its effects on weathering, soil formation and eco-system development in the tropics. The importance of soil-organic matter is emphasised. A minimum of soil classification is introduced. In part two we describe the most important soil types in the tropics and sub-tropics, their distribution and their physical and chemical properties. Part three discusses soil management, and the use of different fertilisers. Emphasise is placed on special problems related to the tropical environment, such as erosion, nutrient deficiencies, salinity, crop rotation etc. The last part presents different maps with information on soils, land suitability/capability at different levels of scale, how the maps are produced and how they can be utilised. Finally we present some future scenarios related to global warming, and their effect on soil and water resources.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final written examination (3 hours): 2/3. Semester assignment: 1/3. Both parts of the examination must be passed.

JORD310 Global and Local Pollution

Global and Local Pollution

Credits: 10 **Language:** English upon request
Staff/institute: Jan Mulder/ IPM
Teachers: Åsgeir Almås, Tore Krogstad, Arne Stuanes
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: MINA200.
Type of course: Lectures: 20 hours. Group work with guidance: 20 hours. Presentation and discussion of scientific papers: 10 hours.
Contents: Metals: sources, modelling of species in soil, distribution, bioavailability, effects on plants and micro-organisms, critical loads. Organic chemicals in the environment: fate of organic chemicals in the environment with focus on soil and water. Climate change: terrestrial and aquatic prosesses with focus on carbon. Phosphorus in soil and on a watershed scale.Nitrogen and sulphur - an ecological stoichiometry approach: considers how the balance of energy and nitrogen and sulphur affect and are affected by organisms and their interaction in ecosystem. Each topic: 10 hours (4h lecture, 4h group work with guidance, 2h presentation and discussion of scientific papers).
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final oral examination: 50%. Three selected essays: 35%. Presentation of scientific papers: 15%. All parts must be passed.

JORD315 Biogeochemistry, Global Change

Biogeochemistry, Global Change

Credits: 10 **Language:** English upon request
Staff/institute: Lars Bakken/ IPM
Teachers: Jan Mulder, Trine Sogn and others.
Start term: Autumn parallel
Terms: By demand
The course is offered: Other - Emnet gis neste gang høsten 2010.
Mandatory activities: A minimum attendance of 80% of the literature seminars.
Prerequisites: MINA200, JORD201.
Type of course: Lectures: 24 hours. Literature seminars: 20 hours. Semester assignment presentations: 6 hours.
Contents: The course starts with the big-bang-theory, creation of stars, heavy elements, planets, the atmosphere, and life \'s biogeochemical signatures on our planet. Further, we treat the climate system, the main biogeochemical element cycles, methods in biogeochemistry, isotope signatures and global changes. Important leitmotifs for the course are \'the biosphere as a reactor in the climate system\' and the \'anthropogenic factor\' now and in the future. A part of the course is dedicated to a presentation and discussion of ongoing climate research at IPM: - Fluxes of greenhouse gases between soil and atmosphere. - Turnover and losses of C and N from terrestrial ecosystems.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final oral examination: 50%. Seminars: 20%. Semester assignment: 30%. All parts must be passed.

KJB310 Protein Chemistry

Protein Chemistry

Credits: 10 **Language:** English upon request
Staff/institute: Ragnar Flengsrud/ IKBM
Teachers: Vincent Eijsink, Lars Skjeldal.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participitation in the exercises and seminar, approved journal. This is a condition for being allowed to meet at the exam.
Prerequisites: Biochemistry equivalent to KJB210.
Type of course: Total:Lectures: 35 hours. Exercises: 64 hours. Seminars: 2 hours. Per normal week: 4 hours lectures,8 hours exercise
Contents: The lectures start 4-6 weeks before the exercises, in order to give the necessary theoretical background. The exercise part is based on a full day per week with a teacher present. It is strongly advised to participate in an active way in the computer exercise since this is of paramount importance for understanding the topics. Basic knowledge in bioinformatics and use of computer is an advantage. Those who do not have this skills are advised to used the previous introductory in

bioinformatics that can be found in the archive of the Fronter. A journal from the exercises has to be approved before the exam. It should be emphasized that this course is intended for master degree students, requiring the ability to work independently in the field using computers and the internet.
Learning outcomes: Give an understanding of the significance of a protein\'s structure for its stability and biological activity and of how the structure of a protein may be determined. Give an understanding of the most common bioinformatics relevant to protein structures. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours.
Examination aids: No calculator, no other examination aids

KJB320 Proteomics I

Proteomics I

Credits: 5 **Language:** English upon request
Staff/institute: Ragnar Flengsrud/ IKBM
Teachers: Vincent Eijsink, Morten Skaugen and external lecturers.
Start term: January block
Terms: January block
Mandatory activities: Participation in all activities.
Prerequisites: Biochemistry equivalent to KJB210.
Credit reduction: 5 credits (ECTS) reduction with KJB420, 2 credits (ECTS) reduction with KJM313 and 2 credits (ECTS) reduction with KJM410.
Type of course: Intensive course, three weeks in January: Lectures 16 hrs; laboratory work 22 hrs; presentation 3 hrs.
Contents: Sample preparation for two-dimensional electrophoresis, two-dimensional electrophoresis, preparation of protein spots for MS-TOF/TOF analysis, MS-analysis, LC-MS, evaluation of results, identification of proteins. It should be emphasized that this course requires the ability and will to work independently and meticulously with advanced biochemical methods. Students shall present one scientific article on a seminar. If necessary, this presentation should be given in English.
Learning outcomes: The students will acquire the training and understandig necessary to perform the methods independently in a research project. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Journal and approved presentation of a topic or article.

KJB420 Proteomics II

Proteomics II

Credits: 10 **Language:** English upon request
Staff/institute: Ragnar Flengsrud/ IKBM
Teachers: Vincent Eijsink, Morten Skaugen and external lecturers.
Start term: January block
Terms: January block Spring parallel
Mandatory activities: Participation in all activities. Approved journal and presentation of topic or article
Prerequisites: Biochemistry equivalent to KJB210.
Credit reduction: 5 credits (ECTS) reduction with KJB320, 2 credits (ECTS) reduction with KJM313 and 2 credits (ECTS) reduction with KJM410.
Type of course: January block: Intensive course for two weeks, including lectures, presentation 22 hrs, laboratory work 22 hrs. Spring parallel: Special exercises: 40 hrs, journal 20 hrs.

Contents: Sample preparation for two-dimensional electrophoresis, two-dimensional electrophoresis, preparation of protein spots for MS-TOF/TOF analysis, MS-analysis, evaluation of results, identification of proteins. LC/MS, stable isotope labeling.
Learning outcomes: The students will acquire the training and understanding necessary to perform the methods independently in a research project.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Journal, presentation and thesis

KJM310 Chromatography

Chromatography

Credits: 10 **Language:** English upon request
Staff/institute: Dag Ekeberg/ IKBM
Teachers: Hanne Devle, Roland Kallenborn
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Laboratory work and course journal. Each student must do analyses, and the result must be of a certain quality in order to pass. Poster presentation.
Prerequisites: General chemistry, KJM100 or equivalent, Organic chemistry, KJM210 or equivalent, Analytical chemistry, KJM240 or equivalent
Type of course: Lectures:2 hours/week. Laboratory work: ca. 60 hours.
Contents: Lectures given by the teacher. Presentation of assigned topics from students. Laboratory work. Writing of reports from the laboratory work.
Learning outcomes: The student should be able to evaluate the use of various methods of separation (for instance HPLC, GC) and conduct separation of organic/biochemical molecules using GCA, LC, various columns/pillars and evaluate other alternative detectors and interpret the results. The student should have in-depth knowledge of and insight into chromatographic theory, and knowledge of chromatographical practices and the theory behind the various separation principles. Through independent study in the laboratory and a theoretical study of the subject, the students will achieve competence in comparing different analysis methods, and gain a basic understanding for quantitative results that, for instance, are related to the pollution of food and environment. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods:
Examination aids: Simple calculator, no other examination aids

KJM311 Organic Spectroscopy

Organic Spectroscopy

Credits: 10 **Language:** English upon request
Staff/institute: Yngve H. Stenstrøm/ IKBM
Teachers: Dag Ekeberg
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: The semester assignment is mandatory. A passing grade (E or better) has to be achieved for the student to be able to take the final exam.
Prerequisites: KJM210 or KJM211 or an equivalent introductory course in organic chemistry that includes fundamental organic structural spectroscopy.
Type of course: 22 lecture hours, divided into 4 hours per week, thereafter 26 hours of problem-solving divided into 4 hours per week. Semester assignments are to be submitted for assessment by the end of the semester.

Contents: Lectures are given by the teacher during the first part of the semester. In the second part of the semester, exercises will be reviewed by the teacher in cooperation with the students.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Semester assignment: 25% of the total grade. Written examination with an external examiner: 75% of the total grade.

KJM312 Natural Product Chemistry

Natural Product Chemistry

Credits: 10 **Language:** English upon request
Staff/institute: Trond Vidar Hansen/ IKBM
Teachers: Yngve Stenstrløm.
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Basic Organic Chemistry equivalent to KJM210.
Type of course: Three hrs per week. All together 30 hrs lectures and 10 hrs assignment review.
Contents: Lectures are given by the teacher throughout the semester. Exercises will be gone through in plenary.
Learning outcomes: Gain advanced knowledge of the most important classes of substances within the natural products. Especially hydrocarbons, fatty acids, terpenes, phenols and alkaloids. Students should be familiar with structures, characteristic properties of the product classes, the most important sources, biosynthetic principles. Basic principles of isolation, characterisation and some examples of syntheses will be given.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5 hours written exam. If the number of candidates is 7 or less, the examination will be oral.
Examination aids: No calculator, no other examination aids

KJM313 Mass Spectrometry

Mass Spectrometry

Credits: 10 **Language:** English upon request
Staff/institute: Dag Ekeberg/ IKBM
Teachers: Roland Kallenborn
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Assignment presented in plenum.
Prerequisites: General chemistry, KJM100 (or equivalent) Organic chemistry, KJM210 (or equivalent) Analytic chemistry, KJM240 (or equivalent) Physical chemistry, KJM230 (or equivalent)
Credit reduction: 10 credits (ECTS) reduction for students with KJM410. 2 credits (ECTS) reduction against KJB320 and KJB420.
Type of course: 2 hours of lecturing/discussion groups/week
Contents: The course covers the following types of mass spectrometry: sector instruments, quadrupole instruments, time of flight instruments, and ion cyclotron resonance instruments. The course also covers the interpretation of mass spectra and the types of interface used for different types of analyses.
Learning outcomes: Give knowledge of both the practical and theoretical background for using mass spectrometry, e.g. GC-MS, MALDI-MS and LC-MS. The candidates should be able to use mass spectrometry for identifying organic and biological compounds. Candidates are to have knowledge of, and be familiar with, the various techniques used to separate 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 candidates will spend time interpreting structures. Students will become familiar with the theory behind the different fragmentations of various compounds formed by different ionization techniques.
Methods of examination: Final Written exam **Grading:** A-F
Examination aids: Simple calculator, no other examination aids

KJM314 Applied Organic Analytical Chemistry

Applied Organic Analytical Chemistry

Credits: 10 **Language:** English upon request
Staff/institute: Roland Kallenborn/ IKBM
Teachers: Dag Ekeberg, Morten Sørlie, Yngve Stenstrøm
First time the course is offered: SPRING 2012
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Assignments and project rapport to be presented in plenum.
Prerequisites: The course is based on scientific knowledge provided by KJM310 \'Chromatography\' and KJM313 \'Mass Spectrometry\' (or equal courses).
Type of course: 4 hours with lectures/ seminars and laboratory exercises per week
Contents: The course will focus on various applications for organic analytical chemistry: - HPLC: for purification and isolation of organic compounds - GC/MS and GC/ECD: within environmental chemistry and pollution - LC/MS, GC/MS and GC/FID: for product control in technical applications and synthesis - LC/MS and GC/MS: for purification and product control within drug production Critical method validation and quality control will be integrated in both lectures and practice.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: 4 hours written exam (60%) and written report (40%)

KJM350 Radiation and Radiochemistry

Radiation and Radiochemistry

Credits: 10 **Language:** English upon request
Staff/institute: Lindis Skipperud/ IPM
Teachers: Brit Salbu, Ole Chr. Lind, Deborah H. Oughton, Marit Nandrup Pettersen, Tove Loftaas.
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: All laboratory exercises and the delivery of laboratory reports must be evaluated as \'passed\' to be able to enter the exam. Remember that the reports are graded 50% of total grade.
Prerequisites: KJM100, KJM120
Type of course: Lectures: 22 hours. Laboratory exercises: 6 exercises: 30 hours. Journal writing and questions answered.

Contents: Lectures: The properties of radionuclides including half life, radiation types and radiotoxicity. The biological effects of radiation and radiation protection. The use of simple measurement methods (alpa, beta, gamma radiation). Laboratory exercises: Simple tracer methods and the use of simple measurement methods for alpha radiation, beta radiation and gamma radiation in qualitative and quantitative analyses. The more challenging parts of the syllabus may be reviewed.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Laboratory reports/journals (6 journals have to be approved before the final examination) and a final written 3-hour examination. Laboratory journals count for 50% of the grade. Written examination (3 hours) counts for 50% of the grade. Both of the exam elements must have a passed grade to pass the course.

KJM351 Experimental radioecology

Experimental radioecology

Credits: 10 **Language:** English
Staff/institute: Ole Christian Lind/ IPM
Teachers: Deborah H. Oughton, Lindis Skipperud, Ole Chr. Lind, Tove Loftaas, Marit Nandrup Pettersen.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Term paper and Laboratory exercises
Prerequisites: KJM100.
Type of course: Lectures: 40 hours. Laboratory exercises (4 exercises): 20 hours. Laboratory journal report to be approved before the final examination. Guided project report: time used depends on the individual.
Contents: Lectures: Radioecology and the transport and mobility of radioactive substances in various ecosystems. Radioactive sources and species (speciation) and the use of advanced methods in radioecology. Laboratory exercises: Sources and radioactive particles (electron microscopy). Radiochemical separation methods, various tracer techniques and advanced measurement methods including particle characterisation and ICP-MS. Speciation, mobility and biological uptake. Project report: An independently chosen topic.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The laboratory journal counts 1/4. The project report counts 1/4. Final written examination (3.5 hours) counts 2/4. All parts of the exam must be passed

KJM352 Radiation and Radiochemistry

Radiation and Radiochemistry

Credits: 5 **Language:** English upon request
Staff/institute: Lindis Skipperud/ IPM
Teachers: Brit Salbu, Ole Chr. Lind, Deborah H. Oughton, Marit Nandrup Pettersen, Tove Loftaas.
First time the course is offered: AUTUMN 2011
Start term: August block
Terms: August block Autumn parallel
Mandatory activities: All laboratory exercises and the delivery of laboratory reports must be evaluated as \'passed\' to be able to enter the exam.
Prerequisites: KJM100, KJM120
Credit reduction: 5 ECTS reduction to KJM350
Contents: Lectures: The properties of radionuclides including half life, radiation types and radiotoxicity. The biological effects of radiation and radiation protection. The use of simple measurement methods (alpa, beta, gamma radiation). Laboratory exercises: Simple tracer methods and the use of simple measurement methods for alpha radiation, beta radiation and gamma radiation in qualitative and quantitative analyses. The more challenging parts of the syllabus may be reviewed.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Laboratory reports/journals (3 journals have to be approved before the final examination) and a final written 3-hour examination. Written examination (3 hours) gives the grade, but both of the exam elements must have a passed grade to pass the course.

KJM353 Radioecology

Radioecology

Credits: 5 **Language:** English
Staff/institute: Ole Christian Lind/ IPM
Teachers: Brit Salbu, Deborah Oughton, Lindis Skipperud, Marit Nandrup Pettersen, and others
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Laboratory demonstrations and hand-in laboratory exercise.

Prerequisites: KJM100
Type of course: Total of 300 hours: Laboratory demonstrations: 6 hours over several days. Obligatory hand-in laboratory exercise.
Contents: Lectures: Radioecology and the transport and mobility of radioactive substances in various ecosystems. Radioactive sources and species (speciation) and the use of advanced methods in radioecology. Laboratory demonstrations: Sources and radioactive particles (electron microscopy). Radiochemical separation methods, various tracer techniques and advanced measurement methods including particle characterisation and ICP-MS. Speciation, mobility and biological uptake.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final written examination counts 100%(3.5 hours). The exam is divided ito 3 parts. All parts of the exam must be passed to pass the exam.

KJM360 Assessing Risk to Man and Environment

Assessing Risk to Man and Environment

Credits: 10 **Language:** English
Staff/institute: Deborah H Oughton/ IPM
Teachers: Per Strand, Brit Salbu, Ole Christian Lind, Lindis Skipperud.
Start term: June block
Terms: August block June block
The course is offered: Even years
Mandatory activities: Field work.
Prerequisites: KJM350.
Type of course: Lectures: 30 hours. Model and tool training/demonstrations: 20 hours. Seminars/Presentation of thesis: 10 hours. Independent study: 240 hours.
Contents: Effects of environmental stressors on man and the environment. The course will use ionising radiation as a case study, but will cover protection and assessment approaches for any environmental pollutant, and students can choose their own stressor for their case study. Thus the course will be relevant for students within radioecology as 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. Themes: Biological effects, hazard characterisation, dose effect relationship, dose-models, RBE, biological endpoints, cancer, dose to biota, ecotoxicology, micro-dosimetry. Ecological Impact and Risk Assessment: Environmental risk, risk characterization, species sensitivity distribution, population dynamics. Countermeasures and remediation. Environmental ethics: philosophy and principles. ALARA and BAT principles, international politics and conventions Field Course: Studies of radionuclides in terrestrial, freshwater and marine ecosystems, sampling and environmental radiation monitoring.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The semester assignment counts 50% and the written exam counts 50% of total. Both parts must be passed.

KJM410 Organic Mass Spectrometry (MS)

Organic Mass Spectrometry (MS)

Credits: 10 **Language:** English upon request
Staff/institute: Dag Ekeberg/ IKBM
Teachers: Roland Kallenborn
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Assignments and lab. rapport to be presented in plenum.
Prerequisites: General chemistry, KJM100 or equivalent. Organic chemistry, KJM210 or equivalent. Analytic chemistry, KJM240 or equivalent.
Credit reduction: For students who have completed KJM313: 8 credits reduction, for those who have completed KJB320 or KJB420: 2 credits reduction.
Type of course: 6 hours of lecturing/discussion/week.
Contents: The course covers the following types of mass spectrometry: sector instruments, quadrupole instruments, time of flight instruments, and ion cyclotron resonance instruments. The course also covers the interpretation of mass spectra and the types of interface used for different types of analyses.
Learning outcomes: Give knowledge of both the practical and theoretical background for using mass spectrometry, e.g. GC-MS, MALDI-MS and LC-MS. The candidates should be able to use mass spectrometry for identifying organic and biological compounds. Candidates are to have knowledge of, and be familiar with, the various techniques used to separate 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 candidates will spend time interpreting structures. Students will become familiar with the theory behind the different fragmentations of various compounds formed by different ionization techniques.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Final oral examination.

LAD100 Introduction to digital tools in landscape architecture.

Introduction to digital tools in landscape architecture.

Credits: 5 **Language:** English upon request
Staff/institute: Ramzi Hassan/ ILP
Start term: January block
Terms: January block
Mandatory activities: 80% of lab work with supervision - ie 80% of the assignments should be submitted at the end of the course and is the basis for the evaluation of students. Revision at the end of the course is compulsory.
Type of course: About 75 hours lectures and lab work with supervision. About 75 hours individual work on assignments.
Contents: Through lectures, demonstrations and practical exercises, students will be introduced to digital techniques to be included in their projects in subsequent courses. The course consists of 3 different parts: First part: Introducing computers as design tools so that students can create and manipulate / edit drawings on computers. Basic visualization techniques for photo manipulation, graphic design and layout using the Adobe tools Photoshop, Illustrator and Indesign. Second part: Basic

2D CAD with AutoCAD. Basic drawing operations, understanding of different drawing objects, processing of the map base and printing. Third part: Basic GIS with understanding of standardization of geographical information, map projections and the importance of data quality for use in analysis and planning.
Learning outcomes: Students will get a brief introduction of digital visualization and design tools for landscape planners, as well as some training in digital techniques for use in planning, analysis, design, presentation and drawing.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Individual assignments are evaluated according to the principles that are demonstrated in the lectures.

LAD202 3D Computer Modelling for Landscape Architecture

3D Computer Modelling for Landscape Architecture

Credits: 5 **Language:** English
Staff/institute: Ramzi Hassan/ ILP
Teachers:
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: - 80% of course assignments. - Final project.
Prerequisites: LAD101/LAD100,LAA116,LAA214
Type of course: The course is based on lectures and practical exercises with supervision at the computer lab through the semester. As a finale assignment, students are asked to model a design concept in 3D or a case study. The final project should be approved by the supervisor first.
Contents: The course is ideal for Landscape architectural or Planning students who needs to create 3D models or rendered stills of a 3D model for landscape analysis and project presentations.
Learning outcomes: In order to be able to create and visualize three-dimensional (3D) illustrations that support a design concept, one should be able to model in 3D using the right techniques. This course will provide a hands-on experience of basic 3D modelling, using standard modelling packages such as AutoCAD and SketchUp for landscape designers. Students will gain knowledge of basic modelling techniques with materials and textures, virtual lights/sunlight and cameras, and rendering stills. The techniques learned in the course will then be applied to a landscape design project. The final output from each student will be a 3D model illustration of a design project.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: The final project work and course assignments are evaluated. The evaluation is presented in a seminar at the end of the course in the presence of an external examiner.

LAD302 3D in Design

3D in Design

Credits: 5 **Language:** English
Staff/institute: Ramzi Hassan/ ILP
Teachers: Irene Rasmussen
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Other - Will not be offered 2011/2012Tilbys ikke 2011/2012
Mandatory activities: Attending the supervision sessions + presenting final project.
Prerequisites: LAD101/LAD100, LAA116,LAFT 103, LAFT201, LAA201, LAD202. Or similar competance
Type of course: Students are required to investigate visual tools in order to develop design concepts through applied design methods. They will be able to develop their design practice through a project or a case and communicate design concepts through different media. Students will work in a combination of 3D analogue and digital modelling, sketching physical 3D models and shaping prototypes, becoming aware of the comparative values inherent in different digital and analogue medias.

The main aim is exploring the potentials within visual media in order to communicate and design work. Students will be able to develope a visual awareness, through an ability to analyse and self-evaluate their visual approach in their working prossess, focusing on aspects of the specific visual material one is working with. Students will use digital tools and 3D computer visualization techniques as a supportive tool for working with landscape design and planning issues.
Contents: The course is based on a combination of lectures, excursions and group work, and consists of a theoretical part, a studio part and a part with introduction into 3D modelling techniques. The emphasis is put on investigation of the added values of using 3D in design and the interpretation of a space. The participants will be provided with an overview of the 3D modelling and visualizations in order to explore some design questions: How does a designed space perform in various locations? What is the impact the designed space has on the surrounding? How does the observer perceive the proposed design? In addition, the course will propose procedures for collaboration and communication for design concepts through interactive display systems (VR-Lab). The VR-Lab will offer an arena for testing new ways of communication and knowledge-sharing, increasing collaboration, motivation and engaged learning.
Learning outcomes: The course will function as an arena to investigate and work with various topics connected to the use of 3D modelling and visualizations in design and planning. After introducing the main topic through planned lectures, students will work individually with supervision on a selected case study.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Students will present their final project work in a seminar at the end of the course in the presence of an external examiner.

LAFT210 Drawing - a visual language

Drawing - a visual language

Credits: 5 **Language:** English upon request
Staff/institute: Tove Judit Næverdal/ ILP
Teachers: Christian Montarou, Lise Farmen, Hennie-Ann Isdahl Tove Judit Næverdal
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Prerequisites: Course requirements: previous participation in LAFT subjects in courses LAA115 and LAA116, or an equivalent competance achieved by other means.
Type of course: 12 hours lectures. 84 hours practice/tasks with individual guidance. 54 hours practice indipendantly. Obligatory study trip. 80% participation in lectures and studio practice.
Contents: The aim of the course is to provide a further development of students`basic abilities within drawing, form and colour thereby strengthening their visual competence within the subject of landscape architecture. The course aims at showing the student how this experience can be used during idea development and when communicating their spacial ideas. The course will be structured to cover different drawing techniques (f.ex pencil, charcoal, watercolour and pen drawing),and be based upon both direct observation and abstraction and the use of geometery in drawing. The course will also provide a basic knowledge of colour theory and practice. the classes will be held both within the studio and within the landscape and campus environment, and follow a specific thematic structure. Each new thematic period will be preceded by lectures where examples of the chosen theme will be shown and discussed.
Learning outcomes:
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

LAØ370 Landscape Ecology

Landscape Ecology

Credits: 10 **Language:** English
Staff/institute: Mari Sundli Tveit/ ILP

Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: 80 % attendance/participation.
Prerequisites: Courses at 200-level in ecology, landscape analysis, or nature management.
Type of course: 25 % lectures and seminars, 35 % self study, 40 % project work.
Contents: Students will be introduced to landscape-ecological concepts through work with field and map data of real landscapes. They will learn how to measure and quantify landscapes, how to define patches and quantify their characteristics such as size, shape, edge characteristics, pattern, connectedness etc. Students will then examine the physics of processes such as habitat fragmentation by using simulations of logging processes in forest ecosystems. Furthermore, the students will learn about the ecological and human consequences of landscape processes including fragmentation, connectivity, complementation, supplementation, heterogeneity, grain size, etc. The role of landscape ecology in wildlife management will be taught in seminars on the effects of landscape structure on wildlife populations and communities, barriers, wildlife corridors, fauna passages and the theory of metapopulations. Early in the process, the students will start working on assignments that exemplify landscape-ecological concepts using specific examples related to the background theories and course literature.
Learning outcomes: - be able to undertake computer-based landscape-ecological analysis of mapped data or aerial photographs, - be able to identify the types of habitat and species that are vulnerable to habitat fragmentation, - be able to evaluate landscapes, to identify potential corridors and barriers to the movement of people and wildlife, - be able to create solutions for landscape planning problems based on landscape ecological principles, - be able to demonstrate an awareness of the limitations of generalising management solutions from one landscape to another.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: 1. Mini projects: Pass/ fail. 2. Oral exam in English: 50 %. 3. Term paper: 50 %.

LNG130 Norwegian as a Foreign Language

Norwegian as a Foreign Language

Credits: 5 **Language:** English
Staff/institute: Esben Leifsen/ Noragric
Teachers: Teachers from Voksenopplæringssenteret in Ås.
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
The course is offered: Other - Given twice a year - spring and autumn.Gis 2 ganger i året, både i vårparallell og i høstparallell.
Mandatory activities: Submit an essay. 80 % attendance at lectures is compulsory.
Contents: Engelsk: Getting acquainted; Family and home; Eating; Daily routines; Shopping; Weather; Travelling and transport; Arriving in Norway; Work
Learning outcomes: The course will give the students basic knowledge of spoken Norwegian, with the aim of understanding and using the language in everyday situations. Pronunciation and oral exercises are given priority. It is expected that students will work on their own with the CD and grammar exercises on the Internet (http://pavei.cappelen.no)
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Final oral exam

LNG135 Norwegian as a foreign language II

Norwegian as a foreign language II

Credits: 5 **Language:** English
Staff/institute: Esben Leifsen/ Noragric
Teachers: Lecturer from voksenopplæringssenteret in Ås.
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel

Mandatory activities: Engelsk:A short essay must be submitted during the semester and 80 % attendance at lectures is compulsory.
Prerequisites: English and Norwegian I or equivalent
Credit reduction:
Type of course: Language instruction: 40 hours
Contents: Facts about Norway
Learning outcomes: The course builds on Norwegian for foreigners I, giving more extensive knowledge of Norwegian with more sophisticated texts. Pronounciation and oral exercises are given priority. It is expected that the students will work on their own with the CD and grammar exercises on the Internet (http://pavei.cappelen.no).
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam
Examination aids: No calculator, no other examination aids

LNG150 Swahili Intensive Course

Swahili Intensive Course

Credits: 5 **Language:** English
Staff/institute: Grete Benjaminsen/ Noragric
Teachers: Responsible teacher is to be announced later.
Start term: June block
Terms: June block
Mandatory activities: Short written essay.
Type of course: 2 lecturing hours per week.
Contents: Engelsk: The course will provide basic introduction to Swahili grammar and vocabulary. Oral exercises will be prioritised.
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.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: 100% oral examination.

LNG240 Academic Writing

Academic Writing

Credits: 10 **Language:** English
Staff/institute: Jens Bernt Aune/ Noragric
Teachers: William Warner
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
The course is offered: Other - The courses is given each autumn and spring parallelKurset gis hver høst- og vårparallell
Mandatory activities:
Prerequisites: EDS275 or approval of the instructor
Type of course: 26 hours of lectures and discussions during 13 weeks.
Contents: This course covers the fundamentals of academic writing for both the social and natural (physical) sciences. The first half concentrates on structure; specifically, how to outline expository, argumentative and analytical papers. The second half focuses on style: how to write clearly, cohesively, and concisely. Re-writing is emphasized. The students will receive comments on their writing assignments. Class attendance and weekly writing assignments are mandatory.
Learning outcomes: The objective is to help M.Sc. and Ph.D. students develop writing skills for term papers, theses, and scientific publications.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

Assessment methods: Successfully completing exercises in class and assignments out of class

LAA308 Landscape Design

Landscape Design

Credits: 20 **Language:** English upon request
Staff/institute: Ola Bettum/ ILP
Teachers: Ole Rømer Sandberg
Last time the course is offered: HØST
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The semester assignments must be approved. Attendance at 80 % of the review sessions and seminars is required.
Prerequisites: LAA116, LAA215, LAFT202 or the equivalent.
Type of course: Lectures: 30 hours. Discussion groups and seminars: 60 hours. Supervision: 15 hours. Review sessions in class: 40 hours. Field work and surveys: 30 hours. Study trip: 40 hours.
Contents: The course contains a large, individual project assignment which has a high degree of difficulty, connected to a realistic situation. Students choose their assignments themselves within a defined framework. The course evaluation will mainly be based on this assignment. An analysis and a theoretical assignment done in groups are also handed in. Lectures and discussions are arranged in cooperation between the teachers and students. Individual supervision regarding the projects and theory assignments is given. In addition, a 5-10-day study trip is arranged, dependent of the budget situation. Work on the project assignment is based on advanced use of IT-based graphical drawing programs and presentation techniques.
Learning outcomes: Students should acquire thorough knowledge of current architecture and landscape architecture. They will be able to solve complex problems connected to projects related to parks or green areas at a high level, from analysis and concept development to detailed design. Students will be able to handle planning and decision-making processes related to complex projects, including construction methods used in landscape areas and visualisation of architecture projects, from concept to detailed building instructions. Through the students\' individual work, they will develop independent problem-solving skills, plus the skill of independent work, scientific thinking and reflection.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Independent work, individually. Handed-in project assignment counts 4/5, and an oral presentation of the assignment counts 1/5.

MATH250 Partial Differential Equations and Models

Partial Differential Equations and Models

Credits: 10 **Language:** English upon request
Staff/institute: John Andreas Wyller/ IMT
Teachers: John Wyller.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Mandatory activities: Compulsory assignments must be approved within the given deadlines.
Prerequisites: MATH111, MATH112, MATH113.
Type of course: Lectures: 4 hours per week. Calculation exercises: 2 hours.
Contents: Lectures cover the most important parts of each topic. After this, they are given exercises on the same topics. The exercises are intended to help students practise calculation technique, understand methods and ideas as well as be able to apply the subject to technical-physical problems. Projects based on MATLAB will be an important part of the course.
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, Fourrier series and Fourrier transform techniques, Greens functions, difference methods an finite elements 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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written examination, 3.5 hours.
Examination aids: No calculator, specified other examination aids

MATH270 Complex Analysis and Transformation Methods

Complex Analysis and Transformation Methods

Credits: 10 **Language:** English upon request
Staff/institute: Bjørn Fredrik Nielsen/ IMT
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory assignments must be approved within the given deadlines.
Prerequisites: MATH111, MATH112, MATH113
Type of course: Lectures: 4 hours per week. Calculation exercises: 4 hours per week.
Contents: The most important information on each topic of the course is given in lectures. After this, the students are given problems to solve on the same topics. The aims of the problem-solving are for students to practice calculation technique, understand methods and ideas, as well as be able to apply the subject to technical-physical problems.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours.
Examination aids: Simple calculator, specified other examination aids

MATH280 Applied Linear Algebra

Applied Linear Algebra

Credits: 10 **Language:** English upon request
Staff/institute: Ulf Geir Indahl/ IMT
Teachers:
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities:
Prerequisites: MATH113 or MATH131
Credit reduction: 10 credits reduction against MATH260
Type of course: Lectures: 4 hours per week. Calculation exercises 2 hours per week.
Contents: The most important parts of each topic are covered in lectures. Thereafter the students are given exercises on the same topics. The aims of the exercises are for students to understand methods and ideas as well as to be able to apply the subject various subjects to relevant problems.
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

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods:

MATH290 Real Analysis

Real Analysis

Credits: 10 **Language:** English upon request
Staff/institute: Arkadi Ponossov/ IMT
Teachers: Arkadi Ponossov.
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Mandatory activities: Compulsory assignments
Prerequisites: MATH111, MATH112, MATH113.
Type of course: Lectures: 4 hours per week, calculation exercises: 2 hours per week.
Contents: The most important parts of each topic are covered in lectures. The students are then given exercises on the same topics. The aims of the exercises are for students to understand methods and ideas as well as to be able to apply the subject to relevant problems.
Learning outcomes: The students are to learn how to use mathematical ideas precisely. This is a necessary background for understanding mathematical analysis. After completing the course, students are to master: - axiomatic description of the different number systems, - basic topological ideas such as metrical space, completeness, compactness, - convergence and uniform convergence, - the Riemann integral, - selected topics in functional analysis.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination.

MATH310 Continuous Dynamical Systems

Continuous Dynamical Systems

Credits: 10 **Language:** English
Staff/institute: John Andreas Wyller/ IMT
Teachers: John Wyller.
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Other - The course is offered after agreement.Emnet gis etter avtale
Mandatory activities: Compulsory semester assignment.
Prerequisites: MATH111, MATH112, MATH130, MATH140, MATH270 and MATH290.
Type of course: 4 hours lectures per week. 2 hours seminar per. week
Contents: The most important parts of each topic are covered in lectures. The students are then given exercises on the same topics. The aims of the exercises are for students to understand methods and ideas as well as be able to apply them to problems in physics, biology or environmental subjects. The students are given individual guidance on the application of these topics to the problem issue that is studied in the semester assignment.
Learning outcomes: Students are to learn the theory concerning continuous dynamical systems (ordinary and partial differential equations) and the application of such systems to selected problems in environmental subjects, biology and physics. The course contents may vary from year to year, but will normally consist of the following parts: - dimension analysis, scaling and perturbation methods, - geometrical theory for systems of ordinary differential equations (phase space, Picard\'s theorem, equilibrium, limit cycles, stability analysis, bifurcation theory and normal forms) and delay- equations. The theory is applied to for instance reaction kinetics, biological oscillations and the propagation of electrical signals in nerve fibres. - selected topics in diffusion equation theory, reaction diffusion equation theory and nonlocal models. The theory is applied to excitable media, the Turing-mechanism and pattern-forming processes.
Methods of examination: Final Oral exam **Grading:** A-F

Assessment methods: Oral examination. Presentation of project work.

MINA310 Project Management and Research Methods

Project Management and Research Methods

Credits: 10 **Language:** English
Staff/institute: Lindis Skipperud/ IPM
Teachers: Lindis Skipperud, Huw Jones from Middlesex University UK, Brit Salbu and the students\' advisors
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Coursework 100%. Eight pieces of coursework to assess students ability to enterpret data and apply statistical techniques. One project proposal with presentation to demonstrate students ability to design and plan a MSc project. Analysis of given cases, workshops/tutorials.
Prerequisites: KJM100.
Type of course: Lectures and supporting computer laboratories to impart knowledge and applied workshops to familiarise with various statistical techniques: 40t (intensive week). Other study hours: 140 hours. Total study hours per semester: 180 hours. Other study hours: interpret data, literature search, design and plan a MSc project, make a presentation.
Contents: Research methods: Statistics and data handling, database and literature resources, critical analysis of publications, efficient scientific writing Project management: Design (stats), implementation and management of projects. Introduction to generic management/statistical tools.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Coarsework 100%

MINA410 Environmental Radiobiology

Environmental Radiobiology

Credits: 5 **Language:** English
Staff/institute: Deborah H Oughton/ IPM
Teachers: Prof Carmel Mothersill, McMaster University, Canada Prof Colin Seymour, McMaster University, Canada
First time the course is offered: AUTUMN 2010
Start term: Spring parallel
Terms: By demand
The course is offered: Even years
Mandatory activities: Lectures (80% attendance) Written assignment
Prerequisites: basic principles of radiation protection (eg. KJM350 or similar)
Type of course: 25 hrs lectures 25 hrs preparation/self-study 100 hrs written assignment
Contents: The course is based on a weeks intensive lectures. Students are expected to have read and prepared from the pensum beforehand. One afternoon will include lab demonstration of some of the biomarker methods. An additional indepth self-study on a selected topic will be required for the written assignment.
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.
Methods of examination: Final **Grading:** Pass/Fail

Assessment methods: The students will prepare a written assignment on a choice of topics. The assigment will require self-study and should be handed in 3 weeks after completion of the lectures

MVI240 Sensory science

Sensory science

Credits: 5 **Language:** English upon request
Staff/institute: Margrethe Hersleth/ IKBM
Start term: January block
Terms: January block
The course is offered: Other - Depending on the Department\'s resourses. Emnet undervises dersom ressurstilgangen tillater det.
Mandatory activities: Practical exercises
Prerequisites: Basic statistics
Credit reduction: 5 credits (ECTS) versus the 10 credit version of MVI340.
Type of course: 40 h lectures, 20 h laboratory exercises
Contents: Introduction to anatomy and physiology relevant for sensory analysis. Sensory analysis for research and industry purpose. Training of assessors and conducting a sensory task. Students will be trained as panel leaders and also as assessors. Journals describing the practical exercises will be evaluated and taken in consideration as part of the final examination.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written examination

MVI261 Heat Engineering I

Heat Engineering I

Credits: 5 **Language:** English
Staff/institute: Reidar B. Schuller/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: Mathematics equivalent to MATH100. Physics equivalent to FYS100.
Type of course: Lectures; 2 x 2 hours per week, calculation exercises and laboratory work 2 hours per week.
Contents: Mass balances, energy balances, pumps, fans and compressors, circular processes, heat transfer, evaporation and evaporators, humid air and drying, and cooling processes.
Learning outcomes: Students will acquire knowledge of unit operations and machine equipment that are part of processing lines.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5 hour written exam.
Examination aids: Simple calculator, specified other examination aids

MVI271 Fish and meat as raw materials

Fish and meat as raw materials

Credits: 5 **Language:** English upon request
Staff/institute: Bjørg Egelandsdal/ IKBM
Teachers: Magny Thomassen (main lecturer), Jan Berg, Nils Petter Kjos, Birger Svihus, Turid Mørkøre, Mia Rørå
Start term: Autumn parallel

Terms: Autumn parallel
Mandatory activities: Group work with presentations that must be approved before the final, written exam.
Prerequisites: Basic knowledge of chemistry and biochemistry.
Credit reduction: HFX 206, 5 credits (ECTS).
Type of course: Lectures (25-30 hrs). Group work (20-25 hrs) plus presentations.
Contents: The students will first acquire an overview of the Norwegian production of animal raw material, inclusive fish and their importance for the Norwegian households. Trends in the consumption of these raw materials. The quality of raw materials: definition, measurements and monitoring. A substantial part of the course is devoted to explaining the structure of muscles, chemical composition, post-mortem processes and the latter processes\' impact on quality and shelflife. The final part of the course is devoted to managing and monitoring the production of slaughter animals of the desired quality. The differences among species (cattle, pork, lamb/sheep, poultry and eggs) are emphasized.
Learning outcomes: The students should acquire a basic understanding of the quality of raw materials originating from fish, meat and eggs. The nutritional importance of these raw materials is emphasized. The effect of ante-mortem and early post-mortem treatment of the animals for the quality of the raw material is lectured. Raw material quality is defined, and typical, important methods of measuring raw material quality will be elaborated.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Semester assignment must be approved; written exam gives 100% of final grade; both parts have to be approved/passed. Participation on student presentations (minimum 80 %) is mandatory.
Examination aids: No calculator, no other examination aids

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

Proteins, Polysaccharides and Fat/oils: Structure and Functionality

Credits: 10 **Language:** English upon request
Staff/institute: Gerd Elisabeth Vegarud/ IKBM
Teachers: Tove Devold, Elling-Olav Rukke, PhD students
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The first lecture and all colloquia groups are compulsory in addition to student presentations and group activities (oral/written) throughout the semester.
Prerequisites: Knowledge in food chemistry equivalent to KJB210.
Credit reduction: MVI410, 10 credits (ECTS).
Type of course: 6 hours per week. These hours are made up of lectures, group work, colloquia and student presentations (written and oral).
Contents: The course is made up of three units; 1. Polysaccharides; structure and function. 2. Proteins; structure and functional properties 3. Fats and lipids; types, modification and uses. Each unit contains lectures, group work and colloquia. The students are obliged to write projects/essays and hold presentations (written/oral). Independent study and Internet searches are both important. We recommend students to take the database search course given at the Library. The course has guest lecturers and demonstrations from relevant industry.
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 have 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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Group activities, submitted written assignments and oral presentations during the semester count 50 %. Assessed by the course teachers and have to be passed. Written essay (14 days) handed in at the end of semester counts 50 %. Assessed by an external examiner.

MVI321 Fermentation Microbiology

Fermentation Microbiology

Credits: 5 **Language:** English upon request
Staff/institute: Hilde Marit Østlie/ IKBM
Teachers: Zhian Salehian, Sabina Leanti La Rosa
Start term: August block
Terms: August block
Mandatory activities: Laboratory exercises with journals and excursion.
Prerequisites: Knowledge of food microbiology corresponding to MVI220, biochemistry corresponding to KJB200 and general microbiology corresponding to BIO130.
Type of course: Lectures: 6-8 hours/week. Laboratory exercises: 8 hours in week 1, 24 hours in week 2 and 3 hours in week 3.
Contents: The following topics are covered both theoretically and practically by lectures and laboratory exercises/individual projects: - Systematics for bacteria, yeast and mould that are used in the food industry. - Metabolism, stability/instability, bacteriophage problems - Production, control and maintenance of cultures for fermentation purposes.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written exam (3.5 hours) counts 50% of the final grade. Reports of laboratory experiments count 50% of the final grade. Both the exam and the reports must be approved to pass the course.

MVI322 Pathogenic Microorganisms

Pathogenic Microorganisms

Credits: 10 **Language:** English upon request
Staff/institute: Helge Holo/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Laboratory excercise. Presentation of literature assignmnet.
Prerequisites: Microbiology corresponding to BIO130. Biochemistry corresponding to KJB200.
Type of course: Lectures,discussion groups and laboratory excercise: 3 hours per week.
Contents: The course will give an overview on food and waterborne pathogenic organisms. Biology and pathogenesis. Preventive measures. Routes of infection. Toxins. Epidemiology. Detection and tracing of pathogens by modern molecular tools.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Portfolio assessment and written exam. The literature paper counts 25 % and must be handed in by week 43. The written exam counts 75 %.

MVI330 Experimental Design and Data Analyses

Experimental Design and Data Analyses

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

Staff/institute: Tomas Isaksson/ IKBM
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises: 2 hours per week with a short written report.
Prerequisites: Bachelor of Food Science or corresponding
Type of course: 6 hours per week for 14 weeks (incl. exercises).
Contents: The course deals with how to plan experiments, both in the laboratory and in pilot and production processes. Methods such as full factorial and fractional factorial experimental design, CCD (central composite design) and mixture design will be part of the course. The main part of the course covers various methods for analysing multivariable data. Central methods are: pre-processing and centring of data, cross correlation, data compressions (PCA, principal component analysis), multivariable regression (MLR, multiple linear regression, PCR, principal component regression, PLS, partial least squares regression) and classification (cluster analysis and discriminating analysis, LDA, linear discriminating analysis, Fisher\'s linear discriminating function, KNN, K-nearest neighbour, SIMCA, soft independent modelling of class analogies). The methods will be covered theoretically, through students carrying out practical calculations (exercises) and through demonstrations. The vast majority of the examples are taken from Food Science.
Learning outcomes: After the course, the student will be able to conduct and analyse statistical experimental designs and data-analytical multivariable calculations related to food science and food production processes.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5 hour written examination, counts 100%.
Examination aids: No calculator, no other examination aids

MVI340 Sensory and consumer science

Sensory and consumer science

Credits: 5 **Language:** English upon request
Staff/institute: Margrethe Hersleth/ IKBM
Teachers: Margrethe Hersleth
Start term: June block
Terms: June block
The course is offered: Other - Depending on the Department\'s resourses.Emnet undervises dersom ressurstilgangen tillater det.
Mandatory activities: Group discussions and seminars.
Prerequisites: Knowledge of sensory analysis equal to MVI240, as well as knowledge of statistics corresponding to STAT100.
Credit reduction: 5 credits (ECTS) versus the 10 credit version (= the former version) of MVI340.
Type of course: About 40 hours lectures, 20 hours seminars/groupwork
Contents: Brief introduction to anatomy and physiologi related to sensory science. Introduction to the use of sensory analysis in research and industry, sensory methods and reporting of sensory results. Instrumental measurements correlated to sensory quality, qualitative and quantitative methods for consumer testing, statistics and multivariate analysis of sensory data, segmentation of consumers, factors that influence perception and preferences for food and general consumer understanding.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: One week home exam, written report on a given topic.

MVI361 Unit Operations and Measurement Methods

Unit Operations and Measurement Methods

Credits: 10 **Language:** English upon request
Staff/institute: Reidar B. Schuller/ IKBM
Teachers: Tomas Isaksson.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Semester assignment.
Prerequisites: One of the following courses: MVI260/MVI261/MVI280 or equivalent.
Credit reduction: MVI361 replaces MVI360 and MVI370. Credit reduction will be implemented for students that have previously taken these courses.
Type of course: 6 hours per week for 13 weeks.
Contents: Transport phenomena, air/water mixtures, rheology, pipe transport, porous beds, fluidisation, filtration, separation processes, heat transfer, dehydration and measurement methods. The course will give an overview of important methods for measuring the quality of raw materials, intermediate and final products. The course will cover both off-, at-, on- and in-line measurement methods.
Learning outcomes: Students will aquire deeper knowledge and more skills in relation to unit operations in food engineering. They will also acquire a greater insight into the conditions regarding machinery, instruments and other equipment in the food industry, and further knowledge of measurement methods. The students should be able to use or implement measurement methods into food production.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: 3.5 hour written examination counts 80 %. Semester assignment counts 20 %. Both parts must be approved.

MVI381 Muscle Food Processing Technology

Muscle Food Processing Technology

Credits: 10 **Language:** English upon request
Staff/institute: Bjørg Egelandsdal/ IKBM
Teachers: Various engineers (Dept. of Chemistry, Biotechnology and Food Science), Tom Chr. Johannessen (NOFIMA-FOOD).
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Mandatory activities: Practical exercises and excursion. During plenary presentations by students, the presence of co-students is mandatory.
Prerequisites: Knowledge of unprocessed food corresponding to MVI271, biochemistry corresponding to KJB200 and KJB210.
Credit reduction: NMF271 (as offered until 2002/2003), 5 credits.
Type of course: Lectures: 40-60 hours. Work in pilot installations and laboratories: 6-8 days. Student presentations of theoretical project assignments in plenary. Possibly one excursion.
Contents: Animal welfare in connection with stunning of animals. Slaughter technology, grading and by-products of slaughter. Technology used to ensure tenderness. Process technology: Heat treatment and cold storage. Minced meat technology. The use and function of selected ingredients/additives. Salting and smoking technology. Lipid oxidation and warmed flavour: Technology for avoiding lipid oxidation. Products with improved fatty acid composition. Marinating: The process and its ingredients. Production of fermented dry-cured sausages: The process and the development of flavour. Fundamentals on flavour development of meat, boar taint and the problems related to male pig production. Microbiology/ hygiene/parasites and similar, specific for meat, will be included in the course, depending on the background knowledge of the participants. A project may be given on this topic. Recipe optimisation methodology and (mathematical) modelling relevant for shelf life managing of animal products is introduced.
Learning outcomes: The student will gain an understanding of several of the industrial processes (minced meat technology, salting/smoking, fermentation and similar) that are used for keeping and processing meat products. The student will gain

detailed insight into the production process, the choice of raw materials as well as the quality of selected final products. The course covers to some degree the well-being of animals/the slaugtherprocess and its impact on final product quality. In addition, environmental problems related to handling waste materials from slaugtherhouses and the insufficient consumption of by-products are touched upon. Oxidative stability of meat through storage and processing as well as the major mechanisms that influence degradation of food components through processsing will be lectured. The course is built around four larger projects where the students are producing and evaluating different meat products using their own analysis. As a rule, dry fermented sausages, bacon and two heated, comminuted meat products are produced. However, minor changes are made every year. An experimental project can also be changed to a theoretical project. The student should acquire sufficient knowledge to be able to apply their qualifications to the development of meat products and be able to judge the consequences of their choices with regards to final product quality. The student should be able to select raw materials, ingredients and control processes towards the desired final product quality (for selected products). The student must know methods for suggesting an improved process when faults occur.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Project work and report: 40%. Literature evaluation: 20%. Written examination: 40%. The student must pass every part of the course.

MVI382A Alcoholic Beverages

Alcoholic Beverages

Credits: 5 **Language:** English upon request
Staff/institute: Trude Wicklund/ IKBM
Teachers: Arne tronsmo and external lecturers.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Excursion and presentations.
Prerequisites: Knowledge of fruit and cereal raw materials equivalent to MVI272, food technology equivalent to MVI280 and MVI281.
Type of course: 3 x 2 hours per week for 6 weeks.
Contents: Qualities of different raw materials for production of cider, beer, wine and spirit. There will be emphasis on quality ingredients and different processing methods and the impact this may have on the quality of the finished product.
Learning outcomes: Students learn about the production of cider, beer, wine and spirits.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Project assignment (50 %) and 2 hours written test (50 %).

MVI382B Cereal Technology

Cereal Technology

Credits: 5 **Language:** English upon request
Staff/institute: Trude Wicklund/ IKBM
Teachers: Anne Kjersti Uhlen, IPM
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Lab exercises and excursion.
Prerequisites: Knowledge of cereal as raw material, corresponding to MVI272. Knowledge of technology corresponding to MVI280 and MVI281.
Type of course: 3x2 hours lecture per week including laboraty and group work for 6 weeks.
Contents: Cereals, importance in the diet, chemical composition. Starch - energy, synthesizing and degradation of starch. Protein, amino acid composition in cereals, functional properties, quality aspects. Fibre, different qualities, properties and

importance in the diet. Minerals and vitamins, antioxidants in cereals. Wheat, rye, oats and barley, tropical cereals, rice, maize, sorghum and millet. Baking technology, niche products from cereals - Spelt - Einkorn, Buck wheat. Extrusion/breakfast cereals, pasta, biscuits and cakes, crisp bread.
Learning outcomes: Students will gain advanced knowledge of different aspects concerning the quality and use of cereals.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Project assignment 50 % (must be approved), and 2 hours written exam 50%.

MVI383A Dairy Technology

Dairy Technology

Credits: 15 **Language:** English upon request
Staff/institute: Roger K. Abrahamsen/ IKBM
Teachers: Siv Skeie, Judith A. Narvhus
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises in the pilot plant and analysis work in the laboratories. Excursions. Journals shall be handed in for evaluation 2 weeks after the exercise is completed. All mandatory activities have to be accomplished and accepted before examination can take place.
Prerequisites: Knowledge of unprocessed food equivalent to MVI270. Knowledge of food production processes equivalent to MVI280 and MVI281.
Type of course: Ca. 32 double lectures hours are planned given by the teachers at the department. The lectures will be distributed throughout the semester. Two excursions of 3 days in total. Excursion dates are given when the course starts up. The exercises in the pilot plant and in the laboratories are done during ca. 10 days. 10 hours per week used for lectures, practicals, discussions and excursions.
Contents: Milk as a raw material for dairy products. The treatment of milk in the dairy. Unfermented and fermented consumption milk products. Butter manufacturing technology. Powdered milk. Cheese technology. Types of cheeses. Uses of whey. Brown whey cheese technology. Ice cream technology.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours, counts 100%.
Examination aids: No calculator, no other examination aids

MVI383B Fresh Fermented Dairy Products

Fresh Fermented Dairy Products

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

Staff/institute: Judith Narvhus/ IKBM
Teachers: Roger K. Abrahamsen.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Practicals and excursion. These activities must be approved before the exam can be taken.
Prerequisites: Knowledge of milk as a raw material, equivalent to MVI270. Knowledge of dairy technology equivalent to MVI383A. Fermentation microbiology equivalent to MVI321.
Type of course: Each week, one topic is covered. There will be practicals in two of the weeks, each of one and a half days (in total about 12hr for each practical) plus some additional time used for treatment of the results from the practicals.
Contents: The course contains 6 major parts that are conducted as lectures : - Technological aspects of the manufacturing of fermented milk products. - The formation of acid gel. - Yoghurt. - Mesophilic fermented milk products. - Fresh cheeses. - Probiotic bacteria and -products. In addition, the course contains two large practicals. Emphasis is placed on journal writing.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written exam, 3.5 hours - counts 50%. Two journals - count 50%. The deadline for handing in journals is two weeks after having completed the exercise.

MVI383C Cheese Technology

Cheese Technology

Credits: 10 **Language:** English upon request
Staff/institute: Siv Borghild Skeie/ IKBM
Teachers: Tone Molland, Kari Olsen, Kim Marius Moe
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Presantations, discussion groups, exercises and excursion.
Prerequisites: Knowledge of milk as a raw material for food processing equivalent to MVI270. Knowledge of dairy technology equivalent to MVI383A.
Type of course: The course will be given in a period of 8 weeks.Lectures: 20 hours. Colloquia: 8 hours. Exercises: 48 hours. Excursion: 6 hours.
Contents: The course contains 10 major parts conducted as lectures, colloquia and experiments (2): Milk requirements, cheese classification, cheese manufactuing based on ultra-filtered milk, cheese yield, equipment for cheese manufacturing, cheese ripening, low fat cheese technology, special types of cheese, sensory properties of cheese, nutritional aspects of cheese. Emphasis is placed on journal writing.
Learning outcomes: Students will gain insight into and a deeper understanding of the cheese manufacturing and the cheese ripening process. The students should be able to develop process lines for the manufacture of various cheese types by applying recent technology and equipment. In addition, students should be able to evaluate the connection between factors significant for the cheese ripening and the development of its characteristic properties. The students should learn to write a journal according to internationally accepted forms for scientific publishing. Students are to be able to put cheese production into a historical and cultural context. The students are to be able to evaluate what effect various production technologies have on the quality and safety of the products, when regarded as foods.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written examination, 3.5 hours - counts 50 %. Two journals count 30%. The deadline for handing in journals is two weeks after having completed the exercise. One presantation counts 10% and a presantation of a topic on cheese on Wikipedia counts 10 %.

MVI384 Functional Foods: Bioactive components in foods

Functional Foods: Bioactive components in foods

Credits: 10 **Language:** English
Staff/institute: Judith Narvhus/ IKBM
Teachers: Wicklund, Trude; Remberg, Siv F; Vegarud, Gerd: Thomassen, Magny; Uhlen, Anne Kjersti; Haug, Anna.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Student presentations. Obligatory attendance
Prerequisites: Basic knowledge of nutrition, food chemistry and microbiology at the 200 level.
Type of course: Lectures: 4 hours. Student presentations: 2 hours per week. Computer room: 2 hours.
Contents: 1. Definitions, laws and regulations. Trends, ethics and consumer demands. Advertising regulations and methods. Clinical trials. 2. Functional products and ingredients from cereals and other seeds, vegetables and fruits. 3. Functional products and ingredients from milk and fish. 4. Probiotics and prebiotics.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Presentations count 50 % and written multiple choice examination counts 50 %.

MVI385 Product Development

Product Development

Credits: 10 **Language:** English upon request
Staff/institute: Elling-Olav Rukke/ IKBM
Teachers: Tomas Isaksson, Eirik Selmer Olsen, Ola Eide and others.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Seminars/case studies and role plays.
Prerequisites: A relevant bachelor\'s degree.
Type of course: 1. Lectures: 2 hours x 3 per week including seminars (discussion groups and excursion to the FoU section in a food industry.
Contents: The course is constructed around the following subjects; 1. Identifying new products (keys to success and failure, processing technology, food-/healthy products etc.). 2. Key requirements for successful product development (developing an innovation strategy, the PD-process, the knowledge base for PD, the consumer). 3. Research design. 4. Managing and improving PD, including case studies.
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.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Final written examination: 3.5 hours, counts 100%.
Examination aids: No calculator, no other examination aids

MVI390 Immunology, Food Allergy and Intolerance.

Immunology, Food Allergy and Intolerance.

Credits: 5 **Language:** English upon request
Staff/institute: Tor Erling Lea/ IKBM
Start term: August block

Terms: August block
Prerequisites: Knowledge of cell biology equivalent to BIO100. Knowledge of biochemistry equivalent to KJB200. Knowledge of microbiology equivalent to BIO130.
Type of course: Lectures: 24 hours. Supervised discussion groups: 24 hours. Presentation of group assignments.
Contents: A thorough introduction to the immune system structure and function. This will be the starting point for an in-depth study of special conditions linked to the immunology of mucous membranes and mechanisms for the development of allergies, plus give the necessary background for understanding the difference between immune-mediated hypersensitivity reactions and other forms of intolerances brought on by food products. Through lectures, supervised discussions and group projects, the students will have the opportunity to work through key issues, which are particularly relevant for their future careers.
Learning outcomes: After completing the course, students will have a thorough, general understanding of the development and function of the immune system. It is an asset to be able to understand why the body\'s defence system against infections also reacts against non-infectious agents and in this way contributes to the development of hypersensitivity reactions such as allergies and auto-immune diseases. The course approach to food allergies and intolerance entails that students will gain special knowledge of mucosal immunology and, mechanisms behind the development of allergic reactions, plus understanding of the aetiology of other selected immune-mediated diseases in the digestive system. Students will also have a clear understanding of the differences between immune-mediated hypersensitivity reactions and other forms of intolerances. These learning goals assume that the students develop skills that prepare them to access relevant scientific literature, make grounded evaluations and give advice in food production with the goal to avoid allergies and other hypersensitivity reactions. The students will learn and obtain experience with how to prepare and deliver effective oral and written presentations of technical information and scientific results. They will learn to think critically and solve complex and multidisciplinary problems, as well as learn to accurately interpret current research literature.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Group assignment with presentation and discussion: 1/3. Written exam, 2 hours: 2/3. Group assignment with presentation in plenary. Each presentation shall last maximum 30 minutes with time for questions afterwards. In addition to the presentation of own assignment, each group will be responsible for the evaluation of another group \'s assignment, prepare questions and discuss the content and presentation. Written exam: multiple choice. Both group assignment and individual exam must be passed for the whole course to be approved.

MVI390B Immunological techniques

Immunological techniques

Credits: 5 **Language:** English upon request
Staff/institute: Tor Erling Lea/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Participation in laboratory excercises. Semester assignments.
Prerequisites: Basic immunology corresponding to MVI 390.
Type of course: Laboratory exercises, demonstrations and lectures 5-6 hrs. per week total 60 hrs. Colloquia and self study 60 hrs.
Contents: The course will give the students thorough practical experience with isolation of antibodies, the use of antibody reagents for analyses based on precipitation and agglutination, and analytical formats employing enzyme-, fluorescence- and isotope conjugated antibodies (ELISA and RIA). Important methods for isolation and characterization of immune cells, fractionation of immune cells into different subgroups, and techniques for studying functional properties of immune cells will also be reviewed.
Learning outcomes: Students will acquire practical and theoretical experience with the most important analytical methods of immunochemistry and cellular immunology. They should be able to select suitable analytical formats for their own problems, evaluate sources of errors, and resolve problems connected to the use of immunological techniques.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F

Assessment methods: Semester assignment must be approved before the exam. Exam 14 days after the last lecture

MVI391 Diet and Health

Diet and Health

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

Staff/institute: Kari Almendingen/ IKBM

Teachers: Guest lecturers

Start term: January block

Terms: January block

Mandatory activities: The first day lecture is mandatory. Active participation in seminars.

Prerequisites: Knowledge of biochemistry equivalent to KJB200 and KJB210. Knowledge of nutrition equivalent to HFE100.

Type of course: January block (3 weeks) Lectures: 24 hours.Supervised group work: 24 hours.

Contents: The course will focus on what we know about food components and their relation to health. Furthermore, the impact of diet composition, eating habits etc. in relation to health. The course will give an overview over the impact of diet in different phases of life and in relation to the most serious public health challenges. Current issues such as diet supplements and popular diets will be included if the time allows it.

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

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F

Assessment methods: Group assignment with presentation in plenary. Each presentation shall last for maximum 30 minutes with time for questions afterwards, counts 1/3. Written examination, counts 2/3. The written examination has to be graded E or better.

MVI392 Gastrointestinal anatomy and physiology

Gastrointestinal anatomy and physiology

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

Staff/institute: Morten Jacobsen/ IKBM

Teachers: Morten B. Jacobsen

Start term: Autumn parallel

Terms: Autumn parallel

Prerequisites: Biochemistry corresponding to KJB200. Nutrition science corresponding to HFE100. Basic knowledge of microbiology and cell biology.

Type of course: Lectures including colloquia: 6 hrs. one day per week.

Contents: Particular emphasis is placed on intestinal cellular anatomy, neural, humoral and feedback regulatory mechanisms, satiety and hunger, motility, and immune competence of the intestinal tract. The main functions of the stomach, small and large intestine, liver and pancreas are presented in detail. Also the role of the intestinal mucosa in immune defence is discussed. Furthermore students should achieve some knowledge of relevant medical terminology.

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.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F

Assessment methods: Group presentation and individual written exam. Marking is partly based on group presentation (40%) and partly on individual written exam (60%). Both parts must be approved.

MVI480 Food Process Technology

Food Process Technology

Credits: 10 **Language:** English upon request
Staff/institute: Tomas Isaksson/ IKBM
Teachers: Reidar B. Schüller and Trude Wicklund
Start term: Spring parallel
Terms: Spring parallel
The course is offered: By assignment
Prerequisites: MVI280 and MVI281 or equivalent.
Type of course: Discussion groups 2 hours per week for 14 weeks.
Contents: The course contains theory at PhD level regarding food engineering technology, such as mass and energy balance, material characteristics, heat transportation etc. and some information on process control. In addition, important unit operations such as blanching, pasteurising, sterilising, baking, frying, infrared, ohmic and dielectric heating, cooling and freezing are covered. The course is a PhD course and involves discussion groups/independent study.
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.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Oral examination, counts 100 %.

MVI481 Fresh meat science and technology

Fresh meat science and technology

Credits: 5 **Language:** English upon request
Staff/institute: Bjørg Egelandsdal/ IKBM
Teachers: Will vary from year to year.
Start term: June block
Terms: June block
The course is offered: Odd years
Mandatory activities: Exercises.
Prerequisites: Master of Science Degree in either Food Science, Technology, Animal Sciences, Veterinary Sciences or Biochemistry.
Type of course: Five days in June block, 8 hours per day.
Contents: Introductory material on the conversion of muscle to meat, and on muscle pigment. The focus of the course is on new theories on the death of cells and these theories\' implications for early post-mortem processes. Materials on our present understanding of mitochondrion composition and structure, partly during the death process, and this suborganelle\'s possible impact on colour stability post mortem are included. Recent literature on colour stability of meat. Post-translational modification of collagen and ageing of muscle and its impact on meat tenderness are included. Newer theories on early post mortem proteolysis and oxidation and their relation to water holding ability are presented. Finally, a few ideas about the opportunity to improve meat quality through enhancement technology encompassing antioxidants and packing are given.
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.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Oral examination with presentation of project work counts 100 %.

MVI482 Processed Meat Technology: Dry-Cured Products

Processed Meat Technology: Dry-Cured Products

Credits: 5 **Language:** English upon request
Staff/institute: Bjørg Egelandsdal/ IKBM

Teachers: Various teachers according to need
Start term: June block
Terms: June block
The course is offered: Even years
Mandatory activities: Excursion.
Prerequisites: Master of Science Degree in either Food Science, Technology, Animal Sciences, Veterinary Sciences or Biochemistry.
Type of course: Block course, 1 week.
Contents: Manufacturing of dry-cured (intact) meat. Types of dry-cured products. Characterisation of proteolysis and lipolysis. Flavour development. Nutritional properties. Effect of raw materials and processing on quality. Main defects and preventive measurements. Quality monitoring techniques. Safety aspects.
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.
Methods of examination: Final Oral exam **Grading:** Pass/Fail
Assessment methods: Oral examination with presentation of project work (counts 100 %).

MVI483 Dairy Technology

Dairy Technology

Credits: 10 **Language:** English upon request
Staff/institute: Roger K. Abrahamsen/ IKBM
Teachers: Siv Skeie, Judith Narvhus
Start term:
Terms: By demand
The course is offered: By assignment
Prerequisites: Relevant Master\'s degree, prefereably with focus on dairy technology. An individual evaluation of the candidate\'s knowledge will be made. The candidates\' qualifications in dairy technology should preferably be on the same level as the knowledge acquired by taking courses in dairy technology at the master level at UMB.
Type of course: Discussion groups are arranged when required.
Contents: This PhD course is suited for students whose research is within the area of dairy technology or related areas, or are doing research in which dairy technology knowledge is of substantial importance. The course will to a large extent be production oriented, but builds on a comprehensive knowledge of the components of milk and on the units operations in dairy technology. Utilising the components of milk in product manufacturing, product quality and characteristics, and relevant control of products and of production processes will be central topics in the course.
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.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Normally, a final written examination. If the course is taken completely on an individual basis, oral examination or written assignment can be used.
Examination aids: No calculator, no other examination aids

MVI484 From Milk to Cheese

From Milk to Cheese

Credits: 5 **Language:** English
Staff/institute: Siv Borghild Skeie/ IKBM
Teachers: Associate Professor Inga Ciprivica, LLU, Latvia, Professor Roger Abrahamsen, UMB, Norway, Professor Anders Andrén, SLU, Sweden, Research scientist Tiiu Maie Laht, TUT, Estonia, Associate Professor Finn Vogensen, KU Life, Denmark, Professor Ylva Ardö, KU Life, Denmark, Professor Tapani Alatossava, UH, Finland,
Start term: August block

Terms: August block
The course is offered: Other - On demand (min 5 students)
Mandatory activities: The gathering at campus Ås is mandatory for all participating students.
Prerequisites: A Masters degree in Food Science or a comparable bacground. The scientific content of the course will be based on this assumption.
Type of course: Each day consists of two sessions: a morning session between 8.15 and 12.00 and an evening session between 12.30 and 16.15. Each session will start with a lecture followed by further discussions of the topic in colloquia. I.e. one hour lecture and three hours colloquium. It is mandatory that the students have read the given literature before the gathering at campus Ås. During the colloquia the students will work on problems given by the lecturer. On day four, the colloquium will be replaced by practical exercises in a cheese pilot plant. All relevant documents will be available on Classfronter, which will be opened around the 1st of August. Relevant problems and questions for each topic will also be found at this web site.
Contents: The course focuses on the aspects related to cheesemaking, such as milk quality and milk treatment; coagulation kinetics during renneting; structure development of the cheese curd; antimicrobial interactions; starter cultures; influence on cheese making and the foundation for flavour development and cheese making technology.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: The course will be finished by a 10 pages report, evaluated by professors involved in the course.

NATF210 Environmental Monitoring

Environmental Monitoring

Credits: 5 **Language:** English upon request
Staff/institute: Svein Solberg/ INA
Teachers: Five guest lectures from Norwegian institutions carrying out environmental monitoring.
Start term: January block
Terms: January block
Mandatory activities: 1 compulsory excursion. 75 % of exercises must be submitted and approved.
Prerequisites: STAT100.
Contents: Lectures: Monitoring methods including field methods, bioindicators, automatic monitoring, telemetry and remote sensing with airborne and satelliteborne sensors. Data handling and interpretation, including databases, GIS, environmental standards, proxy and paleo data, and politics versus science. Presentation of ongoing monitoring for selected topics, such as air pollution, climate change, radioactivity, tropical deforestation and biodiversity. Overview of monitoring activities and international conventions. Some examples are taken from Norway, however, it is mainly international focus. Data lab training: Working with monitoring data, data bases, GIS and remote sensing Excursion: One day in the field, focussing on field methods and automatic monitoring. Tree climbing. Social trip. Exercises: 20 short exercises, of which 15 need to be approved. Calculation and interpretation on data from environmental monitoring.
Learning outcomes: After the course the students shall: - have an overview of the methods for environmental monitoring; - know major international monitoring activities and treaties; - have some knowledge about the background of environmental monitoring: i.e. the environmental problems; - be able to handle and interprete monitoring data.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam
Examination aids: No calculator, no other examination aids

NATF300 Conservation Biology

Conservation Biology

Credits: 5 **Language:** English
Staff/institute: Jon Swenson/ INA
Start term: August block
Terms: August block
Prerequisites: ECOL200, NATF200.
Type of course: Lectures and discussions: 30 hours.
Contents: Guest lecturers have high competence in the relevant topics. Discussions of relevant scientific papers. Progression from theory to practical examples.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: The written examination lasts 3 hours.
Examination aids: No calculator, no other examination aids

NATF320 Ecology and Management of Natural Resources in the Tropics

Ecology and Management of Natural Resources in the Tropics

Credits: 10 **Language:** English
Staff/institute: Torbjørn Haugaasen/ INA
Teachers: Jonathan Colman
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Seminars and short reports.
Prerequisites: ECOL200.
Type of course: Lectures, 4 hours per week.
Contents: The course is a combination of basic ecological elements (e.g. species diversity and ecosystem functioning) and more applied dimensions, focusing on management and conservation issues. Human dimensions necessary for understanding and effectively managing tropical ecosystem are also included. Students will be exposed to international conventions, the importance of local knowledge and bio-prospecting issues. The course also draws from a wide range of expert contributions and examples from all over the world. The students, acting as a participatory component via presentations and discussions, form an integral part of the course and our learning progress. Guest lectures will also provide exciting state-of-the art knowledge and expertise.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written exam, 3.5 hours, counts 3/5 of the grade. Semester assignment counts 2/5 of the grade. All of the evaluated elements in the course must be passed to pass the course.

NATF350 Community Based Natural Resource Management

Community Based Natural Resource Management

Credits: 5 **Language:** English
Staff/institute: Fred Midtgaard/ INA
Teachers: Thor Larsen and Jonathan Colman
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Class presentations.
Prerequisites: Completed Bachelor\'s degree and knowledge in ecology at ECOL200 level.
Type of course: Seminars: 20 hours, lectures: 10 hours.

Contents: Throught the world we find examples of conflicts between conservation and human development. During the past decade, however, there has been an increasing realisation that conservation and preservation of natural resources cannot be effectively achieved without incorporating local people and their needs. With a focus on developing countries the course explore how to integrate important ecological, social and economic tools in an integrated ecosystem management approach. Part of the course will focus on case studies from different parts of the world. We will study different approaches to community based natural resource management and look at previous elements of success and failures. The entire course will depend on student participation. One or several students in the class will present each topic. After each presentation, we will have plenary discussions. Thus, it is essential that all students are prepared before classes. Students are also expected to write a 6-7 pages semester assignment that will be published electronically on the INA web site.
Learning outcomes: The course is designed to provide an in-depth understanding of how people and ecosystems interact.The main goal is to explore different conflicts between development and conservation and how these conflicts can be reduced by community involvement in natural resource management.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The course is evaluated based on a short semester assignment.

PAE301 Ecology of Farming and Food Systems

Ecology of Farming and Food Systems

Credits: 5 **Language:** English
Staff/institute: Geir Lieblein/ IPM
Teachers: KU: V. Langer; SLU:M. Quadra; Helsinki Univ.: J. Helenius, I. Herzon; UMB: Tor Arvid Breland
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: Bachelor\'s degree or its equivalent in agriculture, plant science, economics, natural resources, human nutrition or other relevant social or natural sciences.
Contents: With a concrete case as starting point, the course deals with structure and functioning of agroecosystems as whole entities seen from different perspectives. Examples of such are ecological, economic, social, time and spatial scale, and organisational level perspectives. The students will also learn about and practice methods for describing and analysing the case and its goals, and they are expected to suggest improvements.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Details for the portfolio assessment will be given at course start. Students will be assessed on written assignments, on understanding of the materials, on ability to conceptualise the course content and on making application to the case and to their current local situations. Their papers, short assignments, and contributions to discussions will be the basis for a grade.

PHA320 Applied Plant Physiology in Controlled Environment

Applied Plant Physiology in Controlled Environment

Credits: 10 **Language:** English upon request
Staff/institute: Hans Ragnar Gislerød/ IPM
Teachers: Sissel Torre.
Last time the course is offered: HØST
Start term: Autumn parallel
Terms: Autumn parallel

The course is offered: Odd years
Mandatory activities: Excursion and semester thesis
Prerequisites: BOT200 or Bachelor\'s degree in Plant Science or equivalent.
Type of course: Lectures: 62 hours, 46 hours per week for 13 weeks. Exercises: 16 hours, 2 hours per week for 8 weeks. Computer room. Excursion: 1 day, 8 hours.
Contents: The following central topics are covered thoroughly: 1. Fertilisation planning. 2. Growth, developmental physiology and growth regulation. 3. Post-harvest physiology. The course is a part of the Master\'s programme in Plant Sciences, and it is one of the courses offered for other relevant MSc programs at UMB. There is a distinct environmental profile in this course.
Learning outcomes: After completing the course, the students should be able to use their knowledge of plant physiology and fertilisation planning as a foundation for effective and environmentally friendly production of flower plants of high quality for the local environment. A thorough covering of the following, central topics: 1. Fertilisation planning for greenhouse crops. 2. Growth and development physiology, and growth regulation. 3. Post-harvest physiology. Solving of both theoretical and practical problems in connection with the use of fertilisation planning and climate control in greenhouse cultures for optimal growth and plant quality. Also analyses and interpretations of reasons for irregular growth, damage symptoms, bad plant quality and durability. Several of the topics in the course focus on an environmentally friendly greenhouse production. This contributes to students gaining attitudes that may lead to more attention being paid to this topic when they turn up as teachers, advisors and researchers in the horticulture field.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Continuous assessment in topic 1, 2 and 3 with part tests/ handing in of exercise, counts 3/10. Final oral examination, counts 7/10. 30-45 minutes per candidate. Both parts have to be passed.

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

Applied Plant and Production Physiology in Controlled Environment, theme paper

Credits: 15 **Language:** English upon request
Staff/institute: Hans Ragnar Gislerød/ IPM
Teachers: Sissel Torre and others.
Last time the course is offered: HØST
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Prerequisites: BOT200 or Bachelor\'s degree in Plant Science or equivalent.
Credit reduction: PHA320, 10 credits.
Type of course: Lectures: 62 hours, 4-6 hours per week for 13 weeks. Exercises: 16 hours, 2 hours per week for 8 weeks. Computer room. Excursion: 8 hours. Guidance in connection with semester papers. The papers are gone through. In total: ca. 25 hours.
Contents: The following central topics are covered: 1. Fertilisation planning. 2. Growth, development physiology and growth regulation. 3. Post harvest physiology. 4. Semester assignment. The course has a distinct environmental profile.
Learning outcomes: After completing the course, the student is going to have a deep understanding of applied plant physiology and fertilisation planning as a base for an effective and environmentally friendly production in greenhouse of high quality and beneficial for the local environment. For further information see PHA320. In addition, the student will gain experience in writing a semester assignment of 5 credits in a selected topic.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The assessment consists of three main parts and is done by: Part 1: Continuous assessment of topic 1, 2 and 3 with part tests/ handing in of exercises, counts 3/15. Part 2: Topic 4: continuous assessment of semester paper, counts 5/15. Part 3: Final oral examination, counts 7/15. 30-45 minutes per candidate.

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

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

Credits: 10 **Language:** English upon request
Staff/institute: Hans Ragnar Gislerød/ IPM
Teachers: Sissel Torre and others.
Last time the course is offered: HØST
Start term:
Terms: By demand
The course is offered: By assignment
Prerequisites: BOT200 or Bachelor\'s degree in Plant Science.
Type of course: Ca. 2 hours per week. Individual guidance corresponding to ca. 20 hours.
Contents: Independent study on a topic that has been agreed upon, and literature with guidance. The choice of topic will primarily be linked to ongoing projects.
Learning outcomes: The student is to have theoretical depth on certain topics in applied plant physiology related to greenhouse crops.
Methods of examination: Final **Grading:** A-F
Assessment methods: Semester assignment counts 100%.

PHI401 Research Ethics and Philosophy of Science I

Research Ethics and Philosophy of Science I

Credits: 5 **Language:** English
Staff/institute: Frode Kjosavik/ IØR
Teachers: Terje Kvilhaug, Deborah Oughton.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: The studentens must attend at least 70 % of lectures and seminars.
Credit reduction: The course overlaps the first part of the course PHI 402. Students who take the course PHI 402 in addition to PHI 401 will only receive 5 study points. Students who have taken the course PHI 400 (given last time autumn 2008) will receive no study points by taking the courses PHI 401 or PHI 402.
Type of course: Around 28 hours lectures + seminars and group discussions.
Contents: An elementary and introductory course in philosophy of science will give the student a good basis for a better understanding of issues in the main part (research ethics/social responsibility of science), both through illuminating science as a practice form and through its own ethical aim (\'good\' science). Among the issues to be discussed can be mentioned: The value- and norm systems of science; facts and values; political-economical interests and scientific integrity; research ethical guidelines; duties towards other scientists and research objects; science, technology and society; ethical challenges in developmental research; scientific rationality and scientific methods; scientific realism and social constructivism; metaphors and theory formation; theoretical experience/experimental experience.
Learning outcomes: The course aims at an increased understanding of science in practice, i. e. science as it is carried out in diverse ways within the natural, social and cultural sphere. The course considers what is specific about scientific practice, rationality and method in diverse fields, what its aims are, how it is influenced by society and what kinds of social and cultural consequences it may be said to have. The objective is to stimulate students to reflect on their own and others research projects and research fields, in particular with a view to increase their ability to see and diagnose philosophical and ethical problems in the sciences as well as their consciousness of their ethical responsibility.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: Term paper.

PHI402 Research Ethics and Philosophy of Science II

Research Ethics and Philosophy of Science II

Credits: 10 **Language:** English
Staff/institute: Frode Kjosavik/ IØR
Teachers: Terje Kvilhaug, Deborah Oughton.
Start term: Autumn parallel
Terms: Autumn parallel January block
Mandatory activities: Students must attend at least 70 % of lectures and seminars in the part that is common with PHI401 and 70 % of the additional part that is exclusive to PHI402.
Credit reduction: See PHI 401.
Type of course: Around 40-44 hours lectures + seminars/group discussions.
Contents: The contents and structure of this course are by far the same as in the course PHI 401 (see \'Contents\' under PHI 401). But the course PHI 402 offers an extended study in philosophy of science especially. It should be noted that the following examples of issues to be discussed here are also ethically relevant: The relation between natural and human sciences; science in society (science as social practice); what nature must be like for science to be possible; open and closed systems; epistemological problems in open (natural and social) systems; naturalism and its limits; the transformative model of society; laws, powers, models and idealization; reductionism and anti-reductionism in biology; problems related to the understanding of the selection entities; anti-reductionism and the developmental system-theories about onto-genesis and evolution.
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.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: Term paper.

PJH212 Cropping Systems of Grain Crops and Grasslands

Cropping Systems of Grain Crops and Grasslands

Credits: 15 **Language:** English upon request
Staff/institute: Anne Kjersti Uhlen/ IPM
Teachers: Åshild Ergon, Marina A. Bleken, Trond Børresen, Tore Krogstad
First time the course is offered: SPRING 2011
Start term: Spring parallel
Terms: Spring parallel June block
Mandatory activities: Assignment and presentation Excercises/lab Excursions
Type of course: Lectures: 48 t Excercises/lab: 8 t Excursions: 8 t Student presentations: 8 t
Contents: The course comprise lectures and practicals (counting 10 sp) and an assignment with oral presentation (counting 5 sp. This course includes grain crops used for food and feed, as well as forage grasses and grassland production. Main focus are on management practises and cropping systems, both conventional and organic. Main topics are tillage and plant establishment, fertilisation and fertilisation methods, winter survial and hardiness, crop rotations,mixed cropping and the use of catch crops, quality of the harvested products.
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
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam counts 2/3, and the assignment and its presentation counts 1/3. Both parts must be approved to pass the exam in this course.

Examination aids: No calculator, specified other examination aids

PJH250 Production in greenhouses

Production in greenhouses

Credits: 15 **Language:** English upon request
Staff/institute: Sissel Torre/ IPM
Teachers: Hans Ragnar Gislerød
First time the course is offered: SPRING 2011
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years
Mandatory activities: Excursions, case work (theme paper), approved exercise work with an approved participation and approved reports
Prerequisites: BOT130, PHJ103 (BOT201) or equivalent
Type of course: 450 hours
Contents: The course focuses on the relationship between climate factors and plant growth and how this knowledge can be utilized to optimize plant production in greenhouses. Crop responses to temperature, light climate, air humidity and CO2 will be presented and discussed in relation to yield and product quality. Also, the course will contain greenhouse technology, cultivation systems, growing media, and fertilization strategies for the most common greenhouse crops. The different requirements will be discussed in relation to an environmental friendly production. The students will perform short and long term plant growth experiments, measure different growth- and quality-parameters and write reports. Several excursions will be arranged during the course and the students will get the opportunity to gain insight into practical greenhouse production in Norway. The students have to write a case work on a chosen topic.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Case work (1/3) and written examn (2/3). Both parts must be passed

PJH300 Sustainable Production Systems

Sustainable Production Systems

Credits: 15 **Language:** English upon request
Staff/institute: Marina Azzaroli Bleken/ IPM
Teachers: Lars Olav Brandsæter, Tore Krogstad, Trond Børresen, Ole Martin Eklo, Helge Skinnes and other internal and external lecturers
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: A number of exercises and group discussion is compulsory. In the case of exercises this regards both the delivery of written answers within a given deadline and the correction in the class. A specified list of the compulsory activities will be available at the beginning of the course.
Prerequisites: Bachelor in agronomy and PJH212. Students from other institutions than UMB mast have knowledge of genetics, plant pathology, soil science and plant production at intermediate level, corresponding to a UMB\'s bachelor in PV, specialisation in agriculture (among others BIO243, PLV200, JORD230)
Credit reduction: 5 ECTS if you have taken JORD340, and 5 ECTS if you have taken PØL300.
Type of course:

Contents: - Political frames around agriculture, particularly about environmental aspects and toxic substances - Food safety and food security - Experience from history: successful and disastrous agricultural systems, long term trials, the story of release and withdrawal of synthetic compounds for plant protection, recent trends in agriculture. - Carbon, Nitrogen, Phosphorus and Sulphur cycles: from field/crop rotation to biogeochemical aspects and recycling from society)including elements of ecological sanitation) - Toxic substances: persistence of heavy metals and pesticides - Elements of epidemiology regarding pests, diseases and weeds: crop protection seen in a production system perspective - Use of different resistance mechanisms in plant breeding - Management as tillage, crop rotation, mixtures and other methods of handling biodiversity: effects on plant competition, soil quality, soil erosion and nutrient losses, diseases\' as well as pests\' persistence and spreading, and effects on the yield (productivity and quality) - Management of soil fertility in organic farming (Fertilization planning in conventional agriculture is dealt with in JORD231) - Strategies for improving water use efficiency - Introduction to life cycle assessments (LCA) - Introduction to strategies for adaptation to global changes
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Oral examination with an external evaluator counts 85%, exercises and partecipation in the class counts 15% of the grade.

PJH340 Quality in Food Plants

Quality in Food Plants

Credits: 10 **Language:** English upon request
Staff/institute: Anne-Berit Wold/ IPM
Teachers: Siv Fagertun Remberg, Anne Kjersti Uhlen
First time the course is offered: AUTUMN 2012
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Mandatory activities: Laboratory exercises and student presentations
Prerequisites: BOT130
Type of course: 6 hours lectures and laboratory exercises per week
Contents: The course will focus on food plants in the human diet. This will include fruits, berries, vegetables, potato and cereals. Important nutrients and health related compounds in food plants will be emphasised. The effect of genetic variation, environmental factors and agronomic practices will also be important aspects. The importance of selected compounds in the plants and their influence on human health will also be included.
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

Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam counts 100%
Examination aids: No calculator, no other examination aids

PJH350 Applied Plant Physiology in Greenhouses

Applied Plant Physiology in Greenhouses

Credits: 10 **Language:** English upon request
Staff/institute: Sissel Torre/ IPM
Teachers: Hans Ragnar Gislerød
First time the course is offered: AUTUMN 2013
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Mandatory activities: excursions
Prerequisites: PJH250, BOT130, BOT200, BOT201
Type of course: 4 hr lectures every week, case studies on selected topics + 2 excursions
Contents: Topics:1.Nutrition and nutrition planning of greenhouse crops. 2.Growth and developmental physiology, focus on photosynthesis, yield, control of vegetative and generative growth. 3.The influence of environmental factors on quality and storability of greenhouse grown products. How to use climate factors as a tool to manipulate different quality parameters. 4.Energy consumption and greenhouse technology
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 with a long post harvest life.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Oral exam (70%), written tests (30%),

PJH360 Term paper in Plant Production

Term paper in Plant Production

Credits: 5 **Language:** English upon request
Staff/institute: Sissel Torre/ IPM
Teachers: Common course for PJH300, PJH340 and PJH350. Course responsible is contact person for the term papers.
First time the course is offered: AUTUMN 2011
Start term: Autumn parallel
Terms: By demand
Prerequisites: PJH300, PJH340 and PJH350, have to be connected to one of these courses.
Contents: Term paper
Learning outcomes: Look at the courses PJH300, PJH340 and PJH350.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: Term paper counts 100%.

PLV300 Plant Health and Plant Protection

Plant Health and Plant Protection

Credits: 10 **Language:** English
Staff/institute: Trond Hofsvang/ IPM

Teachers: Arild Andersen, Anne Marte Tronsmo, Ole-Martin Eklo, researchers from Bioforsk, Plant Health and Plant Protection Division.
Last time the course is offered: HØST
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Odd years
Mandatory activities: Approved journals from laboratory exercises must be handed in at least one week after finishing the exercise. Three small assignments must be approved.
Prerequisites: PLV220, PLV230 and PLV240 or PLV200 .
Type of course: Lectures/exercises: ca. 50 hours.
Contents: Integrated plant protection: definitions, historical development and conditions nationally and internationally. Make diagnoses of pests, biology of pests, interaction between pests and the environment, damage thresholds, fight against pests, risks and environmental effects of pesticides, international trade agreements and risk assessment. Key processes. Pesticides \' destiny in the environment is examined in laboratory exercises to explain the meaning and use of different models for risk assessments. The experiences are summed up and discussed in exercises and the independent assignment.
Learning outcomes: The students shall have the necessary basis to become advisers and to specialize in complex plant protection issues seen in a future-oriented ecological general perspective. The students shall know about integrated plant protection in theory and practice and acquire an understanding of the ecological processes that integrated plant protection is based on. They shall have knowledge about new and current challenges in plant protection today. Understanding of ecological processes and risks of environmental effects as a basis for integrated measures against pests in crop production. Consider dates for different integrated measures in different cultures based on damage thresholds, prognoses, warnings and indicator models. Make plans for integrated fight strategies with the fewest risks for environmental strain. Consider integrated plant protection measures in a general perspective for crop production and environmental quality. Product quality considered as production quality - an expanded quality concept.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The oral exam counts 2/3 (ca. 30 minutes per student). Independent assignment counts 1/3. Both parts have to be passed

PLV320 Plant Pathology in a Changing World

Plant Pathology in a Changing World

Credits: 5 **Language:** English
Staff/institute: Anne Marte Tronsmo/ IPM
Teachers: Jonathan Yuen, Annika Djurle and Dan F. Jensen, SLU, Sweden. Lisa Munk ans David B. Collinge, Faculty of Life Sciences (LIFE), Copenhagen University, Denmark. Minna Pirhonen, Faculty of Agriculture and Forestry (HU-AF),University of Helsinki, Finland. The course is part of the Nordic MSc programme in Plant Pathology.
Start term: June block
Terms: August block June block
Mandatory activities: Attendance and participation in all course activities.
Prerequisites: A first degree (bachelors or candidate degree) in biology or closely related field: Equivalent to 180 ECTS including 90 ECTS in Biology/life science/ or as an alternative: Equivalent to 120 ECTS including 60 ECTS in Biology/life science of which at least 5 ECTS each of plant physiology, microbiology,genetics and floristic and faunistic are part of the 60 ECTS.
Credit reduction: Perhaps some overlap with PLV220. No credit reduction.
Type of course: Lectures ca 25 h. Seminars ca 10 h. Exercises ca 20 h. Project/group work ca 15h. Excursions ca 30 h.
Contents: The content may be tailored to the interests and needs of the individual student. In lectures and seminars the scientific basis of plant pathology is explained, particularly the impact of plant disease on mankind from a historical perspective. Seminars and group discussions cover basic terminology and philosophy of the science of plant pathology, and give perspectives on plant disease management. Career opportunities are discussed with local guest lecturers. In field and laboratory exercises the students will study plant diseases from a field perspective. The students observe disease symptoms

and signs, collect material for subsequent laboratory exercises, and are introduced to basic laboratory methods used in plant pathology. Exercises are production-oriented. Link to Norpath\'s homepages:http://www.nova-university.org/NorPATH/index.htm

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

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail

Assessment methods: Assessment is based on the student\'s reports, seminars and presentations in plenum.

PLV321 Plant Pathology

Plant Pathology

Credits: 10 **Language:** English

Staff/institute: Anne Marte Tronsmo/ IPM

Teachers: Anne Marte Tronsmo, Arne Stensvand, May Bente Brurberg

First time the course is offered: AUTUMN 2012

Start term: Autumn parallel

Terms: Autumn parallel

Prerequisites: Bachelor level courses in Plant Physiology,microbiology, genetics and chemistry (BOT130, BIO130, BIO120 og KJM100) is an absolutely necessary.

Contents: The biology and life style of plant pathogens. How can they be isolated and cultivated. Disease cycle: Survival, dispersal, infection. Which weapons do pathogens have? Disease physiology. How plants defend themselve agains pathogens.Gene for gene theory. Development of plant disease epidemies. Principles behind methods for disease control. Ecological aspects of plant diseses and their control methoda. National and international plant health legislation.

Learning outcomes: Knowledgwe: - Shall understand the biology of the most imporatent virus, bacteria and fungi that are causing plant diseases. - Shall understand methods for identification of plant pathogens. - Shall understand how plant pathogens attack plants. - Shall understand how plants defend themselves against pathogens. - Shall understand the principles in host-pathogen at both cell level and population level. Skills: - Shall be able to employ the knowledge for developing strategies for plant disease management. - Shall be able to evaluate how epidemics develop and advice on risk managemnet. Competence: - Shall be able to evaluate envioronmenta and social consequences of plant diseses and the strategies to combat the diseses. - Shall be able to stay updated on plant diseases threatening our culivated plants.

Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F

PLV330 Insect-plant relationsships

Insect-plant relationsships

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

Staff/institute: Arild Andersen/ IPM

Teachers: Trond Hofsvang

First time the course is offered: SPRING 2012

Start term: Spring parallel

Terms: Spring parallel

The course is offered: Even years

Mandatory activities: Participate in exercises and seminars

Prerequisites: PLV 200
Credit reduction: None
Type of course: Lectures: c. 30 hours Exercises: c. 10 hours Seminars: c. 10 hours
Contents: Different parts of the relations between plants and herbivore animals will be taught through lectures. Important themes are chemicals in plants and the insect\'s reactions to them. In addition, lectures on two important topics for nordic insects will be given: hibernation and migration. The students will concentrate on specific topics in the self study.
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
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Oral exam counts 80%, term paper counts 20%. Both parts must be passed

PLV340 Weed biology and weed-crop relationships

Weed biology and weed-crop relationships

Credits: 5 **Language:** English upon request
Staff/institute: Lars Olav Brandsæter/ IPM
Teachers: Therese With Berge Kirsten Semb Tørresen others
First time the course is offered: SPRING 2013
Start term: Spring parallel
Terms:
The course is offered: Odd years
Mandatory activities: Excercises, self study and seminars
Prerequisites: A first degree (bachelor or candidate degree) in biology or closely related fields. More specific, the first degree should include PLV200 or PLV210, or other cources with similar content.
Credit reduction: .
Type of course: Lectures: about 30 hours Excercises: about 10 hours Seminars: about 10 hours
Contents: Themes about weed biology and ecology, as well as how different weed management practices reach the weeds in a species specific way will be discussed in lectures, exercises and a self study and seminars.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Oral exams 60 %, term paper 20% and excercises 20%.

PLV420 NOVA PhD-course in Plant Pathology

NOVA PhD-course in Plant Pathology

Credits: 5 **Language:** English
Staff/institute: Anne Marte Tronsmo/ IPM
Teachers: Professor Anne Marte Tronsmo, UMB - Organiser in 2011 Professor Minna Pirhonen, HU- Organiser in 2112 Professor Jonathan Yuen, SLU - Organiser in 2013 Professor David Collinge, LIFE, København - Organiser in 2014 International guest teachers
Start term: Spring parallel
Terms: Spring parallel June block

Mandatory activities: Active participation in the intensive course. Participation in dicussion groups. Abstract and presentation of lecture or poster.
Prerequisites: Master degree that qualifies for enrollment as a PhD student in Plant Pathology. Basic courses in Plant Pathology and Microbiology.
Type of course: 7 full days of intensive course. 70 hours: Lectures, discussions, lab. practicals demonstrations. Literature study and discussions before the course: 50 hours (discussion groups arranged in each country). Preparation of the students own presentation and evaluation of the presentation: 30 hours.
Contents: See description on the NOVA home page
Learning outcomes: See description on the NOVA home page
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Contribution and performance in discussions are assessed by nordic teachers. Content and presentastion of poster or oral presentation are assessed by a group of international and nordic teachers.

PPFO401 Being a Research Participant. Interview and Dialogue through Qualitative Method

Being a Research Participant. Interview and Dialogue through Qualitative Method

Credits: 15 **Language:** English
Staff/institute: Edvin Østergaard/ IMT
Teachers: Erling Krogh, Linda Jolly and Edvin Østergaard.
Last time the course is offered: VÅR
Start term: Spring parallel
Terms: January block Spring parallel
Mandatory activities: Participation in the two gatherings and submission of a preliminary outline for the essay.
Prerequisites: The course requires admission to a doctoral programme at UMB, institutions connected to the NOVA cooperation or other universities.
Type of course: Two gatherings of three days. In addition, the students work on the Internet through the course\'s LMS.
Contents: Qualitative methods presuppose an insight into both the specific problem area and the researcher\'s participative role and scientific approach. The course will introduce phenomenology and cultural analysis as tools for placing students\' research topics in a meaningful context. In a phenomenological-hermeneutic perspective, the course will focus on qualitative methods as a double tool: in order to describe and analyse the world s phenomena and to understand own knowledge and values. For this reason, decisive weight is placed on giving individual students the possibility for in-depth study of the method relevant for their own research. Topics: qualitative methods as research area, phenomenology and hermeneutics, case study methodology, narrative research method, cultural understanding and analysis, performing in-depth interviews as a base for knowledge formation.
Learning outcomes: The course aims at providing the doctoral students with a basis for using qualitative research methodology. The goal is that students shall be able to use qualitative methods in their own research project and reflect upon their own role in the research process.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: The essay is submitted two weeks after the last gathering.

PPUT301 Science and Technology in School and Society - LUN

Science and Technology in School and Society - LUN

Credits: 20 **Language:** English upon request
Staff/institute: Erik Knain/ IMT
Teachers: Margrethe Naalsund and others.
Start term: August block
Terms: By demand

Mandatory activities: The students must give a presentation linked to their master\'s thesis and open for discussion with the other students at the seminar. The presentation is assessed as \'passed/failed\'. Participation on seminars is mandatory, 20% absence is accepted. All three compulsory assignments must be passed. Information on dates and program may be found at http://pput11.umb-sll.wikispaces.net/.
Prerequisites: LUN students. PPXP, PPRA301, PPPE301, PPFD301, natural science courses. Science teacher education.
Credit reduction: Equivalent to 10 credits if taken in parallel with the master\'s thesis.
Type of course: Handed out at course start. There are two compulsory assignments and presentations in the autumn semester. In the spring semester, the students will give presentations linked to their master\'s theses. Information on dates and program may be found at http://pput11.umb-sll.wikispaces.net/.
Contents: The students are to develop their use of educational theory by studying literature on educational theory and written texts where the theories are applied to students\' research questions. If three or more students participate in the course, it will include mandatory seminars where students take an active part by presenting, discussing and by providing feedback on other students texts. This constitutes the main part of the course, is given in the autumn semester and contains two compulsory assignments. In the spring semester, the course is intended to support the students in writing their master\'s theses through compulsory seminars.
Learning outcomes: The students will gain insight into literature on educational theory and principles, and apply this literature to their own problems within educational theory. The students are to develop the correct use of quotes and be able to discuss and review literature. Literature shall be used actively in the students\' written work and empirical research. Through presentations and discussions, the students should develop their own opinions about educational theories and principles in the natural sciences. The course aims to give the students a basis before embarking on their master\'s theses.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Two written assignments. 1) An essay on relevant literature. The aim of the first assignment is to develop skills which are important when writing a master\'s thesis: - discuss relevant problems in teaching theory, - find and choose literature to discuss a problem, - using quotes from the chosen literature correctly, critical literature review, - use the literature in a coherent manner, - give an independent review of the literature and solve the problem. 2) The second assignment is an empirical survey in light of the first assignment and may serve as a pilot project for a master\'s thesis. The aim of this assignment is to discuss and use literature in connection with empirical research. Emphasis is placed on discussing teaching theory and using literature, and not on methodology. The first assignments accounts for 40 % of the final grade, and the second assignment accounts for 60%.

REIS300 Nature-based Tourism

Nature-based Tourism

Credits: 10 **Language:** English upon request
Staff/institute: Birger Vennesland/ INA
Teachers: Ole Hofstad and others.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Excursion
Prerequisites: REIS200.
Type of course: Lectures, excursion and project paper: 40 hours.
Contents: Nature-based tourism as a business in Norway. Experiences with nature as a product, supply, demand, organisation, logistics. Project development and project evaluation. Excursion and undertaking of a practical project exercise in cooperation with players in the market.
Learning outcomes: The course should: - Give an overview of nature-based tourism as a business in Norway. - Give a theoretical basis for analysis of nature based tourism projects. - Undertake a concrete analysis of a nature based tourist project.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F

Assessment methods: Project paper (counts 40%) and oral exam (counts 60%). All of the evaluated elements in the course must be passed to pass the course.

SKOG310 Nordic Forestry and Forest Research

Nordic Forestry and Forest Research

Credits: 10 **Language:** English
Staff/institute: Ole Hofstad/ INA
Teachers: Sjur Baardsen, Tron Eid, Terje Gobakken, Karsten Raulund-Rasmussen, Birger Solberg
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Other - This course will not be offered during 2011.Emnet tilbys ikke høsten 2011.
Mandatory activities: Excursion
Prerequisites: Bachelor in Forestry or similar.
Credit reduction: Overlap of 2 credits against SKOG300, 1 credit against SKS303, 2 credits against RØP320
Type of course: Lectures, seminars, excursion, semester assignment.
Contents: A few short lectures will introduce the students to natural and socio-economic conditions for forest management in Norway and the other Nordic countries. Research papers within seven general topics, where INA contributes actively to forest research, will be discussed in seminars with the teachers: 1) Forest inventories in Norway are based on field measurements as well as advanced remote sensing technology. Issues related to inventory methods and the value of the information collected will be discussed. (Gobakken) 2) Planning in Norway is conducted for small private forest holdings as well as for larger forest areas. Procedures, decision-support systems and decision-making related to Norwegian planning will be addressed. (Eid) 3) Silviculture in the boreal region is dominated by Norway spruce and Scots pine. Regeneration and thinning practices for those two species in the Nordic countries will be discussed. (Raulund-Rasmussen) 4) Bioenergy: Competition for forest fiber between forest industries and bioenergy production. Impacts of policy means. (Solberg) 5) International markets: Economic impacts on the European forest sector of a. accellerating forest growth, b. Russian timber export fees, and c. increased forest protection in Europe. (Solberg) 6) Timber market: Roundwood market functioning and research in the Nordic countries (Baardsen) 7) Economy: The concept of forest as capital will be explained. The diminishing role of forestry in national and regional economies as well as in the economy of individual forest owners will be discussed. (Hofstad) 8) Forest policy is determined by private ownership and public incentives. The combination of efficient resource utilization and sustainable ecosystem management is a political aim. Contemporary issues like biodiversity conservation and carbon sequestration will be discussed. (Hofstad)
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written and oral presentations of course literature count 50%. Semester assignment counts 50%.

SKS303 Silviculture

Silviculture

Credits: 15 **Language:** English upon request
Staff/institute: Andreas Brunner/ INA
Teachers: Scientists from INA, Norwegian forest and landscape institute (Skog og Landskap), Norwegian institute for agricultural and environmental research (Bioforsk).
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Other - Course will not be offered in fall 2011.Emnet tilbys ikke i høstparallelen 2011.
Mandatory activities: Excursions.

Prerequisites: SKOG220.
Credit reduction: 1 credit against SKOG310
Type of course: Seminars, 3 exercises, 8 days excursion.
Contents: Silviculture is often based on production ecology of trees. Knowledge on competition and growth is an important prerequisite of most silvicultural treatments. Genetics and natural forest dynamics are two other important basics for silviculture that are chosen as topics. To increase the knowledge of possible silvicultural options we will base the learning on a number of examples within the topics of regeneration, pre-commercial thinning, thinning and final cut. The effect of silviculture on wood quality is another example.
Learning outcomes: Applied silviculture selects treatments to manage forest ecosystems according to given objectives. This activity requires fundamental knowledge of forest ecosystems and their reactions to management (production ecology), local variation of general patterns in forest ecosystems, objectives of forest management and an extensive overview over silvicultural methods. This course on the master level will enable the students to extract knowledge from the international research literature in silviculture. The students will learn technical terms in Norwegian and English, learn to understand and critically interpret research results, learn to see their relevance in the context of other research results, and learn to see the practical use of new knowledge.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Written and oral presentations of course. Literature counts 30%. Written exam (4 hours) counts 30%. Oral exam (4 hours) counts 20%. Semester assignment counts 20%.

STAT200 Regression Analysis

Regression Analysis

Credits: 5 **Language:** English
Staff/institute: Ellen Sandberg/ IKBM
Start term: January block
Terms: January block
Mandatory activities: Project assignments.
Prerequisites: STAT100 or corresponding.
Credit reduction: ECN201, ECN202 and STAT300, full reduction.
Type of course: Lectures covering new material: 2 hours, 5 days per week. Calculation exercises: 2 hours per day.
Contents: Estimation and testing in multiple linear regression models. Subset selection. Analysis of residuals. Predictions. Practical use of statistical software.
Learning outcomes: The students should learn how to model connections between a response variable and one or more explanatory variables. They shall be able to interpret model parameters and to estimate model parameters. They should also be able to criticise the model, and suggest necessary model reductions; both in estimation and prediction purposes. Assignments shall prove that the students have reached the goal.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5-hour written examination.
Examination aids:

STAT300 Statistical Data Analysis

Statistical Data Analysis

Credits: 10 **Language:** English upon request
Staff/institute: Thore Egeland/ IKBM
Teachers: Assistant teachers.
Start term: January block
Terms: January block Spring parallel
Mandatory activities: Compulsory assignments.
Prerequisites: STAT100, or equivalent.

Credit reduction: ECN201 (5 credits), STAT200 (5 credits).
Type of course: January: 4 hours of organised teaching each day, for most days it will be 2 hours of lectures and 2 hours of exercises (parallel teaching with STAT200). Spring: 4 hours of organised teaching each week, for most weeks it will be 2 hours of lectures and 2 hours of exercises.
Contents: Basic aspects within multivariate statistical analysis of data. Simple matrix algebra. Linear regression, selection of explanatory variables, checking assumptions, and validation of models. Multicollinearity. Multivariate normal distribution. Principal component analysis, and factor analysis. Discriminant analyis, classification, and cluster analysis. If time: Partial Least Squares and canonical correlation analysis.
Learning outcomes: The students learn about the assumptions, applications, and theoretical background for the most common methods within multivariate statistical analysis. It will be emphasised that the students, to a given problem in their study or later in their work, will be able to formulate the problem in such a way that it can be analysed by means of suitable multivariate statistical method(s). Furthermore, the students learn to decide which method(s) that can be used to model and analyse the problem, and to do the analysis, (if necessary) by means of suitable software. The students also learn the practical interpretation and to assess the validity of models, methods, and results.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: 3.5 hour written examination.
Examination aids:

STAT310 Design of Experiments and Analysis of Variance II

Design of Experiments and Analysis of Variance II

Credits: 10 **Language:** English upon request
Staff/institute: Trygve Almøy/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Compulsory project assignment.
Prerequisites: STAT100 or equivalent.
Credit reduction: STAT210, 5 ECTS.
Type of course: Lectures and exercises: 6 hours per week in the autumn parallel.
Contents: Fundamental theory for design of experiments and analyses of data from such experiments, replication, randomisation and blocking. Analysis of variance models with fixed, random and mixed effects. Hierarchical models. Orthogonal contrasts. Splitting of sum of squares. Multiple comparisons. Testing equality of variances. Consequences of departure from the assumptions. Transforming data. Analyses of unbalanced data. Some usual experimental plans, such as: Completely randomised design, block design, Latin square design, split-plot design and incomplete block design. Factorial designs; interaction. Two- and three-level designs. Fractional factorial designs. Confounding of effects.
Learning outcomes: The students should learn the statistical principles for design of experiments used to compare different groups or treatments and to analyse data from such experiments, first of all by means of analysis of variance. They also learn the mathematical basis so that they will be able to use their knowledge in new situations that they encounter in their studies and later in their working life. By means of exercises and projects with real problems and data, the students should show that they have reached the learning goals.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3.5 hours.
Examination aids:

STAT330 Analysis of Categorical Data

Analysis of Categorical Data

Credits: 10 **Language:** English upon request
Staff/institute: Ellen Sandberg/ IKBM
Start term: Spring parallel
Terms: Spring parallel
The course is offered: Odd years

Mandatory activities: Assignments.
Prerequisites: Regression analysis equivalent to STAT200.
Type of course: Lectures: 2 hours per week. Calculation/computer exercises: 2 hours per week.
Contents: Poisson, binomial and multinomial distributions. Analysis of 2x2 tables and two-way and three-way contingency tables. Generalised linear models. Logistic and loglinear regression.
Learning outcomes: Be able to analyse contingency tables and binary data by chi-square tests, loglinear regression and logistic regression.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination: 3.5 hours.
Examination aids:

STAT360 Theoretical Statistics

Theoretical Statistics

Credits: 10 **Language:** English upon request
Staff/institute: Trygve Almøy/ IKBM
Start term: Autumn parallel
Terms: Autumn parallel
The course is offered: Even years
Mandatory activities: Project assignment
Prerequisites: STAT100, STAT250, MATH130
Type of course: 4 hours per week. Mainly lectures, but also some calculation exercises.
Contents: Follow-up on estimation theory from STAT250. Fisher information. Cramer-Raos inequality. The most important asymptotic results in estimation theory. Sufficience. Some Bayesian statistics. Linear models treated generally with matrix formulation. Specialisation to regression analysis, variance analysis and covariance analysis. Estimation and hypothetis testing in linear models. Estimability. Optimality in connection with linear models. Multi-variable distributions from a matrix formulation. Theory on model reduction, prediction and classification.
Learning outcomes: The students should acquire a basic theoretical understanding of the most important classes of mathematical-statistical models used among other things when analysing biological data and for the statistical methods developed in connection with such models. They should be able to see connections for exponential distribution classes in general and for linear models especially. The should also understand why and when a model reduction produces better result. The student should also be able to present subject-relevant material both orally and in writing.
Methods of examination: Final Written exam **Grading:** A-F
Examination aids:

STIN300 Statistical programming in R

Statistical programming in R

Credits: 5 **Language:** English upon request
Staff/institute: Thore Egeland/ IKBM
Teachers:
Start term: January block
Terms: January block
Mandatory activities: Project exercises
Prerequisites: STAT200 or STAT210 or corresponding
Type of course: Lectures/interactive computer lab covering new material 4 hours per day for 2 weeks. The last week the students will work on an assigned project.
Contents: R-notation/language, file handling, objects, text objects, regular expressions, functions, script, loops, graphics, R-packages, statistical analyses including estimation, testing, linear models, non-parametric methods, simulation based methods.
Learning outcomes: Upon completion of the course the student should master to perform statistical analyses using a programming approach in R. The course will provide the necessary knowledge to let the students master standard statistical analyses. Additionally the students should be able to make their own functions which utilise/modify available functions in

order to solve specific statistical problems which cannot be solved by standard code. The student should also be able to present the output from the statistical analyses in an accessible and scientific form using text and graphics.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods:
Examination aids:

TAT211 Production Technique in Aquaculture

Production Technique in Aquaculture

Credits: 10 **Language:** English
Staff/institute: Odd Ivar Lekang/ IMT
Teachers: Eriksen Bjørn Frode.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Students are required to hand in two compulsory written assignment.
Prerequisites: KJM100 - General Chemistry, MATH100 - Introductory Mathematics, or corresponding knowledge. In addition is TAT254 or knowledge that correspond required.
Type of course: Lectures: approx. 78 hours.
Contents: The course gives a general survey of production technology for aquatic organisms, with focus on intensive farming where Norwegian salmon farming is used as an example. Knowledge is given in production of broodstock, juvenile and ongrowing. The students will be given an overview of central working operations, site selection, maintenance, production hygiene and regulation for juvenile and ongrowing production. There will be lectures in production planning and making of production plans, which also include evaluation and optimizing of plans. In this topic will also a survey of investments and running cost for major technical equipment be included. The students shall through two exercises make their own production plans for respectively juvenile and ongrowing farms. The exercises shall also include working plans for major working operations. Lectures will also be included in production management and important factors that can be controlled. Production control, design of production control and routines for deviation will also be included in lectures. A main aim with the course will be overall and practical understanding of the production.
Learning outcomes: - Have general knowledge in production of aquatic organisms, with focus of salmonids. - Know how to produce broodstock, juvenile and adult fish - Know how to evaluate and optimize the most important working operations on a juvenile and ongrowing farm. - Knowledge to make a production plan for a juvenile and ongrowing farm. - Know which factors that is important to optimize the production on a juvenile and ongrowing farm. - Know which factors that affect the production velocity, how can they be changed, and what is the effect of this. - Know procedures for season independent smolt production. - Know how to performe site evaluations and know site selection criteria. - Know how to prepare documents for production control and propose efforts with deviation. - Be able to prepare working plans for smolt production and ongrowing production farms. - Know maintenance routines/plans for smolt production and ongrowing production. - Be able to estimate investment and running cost for main components in smolt and ongrowing farms. -Know laws and regulations that have affect on the production planning.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Final written examination, 3 hours.
Examination aids: Simple calculator, no other examination aids

TAT230 Design of Equipment for Norwegian Aquaculture Facilities

Design of Equipment for Norwegian Aquaculture Facilities

Credits: 10 **Language:** English upon request
Staff/institute: Odd Ivar Lekang/ IMT
Last time the course is offered: VÅR
Start term: Spring parallel
Terms: Spring parallel
Prerequisites: TAT 254

Type of course: Lectures: 40 hours. Exercises with teacher present: 30 hours. Exercises are handed out and gone through, if necessary on the blackboard.
Contents: The course is based on problem-solving. Initially, the students are offered lectures on relevant topics. After that, the students are given a project task directly linked to the specific topic. These are practical and realistic tasks, where the students are doing measurements, evaluating solutions, calculating and are doing simple design jobs for various installations. The course is based on the courses TAT101 and TAT 211, and utilises knowledge that the students have acquired from them. A selection of technical components and installations which are used in designing a complete farm is discussed and evaluated. The following topics will be lectured, discussed and used in exercises: 1. Vessels, 2. Systems for aeration and oxygenising water, 3. Systems for heating water, 4. Wastewater from fish farming, 5. Filtration of waste-water, 6. Desinfection of water, 7. Equipment for removal of ammonia, 8. Water recycling, 9. Nets.
Learning outcomes: The students should be able to clarify key issues with regard to design, function and dimensioning of fish farms. Furthermore, the students will have knowledge about and be able to calculate and plan the most important systems and components in this kind of facility, e.g. vessels, equipment for oxygenising, heating and purification of water (with special emphasis on wastewater), purification, equipment for removal of ammonia, recycling as well as breeding facilities and systems for anchoring. The students will be able to evaluate technical solutions in the mentioned areas.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: The students are required to complete 5 sets of compulsory project tasks during the course. The reports are commented on by the teacher and returned for corrections/upgrading before final assessment (Passed/Failed). All five tasks have to be approved in order to pass the course.

TAT250 Laboratory Course in International Aquaculture

Laboratory Course in International Aquaculture

Credits: 10 **Language:** English
Staff/institute: Bjørn Frode Eriksen/ IMT
Teachers: Støkken Harald, Asper Jon, Lekang Odd Ivar.
Start term: Autumn parallel
Terms: Autumn parallel Spring parallel
Prerequisites: Bachelor degree or corresponding - Entrance requirement for the Master\'s programme in aquaculture at UMB.
Credit reduction: TAT101- Aquaculture laboratory course. Students that have completed TAT101 will only be credited 5 credits for a subsequent TAT250 (reduction from 10 to 5 credits).
Type of course: Lectures: 6 hours. Laboratory exercises: 70 hours. Student presentation of exercise results: 6 hours.
Contents: The course will focus on production methods, mainly for Atlantic salmon and rainbow trout. In the laboratory exercises, the students will follow and control the production cycle and make comments about the production results. There will be exercises in measuring of the water quality and using of equipment to improve the water quality. There will also be exercises in controlling other types of equipment used on a fish farm.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Continuous assessment, laboratory reports and presentation counts 1/1.

TAT254 Basic Aquaculture Engineering

Basic Aquaculture Engineering

Credits: 5 **Language:** English
Staff/institute: Odd Ivar Lekang/ IMT
Teachers: Eriksen Bjørn Frode.

Start term: January block
Terms: January block
Mandatory activities:
Prerequisites: Bachelor degree in life science or ongoing bachelor degree studies at UMB.
Credit reduction:
Type of course: Activities consist of lectures and literature studies for a three week period ending with a written examination. The estimated activity includes 8 hours with lectures and theoretical exercises per week + individual literature studies.
Contents: The course gives an overview over technical equipment used in aquaculture production, how it function and is constructed. The course is divided in three modules, 1. Water transport and water treatment, 2. Production units, 3. Additional necessary equipment.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination, 3 hours, counts 100%.
Examination aids: Simple calculator, no other examination aids

TAT350 Planning and Design of Intensive Fish Farms

Planning and Design of Intensive Fish Farms

Credits: 10 **Language:** English
Staff/institute: Bjørn Frode Eriksen/ IMT
Teachers: Lekang Odd Ivar.
Start term: Autumn parallel
Terms: Autumn parallel
Prerequisites: TAT254 - Aquaculture Production, or similar knowledge in the area. TAT211 - Production Technology in Aquaculture, or similar knowledge.
Type of course: Lectures: 3 hours per week, totalling 39 hours. Exercises and project work with supervision: 3 hours per week, totalling 39 hours.
Contents: Through the course, the students will gain new knowledge as well as utilise previously acquired knowledge in a process where they will plan and design an intensive land-based fish farm. The plan will be adapted for an actual site and an actual production. The course has an international scope, and the planning of a farm for international and non-traditional species can be done. Topics for lectures are design and dimensioning of inlet, transfer pipelines, pump stations, fish handling, feed handling, farm design, site selection, superstructure principals, room program, planning and technical design.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: Final oral examination, approx. 3/4 hours per student. At the oral examination, the candidate is assessed by a combination of examination in basic theory and defence of the compulsory project work and report. The grades of both parts is combined into one grade, where the oral examination counts 1/3 and the defence and quality of the project work count 2/3.

TBM250 The Finite Element Method

The Finite Element Method

Credits: 10 **Language:** English upon request
Staff/institute: Tor Anders Nygaard/ IMT
Teachers: Basic FEM/August block: Tor Anders Nygaard (5 ECTS). FEM-design/Autumn semester: Egil Stemsrud (5 ECTS).
Start term: August block

Terms: August block Autumn parallel
Mandatory activities: Compulsory exercises/problems.
Prerequisites: MATH111, MATH112, MATH113, FYS101, FYS102, FYS110, TBM120, INF120.
Type of course: August block: 2 hours lectures per day, 2 hours exercises per day. Autumn semester: 2 hours lectures per week, 2 hours exercises per week.
Contents: Central topics are: Terminology, direct method for element matrices, compatibility, equilibrium, system matrices and boundary conditions. Galerkin method and interpolation functions. Derivation of structural dynamics matrices for beam elements. Solution algorithms. Solution of simple problems by hand and programming. Use of commercial software packages. Beam elements, plate/shell elements and volume elements. Boundary conditions and symmetry. Convergence criteria. Sources of errors and singularities. A number of compulsory problems must be solved in order to pass the course.
Learning outcomes: Having passed the course, the students will have gained basic understanding of how to use the Finite-Element-Method (FEM) in solving practical problems. This class also provides training in problem solving using commercial FEM- software packages.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** Pass/Fail
Assessment methods: Failed/Pass, based on exercises/compulsory problems.

THT280 On-site wastewater treatment - Planning, design and impact assesment

On-site wastewater treatment - Planning, design and impact assesment

Credits: 15 **Language:** English upon request
Staff/institute: Arve Heistad/ IMT
Teachers: Razak Seidu, John Morken, guest lecturers.
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Exercises.
Prerequisites: GEO 100, KJM 100, TAT 201 or equivalent
Type of course: Lectures: 44 hours (11 weeks of 4 hours/week). Presentation and discussion of excercises: 8 hours. One-day excursion.
Contents: Introduction to natural on-site systems, for treatment of wastewater, stormwater and landfill leachate. Purification processes in natural systems including pathogen removal. Wastewater treatment by soil infiltration, bio-filters, wetlands, and package treatment plants. Source separating systems based on alternative toilet technology (vacuum-, composting and urine diverting) and corresponding treatment (hygienizing) of excreta. Agricultural use of organic based fertilizer products. Greywater treatment and reuse. Introduction to system evaluation and risk assessment.
Learning outcomes: The students shall have an overview of on-site systems for wastewater treatment and reuse, and have basic knowledge about the design of treatment systems and their impact on health and environment.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam: 3 hours, counts for 100 %
Examination aids: Simple calculator, no other examination aids

THT281 Appropriate Sanitation for the Developing World

Appropriate Sanitation for the Developing World

Credits: 5 **Language:** English
Staff/institute: Petter D. Jenssen/ IPM
Teachers: Internationally known experts will contribute to the course.
Start term: June block
Terms: June block
The course is offered: Other - The course will not be given in 2012Kurset gis ikke i 2012
Mandatory activities: Lectures, excursions.

Credit reduction: Students cannot obtain credits for both THT281 and THT283. THT283 will be reduced by 5 credits.
Type of course: Lectures: 56 class hours. 8 days of 7 hours per day. Demonstrations/excursions minimum 4 hours.
Contents: Worldwide, two of the major causes of mortality and morbidity are unsafe water supplies and inadequate disposal of human excreta. Sanitation inadequacies also hinder economic and social development, constitute a major impediment to reducing poverty, and inevitably lead to degrading the environment. Unfortunately, the people in poverty stricken areas especially infants and young children suffer the most. This calls for appropriate solutions that are affordable considering local constraints. This course explores ecological sanitation solutions (ecosan) for the poor through case studies presented by international experts. Both the technical and the socioeconomic sides of successfully improving sanitation as well as sanitaion in crisis situations are covered.
Learning outcomes: The students shall have an overview of the challenges of inadequate sanitation in developing countries. Further, knowledge of appropriate technologies for problem remediation and the socioeconomic factors of relevance for successful implementation.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Written exam counts 100%.(Multiple choice)
Examination aids: Simple calculator, no other examination aids

THT282 Introduction to sustainable water and sanitation

Introduction to sustainable water and sanitation

Credits: 10 **Language:** English
Staff/institute: Petter D. Jenssen/ IPM
Teachers: Manoj K. Pandey, Arve Heistad
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Excursions and exersises.
Type of course: 4 lectures and 2 hours exercise per week and one day excursion and shorter excursions close to UMB. The number of lectures/exercises are subject to change.
Contents: The course utilizes problem-based learning and a selection of real life cases that give insight and overview over sustainable water and sanitation situations and possible solutions. Students will be introduced cases, and confronted with the complexity of water and sanitary challenges. How should we approach and evaluate the situation? What physical, technical, economic and social factors are important for our choice of technology? Who are the stakeholders and how should they be involved? How do we secure a sustainable management of the situation? Students will work with specific aspects of case situations. The cases will introduce students to different technical solutions to address water and sanitation challenges in different locations world wide. For each case, a series of questions will be asked, which will require students to seek out, evaluate and apply appropriate knowledge to the given situation and justify chosen solutions. The cases and support material are available on Fronter. Important issues are supported by lectures and each case is followed up by an in-class discussion. Keywords: The concept of sustainability in relation to water and sanitation. Potable water from rainwater harvesting; ground- and surface water sources; centralized and decentralized systems for water and sanitation; conventional and natural systems for wastewater treatment; ecological sanitation; source separation of wastewater; reuse of waste resources; water and sanitation infrastructure in urban and rural planning; preparedness and planning for disaster situations; introduction to health considerations and risk assessment; socio-economic aspects.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written exam counts 50%, term paper counts 50%. Both parts must be passed.
Examination aids: Simple calculator, no other examination aids

THT283 Sustainable sanitation - decentralized, natural and ecological wastewater treatment

Sustainable sanitation - decentralized, natural and ecological wastewater treatment

Credits: 10 **Language:** English
Staff/institute: Petter D. Jenssen/ IPM
Teachers: Internationally known experts will contribute to the teaching
Start term: June block
Terms: June block
The course is offered: Other - The course will not be given in 2012Kurset gis ikke i 2012
Mandatory activities: Teaching (80% presens), selected excursions and exersizes are compulsory.
Prerequisites: Basic knowledge of geology, microbiology and chemistry equivalent to GEO100, BIO130, KJM100, GEO220 or THT280 or THT282
Credit reduction: Students can not obtain credits for both THT281 and THT283. THT283 will be reduced by 5 credits.
Type of course: 3 and a half week of lectures and exercises. Excursions.
Contents: The course will elucidate how unsafe water supplies and inadequate disposal of human excreta hinder economic and social development and constitute a major impediment to reducing poverty, and inevitably lead to degrading the environment. Unfortunately, the people in poverty stricken areas especially infants and young children suffer the most. This calls for appropriate solutions that are affordable considering local constraints. This course explores sustainable sanitation solutions for the poor, but also for rich countries. The different systems are introduced through case studies presented by international experts. Through inductive learning based on real cases from different parts of the world, including sanitation in crisis situations, dry and wet and cold climates, the students are challenged to suggest and design systems. Lectures are given on key topics related to system function and design. The course emphasizes on decentralized solutions, natural systems (wetlands ponds, soil infiltration and sandfilters) treating combined wastewater and greywater, small diameter pressure vacuum and gravity collection systems, source separating systems (dry sanitation, urine diverting and blackwater systems) and anaerobic treatment of waste resources for production of biogas and fertilizer from excreta and organic household waste. Both the technical and the socioeconomic sides of successfully improving sanitation are covered. Prior to the lecture period some course material will be sent to the students. Through self-studies and e-learning the students are given the necessary background knowledge to fully benefit from attending the following lecture and exercise part at the Norwegian University of Life Sciences (UMB). The course work at UMB is divided into three parts: 1) lectures and excercises 2) an excursion showing examples of relevant systems and a taste of Norwegian nature and 3) course summary and exam. Those that complete the course are given 12 ETCS credits. UMB students that take the course THT280 do not need preparatory part (prior to arriving at UMB) and will be accredited 10ECTS credit points instead of 12 ECTS points for the course.
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.
Methods of examination: Final Written exam **Grading:** Pass/Fail
Assessment methods: Written exam (multiple choice) counts 50% and oral presentation counts 50%.
Examination aids: Simple calculator, no other examination aids

THT299 Environmental Engineering, Project Work

Environmental Engineering, Project Work

Credits: 5 **Language:** English upon request
Staff/institute: Jarle Tommy Bjerkholt/ IMT
Teachers: Oddvar Lindholm, Lasse Vråle, Arve Heistad, others.
Start term:
Terms: By demand
The course is offered: By assignment

Prerequisites: The course can normally not be attended before the 3rd year of study. This implies that the student has undertaken the basic courses in science and mathematics and also has some basic courses in technology. The latter is not a prerequisite.
Type of course: 15 hours of supervision.
Contents: The starting period and completion are decided by the supervisor and the student. All periods are relevant. The course will normally consist of work where the aim is to combine assignments of theoretical or experimental nature with practical ones. The work can for example include a study of a relevant problem that can be solved by way of literature study or theoretical analysis. Other types of assignments can be more consultancy or task-oriented, where one can solve a problem in collaboration with a municipal or industrial partner or in collaboration with an ongoing research project.
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.
Methods of examination: Final **Grading:** A-F
Assessment methods: Project.

THT310 Applied Water and Wastewater Treatment

Applied Water and Wastewater Treatment

Credits: 15 **Language:** English upon request
Staff/institute: Harsha Chandima Ratnaweera/ IMT
Teachers: A. Heistad, John Morken and guest lectues.
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Exercises.
Prerequisites: THT280 and THT271.
Type of course: Lectures: 66 hours. (6 hours per week for 11 weeks). Exercises, Presentation and discussion of exercises. Excursion.
Contents: The course provides in-depth knowledge of processes in nature based and alternative (ecosan) treatment systems as well as conventional systems for water and wastewater treatment. In addition the course contains design procedures and dimensioning of treatment systems. The course will also focus on systems evaluation and selection of appropriate systems for rural and urban settings. Through applied exercises, students will gain experience which prepares them for professional work.
Learning outcomes: The students shall upon completion of the course be able to select and design appropriate treatment systems for water and wastewater. Furthermore, the students shall be able to analyse different treatment systems and synthesise knowledge of geology, biology, ecology and technology to design treatment systems that are adapted to local conditions for smaller scale systems. The course will give a deeper understanding of some treatment processes and more emphasis on treatment and practical experiance. The students shall understand advanced methods in pocess control and optimization by use of computerbased tools and modeling. They shall be able to utilize relevant simulation software in process design and planning of treatment plants.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination, approx.45 minutes,counts for 100%

TMP261 Heat and flow simulation

Heat and flow simulation

Credits: 5 **Language:** English
Staff/institute: Odd Ivar Lekang/ IMT
Teachers: Carlos Salas
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: Compulsory exercises and an individual project report involving simulating a unit operation. Examples of projects are: Simulation of a dryer, a cooler, a cyclone, a heat exchanger, a mixer, a freezing room, flows in pipes or valves, pneumatic transport of particles, porous media like membranes, etc.

Prerequisites: MATH 111 - Calculus 1, MATH 112 - Calculus 2, FYS 101 - Mechanics, FYS 102 - Termophysics og electromagnetism.
Type of course: Three hour with lectures and tuition per week through the semester
Contents: The course gives an introduction to heat and flow simulation. The main program used in the course will be flow simulation from CosmosFlow software. Other used simulation programs like CFX will also be briefly described. The course include lessons and exercises with tutorials on model preparation and creation of a flow simulation project. Key elements are: Meshing and thin wall optimization, electric cooling, transient heat transfer, two dimensional flow, conjugate heat transfer, parametric analysis, porous media, particle trajectory, rotating reference frames, cavitation, relative humidity and load transfer from fluid analysis into stress analysis (Finite element analysis).
Learning outcomes: Having finished the course, the student shall be able to utilize modern computersimulation tools to simulate and predict heat and flow transfer in process installations.
Methods of examination: Final **Grading:** Pass/Fail
Assessment methods: The students are evaluated on basis of having passed mandatory exercises and the quality of their final project report.

TMPP350 Process Technology II

Process Technology II

Credits: 15 **Language:** English upon request
Staff/institute: Tor Kristian Stevik/ IMT
Teachers: John Mosbye, Odd Ivar lekang, Carlos Salas
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Reports from excursions and industry-seminars are compulsory. Also, journals/other assignments from the group exercises must be approved before the students can sit the examination.
Prerequisites: MATH112 - Calculus II, FYS102 - Thermophysics and Electromagmetism, TEL240 - Mechatronics II: Control Engineering and Automation, TMPP250 - Process Technology I, or equivalent.
Type of course: Lectures/seminars: 24 hours, 6 hours per week during the first 4 weeks. Group work, exercises and project assignment: 72 hours, 6 hours per week for 12 weeks, with guidance.
Contents: Calculations and numerical methods in certain fields of thermodynamics and fluid dynamics. Internal transportation and logistics for raw materials. Topics in control theory and leadership of development projects. Quality control. production planning (for instance within agroproduction, food-processing, aquaculture, waste-treatment, energy systems etc.) Production and process optimization, project planning, project work and reporting. Feasibility studies. A larger individual projekt task, preferreably in collaboration with reaserchers/industry.
Learning outcomes: On completion of this course, the students should be able to lead a development activity related to: analysing, simulation and optimisation of single unit processes or complete production systems. It is important for the students to gain experience in an analytic way of solving problems, based on science in physics, chemistry and mathematics in relationship to control and process engineering.
Methods of examination: Final Oral exam **Grading:** A-F
Assessment methods: Oral examination, approx. 45 minutes, with presentation and discussion of the project work. The project report must be submitted at least one week before the oral examination.

VANN200 Hydrology

Hydrology

Credits: 10 **Language:** English upon request
Staff/institute: Nils-Otto Kitterød/ IPM
Teachers:
Start term: Spring parallel
Terms: Spring parallel
Mandatory activities: (1) Three exercises must be approved. (2) Excursion and excursion report. (3) Oral presentation of student defined topic on hydrology.

Prerequisites: GEO100, JORD101.
Type of course: Lectures: 50 hours.
Contents: The topic is the hydrologic cycle and properties of water with examples from small (catchment) scale to regional - and global scale. The most important hydrological processes will be elaborated: precipitation; evaporation and transpiration; soil water; groundwater; and runoff. In addition we will look into problems related to measurements and uncertainties. We will emphasize tutorials where we work through practical problems related to different parts of the hydrology. In addition there will be lectures in chemical quality of water, and effects of human interference in the water shed.
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.
Methods of examination: Final Written exam **Grading:** A-F
Assessment methods: Written examination (3.5 hours).
Examination aids: Simple calculator, no other examination aids

ZOOL300 Ecological Entomology

Ecological Entomology

Credits: 10 **Language:** English upon request
Staff/institute: Eline Benestad Hågvar/ INA
Teachers:
Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Seminars.
Prerequisites: ZOOL240, ECOL200.
Type of course: Presentations and discussion of scientific articles: 2x2 hours per week for ca. 12 weeks.
Contents: The first hour is devoted to the student\'s presentation of a scientific article, and the second hour is devoted to a common discussion of the paper. Here we put a critical view on the results and put the conclusions in a broader ecological frame. The entomological articles are grouped in different topics, e.g. tritrophic interactions, plant defence, competition, population dynamics/fluctuations, ecological effects of gene modified plants on insects, habitat fragmentation/ metapopulations/scale, biodiversity/indicators/conservation, ecological effects of biological control. The teachers give an introductory review (1-2 hours) on each main topic.
Learning outcomes: The students should acquire a critical attitude towards published results in ecological entomology and be able to apply the theory in practical situations. They should be familiar with reading, understanding and presenting scientific papers within ecological entomology and be able to discuss the results within a broader ecological frame. Based on the discussions, the student should be able to judge different point of views in environmental questions, included ethical problems. The papers will also give new scientific knowledge within certain topics.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The exam has two parts: A final oral exam which counts 3/5, where scientific articles are presented and discussed. This takes about 30 minutes. The last 2/5 represents the student\'s oral and written presentations during the seminar, together with his/her activity during the discussions. It is not necessary that the student passes every evaluated element in the course to pass the entire course. A passing grade is based on the overall quality of the entire evaluated material.

ZOOL310 Behavioural and Population Ecology

Behavioural and Population Ecology

Credits: 10 **Language:** English upon request
Staff/institute: Geir Andreas Sonerud/ INA
Teachers: Svein Dale.

Start term: Autumn parallel
Terms: Autumn parallel
Mandatory activities: Seminars with teacher present: approx. 40 hours.
Prerequisites: ZOOL250 and ECOL200, and ZOOL210 or ZOOL220.
Type of course: Seminars with teacher present: approx. 40 hours.
Contents: The content of the course is given by the content of the research articles that are selected for presentation. The articles are selected by the teachers. To secure that the collection of articles selected for the course is up to date, less than 20% of the articles used in one year are being used the next year. Each seminar lasts two hours, and includes the presentation and discussion of two articles. These two articles are on the same topic, and are selected to supplement each other, for instance by representing conflicting results and interpretations.
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.
Methods of examination: Continous assessment. The teacher should be able to document how the various course activities are to be assessed, if they need to be passed, and how they are weighted when determining the course's final grade. **Grading:** A-F
Assessment methods: The exam has two parts: 1) A final oral exam of about 40 minutes, which counts 4/5 of the grade. In this exam, the student will be examined in three scientific articles selected by the teachers. One of these articles has been presented by the student himself/herself in a seminar, while the two others have been presented by other students. 2) The last 1/5 represents the student\'s oral and written presentations during the seminar, together with his/her activity during the discussions. It is not necessary that the student passes every evaluated element in the course to pass the entire course. A passing grade is based on the overall quality of the entire evaluated material.

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